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WATER, SANITATION AND HYGIENE: CHALLENGES OF THE MILLENNIUM

Informed decision making for drainage management

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IMPLEMENTING WATER AND sanitation project is very often a constraint minimisation exercise, where the concerns of major stakeholders are comprehensively appraised against different, sometimes discrete and mutually contradicting, factors. This issue is even more complex for developing countries where the investment decisions are characterised by internal trade-offs, primarily to the softer sectors of the society. The history of infrastructure planning in developing countries have enough testimony to prove that given the decision-making is a complex process, the investment decisions are often made without taking into consideration of the concerns of the entire spectrum of stakeholders. Very often the "cost" of the facilities is considered as an only basis to make investment decision.

This case study presents an attempt made to bring the stakeholders and their concerns within a single framework. The exercise was undertaken in Nepal to address the complexity of decision-making process for drainage development. This project demonstrated that any water supply and drainage development intervention requires consideration of a multitude of decision-making variables. This project used a very affordable and judgement based methodology, in that, it utilized Analytic Hierarchy Process (AHP) to make the investment decision. The project was completed in two stages - in the first stage, a master plan was prepared to identify various options; and, in the second, strategy for implementation was prioritised.

General project background

This project was undertaken in Biratnagar Municipality, the second most important industrial town in Nepal, with some 200,000 inhabitants living in about 6,000 ha of area. Although the municipality serves as the major trade and transit route to India and third countries, agriculture still dominates the local economy.

The city presently has approximately 32 km of kerb side drains. However, these drains were constructed without taking into account of the local topography, are heavily encroached and do not have adequate outlets. Moreover, the existing drainage systems were developed without involving local people, and with that these are very poorly managed. Consequently, they do not function as intended, and have been the reason for several million rupees worth of property damage every year. Especially during the monsoon, several areas in the town experience extensive pondage and considerable urban area remains inundated. In particular, the areas located in ward (lowest political boundary) numbers 3,4, 5, 6,15,16,19 and 20 (out of 22) suffer heavily due to pondage.

Project description

The Drainage Master Plan prepared by MSUD (1989) is the oldest and only planning document for drainage improvement works for the Municipality. However, the Plan was and has been scaled down by the municipal engineers and authorities because of budgetary and other limitations and uncoordinated implementation. Thus, a new approach to master plan preparation was conceived in 1999, where the plan first appraised all available options and then, by bringing the concerns of all stakeholders, recommended the best option and phased its implementation. The primary objective of the strategic planning / phasing was to arrive at the best storm and wastewater drainage solution for the town with the stakeholders consensus. The main goal was to develop the stakeholder consensus and involve them, especially the town residents, during planning and in later stages in drainage management.

Information, both secondary and primary, were compiled and assessed for the strategic planning. The information and forecasts were assessed and potential development scenarios or options were developed.

Stakeholder participation

In the process of option identification, prioritisation and phasing the identified stakeholders were involved. The process of informed decision-making involving all the affected people was adopted and, in that, all technically suitable options were reviewed against several factors and sub-factors. The project identified stakeholder by strategically analysing the cross-section of the stakeholders. A meeting was called of government official, municipality and the residents, which first prepared a long-list of stakeholders, which was then lumped together to arrive at a total of five stakeholders, as presented in Table 1.

Table 1: Major Stakeholders and their Characteristics

Stakeholders	Characteristics
Public at Large	Large community of Municipality residents and service users – Beneficiaries
Slum Dwellers	Lowest income communities of the Municipality
Business Community	Higher income community of the Municipality related with Industry, Trade & Business
Farmers	Communities with farm based within the Municipality
Municipality	The authority responsible for planning, implementation and operation of Drainage System

In addition to the five stakeholder groups, views of other stakeholders from other service delivery agencies (Water Supply corporation, Telecommunication, Irrigation, Roads, Airport authorities etc.) were also utilised, primarily under the managerial factor of option assessment.

Option development – evaluation

Initially, all technically viable options to alleviate the existing problems were identified. The study team took precaution to involve all the identified stakeholders at all stages of the technical option development to avoid any conflict of interest at the later stages of strategic planning exercise. The developed options were then evaluated on the basis of the factors and sub-factors as identified in another stakeholder consultation meeting. Table 2 summarises the factor/sub-factor and their objective function.

Option description

The eastern and western boundary rivers namely Singhiya and Keshaliya, respectively are the only two points available to drain off the municipality drainage system. Given the local topography is flat with several built up infrastructures like irrigation canals and roads, the team had a very little flexibility to identify options. Yet, three options were identified to qualify the technical requirement. The three options individually offer distinctively different arrangements of out-fall drains to the Singhiya river, however, there is no difference in drainage layout to the Keshaliya river. All three options also incorporate existing drainage system and most importantly, they not only serve all the problematic area, but also serve the rapidly expanding area of the municipality. Yet the drain alignments and physical parameters are entirely different for all. Box 1 presents the physical assessment of the options.

Table 2: Factors/Sub-factors and their Objective Functions

Factor/Sub-factor	Description	Objective Functions
Socio-economic		
Productivity	Output from the investment/input made by municipality and users	Maximise
Health	Health Benefits to people	Maximise
Affordability	Affordability of the people in the area and their capability for the developed drainage's future O&M	Maximise
Agriculture	Adverse impact to population involved in agriculture	Minimise
Technical		
Risks	Technical risks and related uncertainties	Minimise
Technical Capacity	Technical capability of the municipality expressed in terms of manpower strength, and available equipment and know-how	Optimal use
Time	Time required to complete the project	Minimise
Environmental		
Social	Adverse social impact of the project	Minimise
Biological	Adverse impact on biological environment	Minimise
Physical	Adverse physical environment within the municipality	Minimise
Managerial		
Legal	Based on legal structure of the country / legal complexity	Minimise
Institutional capability	Capability of the municipality as institution	Optimal use
Stakeholders Consideration	Conflict with other service delivery agencies (water supply, irrigation, roads, telecommunications etc.)	Minimise
Financial		
Initial cost	Initial cost of construction of the option	Minimise
O & M cost	Operation and maintenance cost	Minimise
Cost recovery	Self financing and recovering of initial cost incurred	Maximise

Box 1: Option description/comparison

Option 1		Option 2		Option 3	
Total Drain Length:	15.45 km	Total Drain Length:	22.62 km	Total Drain Length:	20.54 km
Main Drain Length:	8.85 km	Main Drain Length:	13.39 km	Main Drain Length:	11.38 km
Existing:	4.41 km	Existing:	7.01 km	Existing:	5.76 km
Proposed:	4.44 km	Proposed:	6.38 km	Proposed:	5.62 km
Sec. Drain Length:	6.60 km	Sec. Drain Length:	9.22 km	Sec. Drain Length:	9.15 km
Existing:	1.15 km	Existing:	1.15 km	Existing:	1.15 km
Proposed:	5.45 km	Proposed:	8.10 km	Proposed:	8.00 km
All together seven outlets, six on main drain (Ghoha Paini) and one directly on Singhiya river.		Provision of eight outlets, Ghoga Paini is divided in six sections to out-fall in the Singhiya river, rest two out-fall is directly to the river. Provision of nine out-falls.		Six from Ghoga Pini to Singhiya river and the rest three directly to the river. One at up-stream of main drain and two at the down-stream.	

Option analysis

The analysis was done using *Expert Choice 9.5 (AHP based computer software)*. In this context, all stakeholder groups were asked to make pair-wise judgement on their preference of various objective and subjective factors and sub-factors. The judgement of each stakeholder group was separately entered within the model (figure 1) and it was run to get the results. In addition to this, sensitivity of various options with respect to the stakeholders and factors was also done to address the planning strategy.

Results and Discussion

Using an option analysis framework, all identified options were analysed to generate an initial option ranking. Sensitivity to the priority of the options with the stakeholders and factors were studied to prepare a tentative list of consequences that may become imminent if the existing planning framework changes or stakeholders' concern modifies at the time of implementation. In particular, the team assessed probability and its aftermath if the municipality implemented the option of its choice without consulting other stakeholders. Following this the team finalised the most suitable option for implementation and generated the planning strategy and necessary policy to be adopted.

The results of the analyses show that the Option-2 is the most preferred option, followed by Option-1 and Option – 3. Given the fact that Option-1 is technically simple and less expensive, if all the stakeholders were not involved and factors/sub-factors not considered it would have been the obvious choice for implementation. It was observed that there existed a common preference of all stakeholder groups as regards to managerial and financial factors, but their concern diverge for other factors. All the stakeholders except slum dwellers were keen on improving the environment through the investment decision. Similarly, the slum dwellers appeared less concern for the health benefits. Quite strikingly, the ranking of option for implementation by slum dwellers and the general public was similar, which indicated that an assimilation of the slum dwellers with the core city dwellers. Similarity in the choice for options among the business community and the farmers further indicate that the farming will remain as an integral component of the local economy for several years to come.

Sensitivity analysis of the judgement indicated that the option ranking would be different, if the municipality completely neglected the concern of other stakeholders associated with the drainage system development. The synthesis of result and their sensitivity with the various stakeholders is presented in Table 3.

Box 2: Analytical Hierarachy Process

The Analytical Hierarchy Process (AHP) uses subjective judgement for structuring and solving multi-person, multi-criterion and multi-time period problems, Structuring problems hierarchically allows for the identification of multiple actors and interests while resulting in prioritization of impacts and/or preferences through pair-wise comparisons by those who have a first hand knowledge to the system. The AHP allows for a margin of inconsistency (or intransitivity) of preferences and is equally suitable for scenario construction and policy selection. The technique draws upon the human ability to conceptualise problems as sets or systems of interdependent factors while simultaneously decomposing the problems in terms of those factors, which are perceived to have the highest priorities.

The AHP's flexible and efficient hierarchic framework guides the decision making process. Because all parts of the hierarchy are interrelated, it is easy to see how a change in one factor will affect the other factors. By laying out decisions in this format, many types of data can easily be incorporated, differences in levels of performance can be accommodate, tradeoffs among things that look different can be identified.

(Adopted from: Saaty, T.L (1980), The Analytical Hierarchy Process, New York: McGraw Hill, Saaty and Kerns: 1995 and Expert Choice 9.5 Help Manual: 1998)

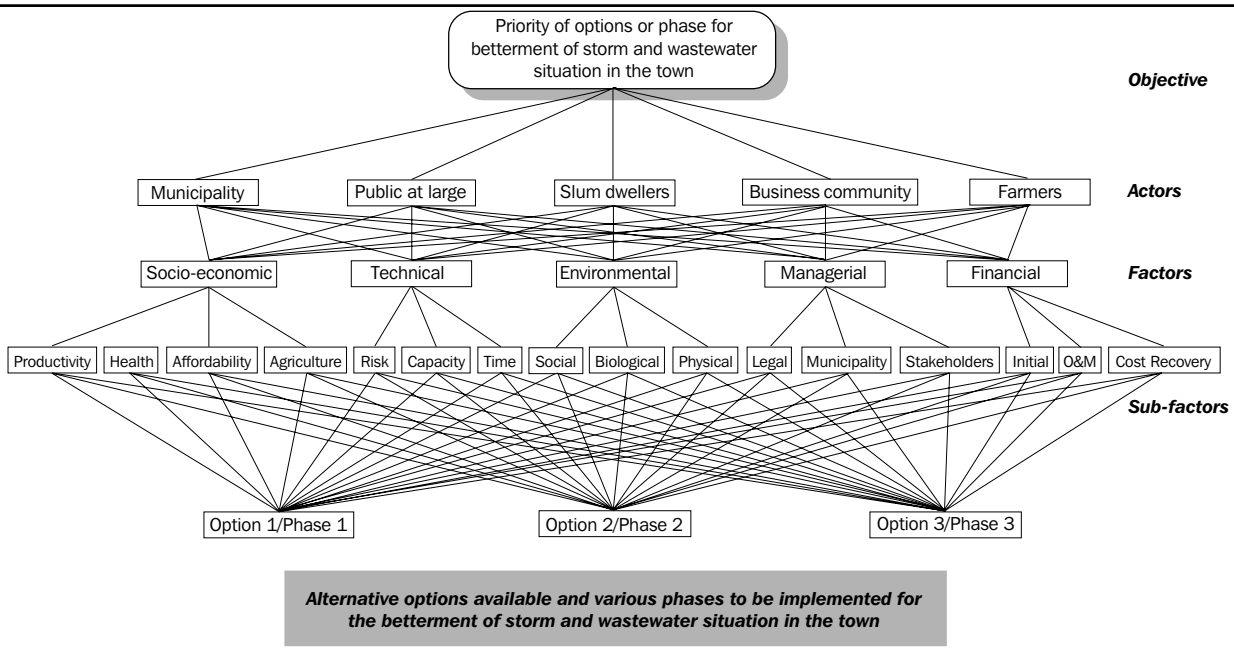

Figure 1: Option Analysis Framework

Table 3: Option Ranking with various Stakeholders and their sensitiveness with various factors

Stakeholders	Base Case	Ranking of options with increasing importance to Factors				
	Overall: 2, 1, 3	Socio-econ.	Technical	Environment	Managerial	Financial
Municipality	1,2,3	2,3,1	1,3,2	2,3,1	1,3,2	1,3,2
Public at large	1,3,2	2,1,3	3,1,2	2,3,1	1,3,2	1,2,3
Slum Dwellers	1,3,2	1,3,2	1,3,2	3,2,1	1,3,2	1,3,2
Business	2,3,1	2,3,1	2,1,3	2,3,1	1,3,2	1,3,2
Farmers	2,3,1	2,3,1	1,3,2	2,3,1	1,2,3	1,3,2

The AHP based decision analysis resulted numerous insights into the sensitiveness of various stakeholders toward the drainage development preference.

- It can be concluded that investment-decisions in water and sanitation infrastructure development require the stakeholders' participation right from the planning stage.
- Infrastructure decision-making is an "integrated plan ning, negotiation and compromising" activity.
- Cost of the infrastructure is not always the determining criteria in the investment decision-making process.
- Given the finance and the technicality is often the decision "prerogative" of the implementers; public participation in a "pre-planned project" may not be participation in the true sense.
- Informed decision-making starts at the planning stage, and, in that, the project-people negotiation should be beyond "cost" or "extent of participation" during project implementation.
- A Stakeholder group can have a distinct set of preference but intra and inter stakeholder group discussion can bring forth a negotiated outcome that is best for everyone's interest.

References

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