17th WEDC Conference
Infrastructure, environment, water and people
Nairobi, Kenya 1991

Systematic project planning and appraisal

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ABSTRACT

This paper outlines a version of the systematic approach to project planning (SAPP) adapted for water supply projects.

An extension of environmental impact analysis, SAPP is a flexible investment planning tool, incorporating global and human contexts, while being comprehensive, multi-disciplinary, integrated and interactive.

Based on previous work (Ref 1) by the author, this methodology recognises that sustainable human development is only possible through appropriate planning and investment.

A case study based on a major water supply project is used to illustrate the practical application of SAPP.

INTRODUCTION

As a part of her doctoral research, (Ref 1) the author reviewed the following:

- -history of development
- -history of technology
- -case histories of technological development in Kenya and Britain

These studies led to the formulation of a developmental trend model (Ref 1, 2). When used to forecast future scenarios this model highlighted the urgent need for global human development calling for major changes in resource investment methods (Ref 1). These methods will have to be geared to meet the challenge of attaining sustainability in development. This will call for the development of investment planning methods which will ensure optimum and appropriate resource usage under global free market trade conditions.

A detailed study of existing appraisal methods (Ref 2) showed that, to meet future needs, this process will have to:

- -include a global and human context
- -be multi-disciplinary, comprehensive, flexible, integrated and interactive.

The systematic approach to project planning (SAPP) is the result of an attempt to develop an appraisal methodology fitting this framework of requirements.

THE SAPP FRAMEWORK

In the context of the systematic approach to project planning (SAPP), the planning process is viewed as shown in Figure 1.

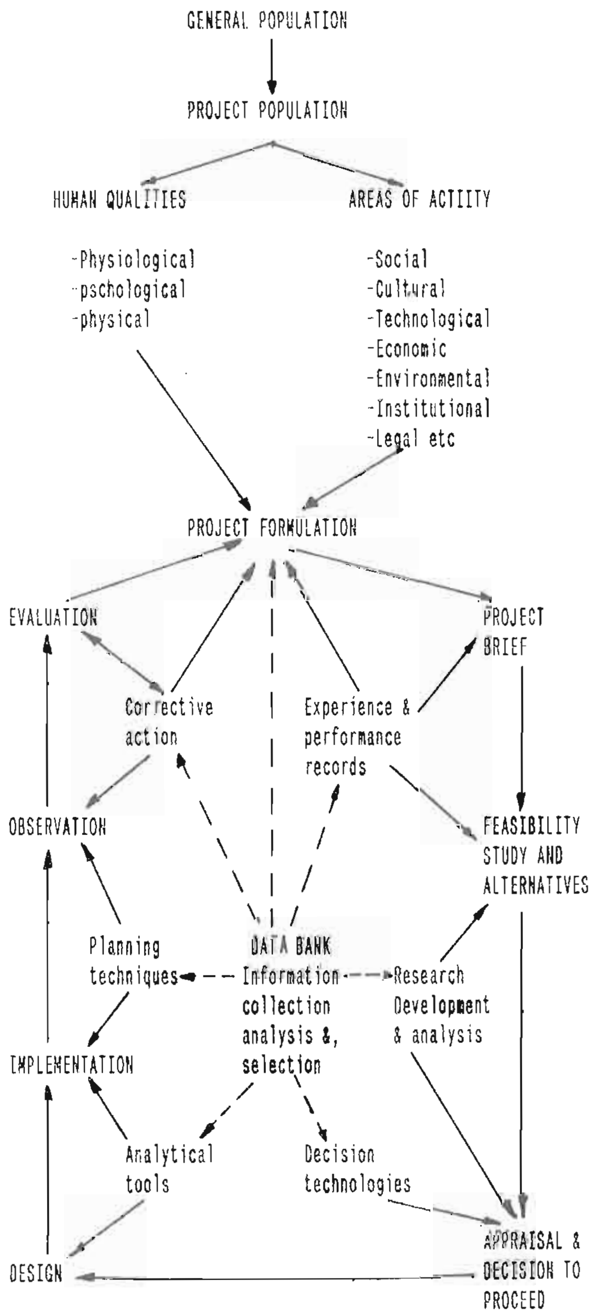

FIGURE 1 COMPONENTS OF THE SYSTEMATIC APPROACH TO PROJECT PLANNING

Within this framework of project planning, components of the appraisal process which constitutes the bulk of decision-making are viewed as shown in figure 2 below.

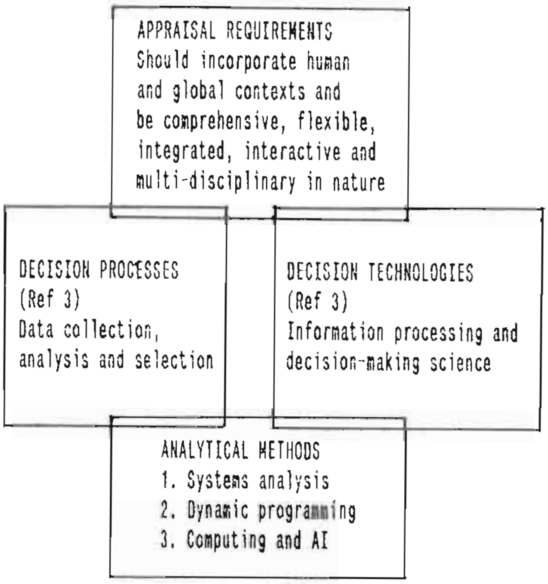

FIGURE 2: THE SYSTEMATIC APPROACH TO PROJECT APPRAISAL

THE RATIONALE

To ensure a global and human context in project planning, the objective functions are linked to human qualities formulated in terms of the physiological, psychological and material needs of the target population in relation to general population. Next, measurement indicators are identified for each of the several aspects of the investment that will have to be integrated into a single system. Accordingly, the project analysis will involve use of many interactive variables. On the basis of Jewell's (Ref 3) assertion that a systems approach particularly lends itself to analysis of large and complex problems, a systems approach is adopted.

The systems analysis approach consists of the following steps (Ref 4):

- State a goal, establish an appropriate measure of effectiveness and develop an objective function
- Determine the limits and establish a set of constraint conditions
- Determine a solution that achieves the stated goal and satisfies all relevant constraint conditions.

Several well tested appraisal methods, in particular cost/benefit analysis and the Environmental impact methodologies are currently used for project analysis. SAPP is not an alternative to these or other well known methods. Rather, SAPP, by creating a systematic framework for project analysis, extends the scope of application of these existing methods.

SAPP APPLIED TO WATER SUPPLY PROJECTS

Step 1. System definition

The objectives are defined as:

HUMAN NEED	OBJECTIVE FUNCTION
1. Physiological: Food, air and water	Provide sufficient quantity and quality of drinking & irrigation water
2. Pychological: Self esteem	Stress self sufficiency, management & development of the project
3. Material: Improvement of physical environment	Provide as much water as possible for industrial and secondary needs

Step 2: Define limits and constraints

The user must define exactly which areas of activity will be considered. For a water supply project the system may be limited to the one shown in figure 3.

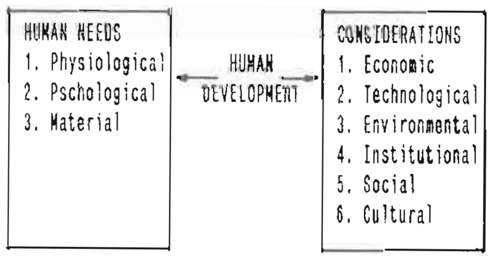

FIGURE 3: SYSTEM DEFINITION

Step 3: The solution

The solution proposed is to draw up a a matrix of considerations against human needs as shown in figure 4 below. Each cell of the matrix is then analysed seperately against a set of indicators.

Since all the effects of the project may not be quantifiable, qualitative analysis may have to suffice for some cells. Lack of data may also make it difficult to quantify some of the effects.

The user will also have to define the weights he may wish to attach to various cells. An example of a weighting system is shown in figure 6. The user can adopt a different system if required.

HUMAN NEED →		PHYSIO-LOGICAL	PSCHO-LOGICAL	MATERIAL
CONSIDERATION ↓	WEIGHT			
ECONOMIC		**		
TECHNOLOGICL				
ENVIRONMENTAL				
INSTITUTIONAL				
SOCIAL				
CULTURAL				

FIGURE 4: SYSTEM MATRIX

Step 4: The analysis

Each cell of the system matrix shown in figure 4 is analysed in detail in a number of stages as described below:

Stage 1: Identify measurement criteria or indicators for each cell. Thus for the cell marked ** in figure 4, The indicators or criteria may be defined as follows:

1) Physiological needs - evaluate the quality and quantity requirements for:
 -drinking water
 -irrigation water
2) Economic considerations - define costs, benefits and spillovers as follows:
 -Quantity or quality
 -evaluation
 -analysis in line with defined decision criteria.

Stage 2: Analyse the cell marked ** using indicators defined in stage 1. Thus, the analysis at this stage would involve:

 -details of the consumption and and irrigation requirements
 -Quantification of these requirements
 -description of quality requirements
 -Quantification of the cost of providing this water
 -Quantification of the benefits and revenues resulting from this
 -Quantification of spillovers
 -Qualification of costs, benefits and spillovers where necessary.

Step 5: The decision

Each cell of the system matrix having been analysed, the decision is made to accept or reject the proposed resource investment.

CASE STUDY - ACTUAL APPRAISAL

In 1897, construction was started of a railway line from the African coast to a cotton growing area inland. Preceding this a transport depot was established at a small watering place along the proposed rail route. This watering place has since developed into a major city. While the initial capacity of this initial water supply is not known, it has since been extended nine times. This case study is based on the eighth phase which upgraded this scheme by 53550m3/d to 203000m3/d. Figure 5 shows details of the actual appraisal done for this project.

GENERAL DESCRIPTION OF WORKS: Intake on river c, raw water pipeline, pumping stations, treatment works, distribution pipelines.

INITIAL CAPITAL COSTS Item	Cost K£	DISCOUNTED CASH FLOW DETAILS:
1. Intake	50 000	Internal rate of
2. Raw water p/l	74 900	return = 10.1% p.a
3. Treatment wks	740 000	
4. Pumping stns	441 159	
5. Dist pipelines	1 347 160	Mean output:
6. Power supply	8 200	= 53 550 M3/d
7. Engineerig 12%	362 487	
8. Contingencies	359 308	Cost/litre=K£0.133
TOTAL	3 383 214	

OTHER COSTS: Annual costs - K£68 000 (year1) to K£254 000 (year 9), Regenerative costs at years 15 & 30 = K£65000, Maintenance = K£262 000 p.a

FIGURE 5: ACTUAL ANALYSIS OF CASE STUDY PROJECT

CASE STUDY - A SYSTEMATIC APPRAISAL

Figures 6 and 7 show results obtained by applying the systematic approach to appraisal of the case study project.

The analysis only shows part of the system matrix. In spite of this, a more comprehensive decision base than the actual analysis is evolved by using SAPP. Weighting of each cell offers a mechanism for measurement of relative importance of each cell in the final decision. The illustration contained in figure 6 shows 58.3% of the decision is in favour of accepting the project. By varying weights slightly a sensitivity test can be done. Thus if the weight of economic consideration is dropped to 0.6 and 0.1 of weight thus released is spread evenly over the rest of the decision only 50.9% of the decision would be in favour of accepting the project.

HUMAN NEED / CONSIDERATION	REF NO i		PHYSIOLOGICAL	PSYCHOLOGICAL	MATERIAL
	i		1	2	3
	j	WEIGHT	0.6	0.3	0.1
1. ECONOMIC	1	0.7			
a) Requirements			Meet demands upto 1984 Demand = 42840m3/d	Projected at population growth rate = 5.9%	Meet demands upto 1984 Demand = 10710m3/d
b) consumption details			Domestic = 60% Irrigation = 20% This is an assumption as no actual data given	Temporary 32l/p/d High income 455l/p/d Average income 264l/h/d low income 114l/h/d	Industrial = 20% This is an assumption as no actual data given
c) Capital costs (Pro rata) Contingencies			Domestic = K£1 814 344 Irrigation = K£ 604 781 Domestic = K£ 215 585 Irrigation = K£ 71 862	Onshore costs = 36% Offshore costs = 59%	Industrial water costs = K£ 604 781 Industrial = K£71 862
Operation & maintenance Regenerative			K£ 209600 p.a Year 1 = K£ 54 400, Year 9 = K£ 203 200 year 15 & 30 =K£52 000		K£ 52 400 p.a Year 1 = K£ 13 600 Year 9 = K£ 50 800 Year 15 & 30 =K£13 000
d) Revenue per litre			K£ 0.133	Benefit/cost ratio = 1	K£ 0.133
e) Discounting over 40 yrs			IRR = 10.1% p.a		IRR = 10.1% p.a
2. TECHNOLOGICAL	2	0.1	% of total investment		% of total investment
a) Plant			costs = 47%	90 % imported	costs = 47%
b) Materials			costs = 35%	60% imported	costs = 35%
c) Services			costs = 18%	61% foreign consultancy	costs = 18%
3. ENVIRONMENTAL	3	0.1			
a) Quality & Standards			WHO std drinking water	No development of local	Same as drinking water
b) Life-forms affected			No depletion analysis	standards or quality	No depletion analysis
c) Pollution controal			No analysis	conrol capability	No analysis
4. INSTITUTIONAL	4	0.1			
a) Design stage			Foreign consultant	39% local staff	Foreign consultant
b) Construction			Foreign and local	30% (approx) local	Foreign & local contractors
c) Operation/maintenance			Local	No capability review	Local
d) Management			Revenue collection & quality control etc	Manpower analysed but no procedure analysis	Revenue collection & abstraction evaluation

FIGURE 6: MAIN SYSTEM MATRIX - FINAL ANALYSIS

CELL REF i.j	DECISION CRITERIA	WEIGHT	
		ACCEPT-ABLE	UNACCEP-TABLE
1.1	Internal rate of return	0.42	
2.1	Reliability and distribution	0.07	0.14
3.1	Internal rate of return	0.07	
1.2	Labour intensity		0.06
2.2	Self dev. & management		0.03
3.2	Labour intensity		0.01
1.3	Environmental analysis		0.06
2.3	local standards development		0.03
3.3	Environmental analysis		0.01
1.4	local participation	0.02	0.04
2.4	Dev of local capability		0.03
3.4	Local participation	0.003.	0.007
	TOTAL WEIGHTS	0.583.	0.417

FIGURE 7: DECISION MATRIX

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