Risk Assessment for Water Quality Management

Final Report to the
Water Research Commission

by

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FOREWORD

This guide is aimed at providing assistance in the assessment of risk from point sources of pollution. It is thus primarily intended for managers of water quality but will hopefully have more general application. The way in which the document has been written is deliberately general in that it intends to promote the methodology of risk assessment. It is also in most cases describing a methodology which is applicable to broader environmental risk assessment as well as to the specifics of point source pollution risk assessment.

It is hoped that the document will serve a useful purpose in promoting the use of risk assessment techniques with more confidence in the field of water quality management.

EXECUTIVE SUMMARY

This document is a result of a review of available risk management techniques in terms of their applicability to point source pollution risk assessment as a decision-making tool for water quality management. Of all the methodologies and techniques received, the most appropriate was found to be that published by the Department of the Environment, UK. The publication is entitled *Guide to Risk Assessment and Risk Management for Environmental Protection,* ISBN 0 11 7530913.

This document uses the methodology outlined in this publication extensively and tailors it to the specific requirements of water quality management.

The methodology employed is one involving:

- description of the intention;
- hazard identification;
- identification of consequences;
- estimation of magnitude of consequences;
- estimation of probability of consequences;
- risk estimation;
- risk evaluation;
- risk assessment;
- risk management.

The methodology is described as a step-wise process which can be iterative in nature.

Important points to emphasise in the use of the methodology are:

- For practical purposes all activities undertaken imply some risk to the environment. What should be done in each case, therefore, is an assessment of what is a tolerable risk, taking into account the benefits likely to be realised as well as the hazards. Adherence to the concepts of sustainable development and the precautionary principle will influence such decisions.

- Most decisions will be taken on the basis of incomplete information and lack of full scientific certainty should not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

- At every stage of a risk assessment the assumptions made should be explicit and recorded.

- Estimation of probabilities is difficult and it is necessary to define carefully exactly what event is under consideration.

- Risk perception plays a key role in determining attitude towards risk and will depend on a wide variety of factors.

- The process of risk assessment and risk management is iterative.

- Risk management, being an iterative process, leads naturally to the development of (for example) a water quality management system, including monitoring.

- It is necessary to retain that, although the framework of a risk assessment is formal, the accurate quantification of risk is not always feasible (sensitivity analysis should be performed on the results of the risk assessment).

Worked examples are given to indicate how the proposed methodology could be used in the context of water quality management.

1. INTRODUCTION

1.1 Purpose of this Document

The assessment of risk is an increasingly important tool in the hands of decision-makers. Unfortunately the subject of risk assessment is plagued by use of apparently complex terminology and mixed in with this, use of everyday words and terms in a risk-specific context which is often contradictory to the common use of the word or term. This leads to a sense of confusion on the part of those trying to use the technique of risk assessment and often discourages managers from blending in the use of risk assessment techniques with their other management procedures.

It is the intention of this guide therefore to present the technique of risk assessment in a clear, unambiguous way which is "user-friendly".

1.2 Why Analysis Risk?

It is generally accepted that a risk-based approach can assist with decision-making and is a useful management tool. It is particularly useful in that it helps to set priorities on a comparative basis and can assist in allocating expenditure of capital and resources.

One of the main misconceptions about the subject of risk analysis is that it requires numerical input and will generate a numerical answer to a risk analysis problem. This may be true but in most cases the volume of the use of a risk-based approach is the way in which the methodology guides the thought processes of decision-makers in a very logical manner, forcing consideration of alternatives and providing a means to evaluate these alternatives rationally.

1.3 Definitions

As mentioned earlier, one of the major drawbacks of the risk analysis field is the confusing use of terminology. To help to clarify this, a set of definitions are given here which, it is felt, best convey the meaning of the terms, in the context of the application of the risk analysis technique.

This list draws on the definitions of hazard, risk and risk assessment and management set out in the 1992 report *Risk: Analysis, Perception and Management* (Royal Society, 1992) which updated a previous publication of 1983. The following definitions are used:

Hazard: a <u>property</u> or <u>situation</u> that in particular circumstances could lead to harm.

Consequences: the adverse effects or harm as the result of realising a hazard which cause the quality of human health or the environment to be impaired in the short or longer term.

Risk: a combination of the probability, or frequency, of occurrence of a defined hazard and the magnitude of the consequences of the occurrence.

Probability: is the mathematical expression of chance (for instance, 0.20, equivalent to a 20% or a one in five chance), wherever this usage is possible but in many cases it can be no more than a prospect which can be expressed only qualitatively. The definition applies to the occurrence of a particular event in a given period of time or as one among a number of possible events.

Applying the everyday meaning of estimation and evaluation to the defined meaning of risk leads to further terms and definitions:

Risk estimation: is concerned with the outcome or consequences of an intention taking account of the probability of occurrence.

Risk evaluation: is concerned with determining the significance of the estimated risks for those affected: it therefore includes the element of risk perception.

Risk perception: is the overall view of risk held by person or group and includes both feeling and judgement.

Risk assessment: consist of risk estimation and risk evaluation.

A SIMPLISTIC ILLUSTRATION OF THE PRINCIPAL TERMS

Intention: to transport a highly toxic chemical by road tanker to an end user via a route which crosses a major dam supplying drinking water to a large city, unless a risk assessment reveals intolerable risks.

One obvious hazard is that an accident could occur involving the road tanker; a consequence is that the highly toxic contents could spill into the dam.

Risk estimation might follow the lines that the probability per unit time that an accident might occur is low while the probability that if an accident does occur it will do so in the vicinity of the dam and spillage will enter the dam is very low. The consequences for the population of the large city whose drinking water has been contaminated are potentially severe.

Risk evaluation determines whether the risk is significant in relation, for example, to other risks to the drinking-water supply and taking cognisance of the relative impact of 10 m^3 of the toxic chemical in a water body of hundreds of thousands of cubic metres volume. Perception of risk should also be taken into account i.e. the fact that people in a large city do not perceive a risk of drinking contaminated water when they open a tap.

The risk assessment would probably be that the risk was high.

If the risk is judged to be significant, risk management would lead to consideration of actions to reduce the level of risk and the cost of such actions. These actions and the reduction of risk thereby achieved would be subject to a like process of evaluation. Possible actions are:

1) Change the road tanker route to keep it away from the dam (and other water bodies) - the extra cost in transporting the chemical by the longer (for the sake of this example) route would be readily calculable but in view of the high risk assessed would have to be accepted by the end user of the chemical.
2) Take the chemical off the market completely (if it is so toxic should society accept a chemical of this nature on the roads under any circumstances?) - the cost to society of removing the chemical completely could be calculated and a decision may be made to tolerate the risk (assuming there are no safer alternatives) because of the benefit which use of the chemical brings to society. Perception may play a part here as well. It is assumed too that the safer route for transport of the chemical has been adopted for the risk to be considered tolerable.

1.4 Other Points to Note

- Most activities are associated with hazards. The concept of "zero risk" is rarely achievable in any facet of human activity. It logically follows, therefore, that a trade-off is made, either consciously or otherwise in conducting any activity, between the hazard or risks expected versus the benefits. The trade-off is made at a point at which the situation is deemed tolerable. If the risks are too high, the proposed activity should be modified until a tolerable result is obtained. This implies that the process of risk management is an iterative one.

- Ideally risks versus benefits should be assessed on the basis of financial cost. In practice, and particularly in the case of environmental issues, it is not often possible to achieve this because it is not possible to put a cost to many issues pertaining to the environment (although valuation techniques are being developed all the time).

- Risk assessment consists of a formal information gathering exercise about a proposed activity followed by a prognosis about its outcome. In some cases it will be possible to quickly discount certain theoretical outcomes based on experience but the assumptions made in each case must be carefully noted. This will facilitate evaluation of the risk assessment by third parties and also the revisiting of the proposed activity should circumstances change in the future.

- The environment in which we live has been significantly modified with time. The way things are now is not as a result of careful planning but simply the outcome of many modifications, often made without evaluation or even considering the environmental effects. We do not know if our environment is sustainable as it is and we cannot therefore discount any proposed change as inherently bad. Keeping things as they are currently does not imply sustainability. We should, however, consider that a change which will result in the loss of a non-renewable resource or reduction of biodiversity would be rated as significantly harmful in any risk assessment.

2 Point Source Pollution Risk Assessment - A Stepwise Protocol

2.1 Risk Estimation

2.1.1 Describe the intention

- List your assumptions.
- "Fingerprint" the intention.
- What were the system characteristics before fulfilling the intention?
- What are the individual steps required to fulfil the intention?
- What is the outcome of the intention?
- What will the system characteristics be after fulfilling the intention?

Note: Do not try to identify consequences at this stage.

2.1.2 Identify the hazards

- Ask the question: "Which of the identified properties of the intended substance, organism, operation, process or undertaking could lead to adverse effects on the aquatic environment and the uses of this resource?"

- Use the checklist below to answer the question:

• toxicity, immunotoxicity, pathogenicity, mutagenicity, teratogenicity and carcinogenicity;
• potential for long-lived presence in the aquatic environment including the potential to bioaccumulate and bioconcentrate;
• potential for effects on environmental processes such as photosynthesis;
• potential for affecting ecosystem function, such as influence on predator/prey relationships or changes in population numbers of the species in an ecosystem;
• potential for causing offence to people or adverse effects on them; and
• potential for accidents.

- Ask the question: "Where, and to what extent might an operation or process, or the individual stages of an operation, of their nature or through failure, cause harm to the aquatic environment or to the user of this resource?"

- Use the "fingerprint" information from Step 2.1.1 to help answer the above question.

- Does the system under consideration warrant the use of a HAZOP (hazard and operability) study to identify hazards (due to its complexity)?

Note: HAZOP studies are time-consuming and costly. They should normally only be considered:

• *if new technology is to be used for effluent treatment;*
• *if the process under consideration can release chemicals to effluents and/or stormwater under emergency conditions.*

A more specific set of parameters for consideration are given below.

TABLE 1: SELECTED WATER QUALITY VARIABLES AND INDICATED PROBLEM		
RIVERS	**PROBLEM INDICATED**	**IMPOUNDMENTS**
E. coli	**faecal pollution**	*E. coli*
Total phosphorus	**trophic status, nutrients indicating potential for algal growth**	Total phosphorus
Soluble reactive phosphate	**nutrients indicating potential for algal growth**	Soluble reactive phosphate
Total organic carbon	**indication of organic pollution, algal growth, oxygen demand potential**	Total organic carbon
Electrical conductivity	**total dissolved salts, inorganic pollution**	Electrical conductivity
Suspended solids	**particulate material, erosion, siltation**	Suspended solids
Turbidity	**Particulate matter, erosion, coagulent demand, algal growth**	Turbidity
Nitrate	**Nutrients indicating potential for algal growth**	
Ammonia	**sewage discharge, anaerobic conditions, nutrients indicating potential for algal growth**	
	trophic status, treatment problems, oxygen demand, possible recreational impairment, possible health hazards	Total algal numbers
	trophic status, specific treatment problems	Taste and odour causing algal numbers
	specific treatment problems	Filter clogging algal numbers
	trophic status, treatment problems, indication of algal biomass production	*Chlorophyll a*

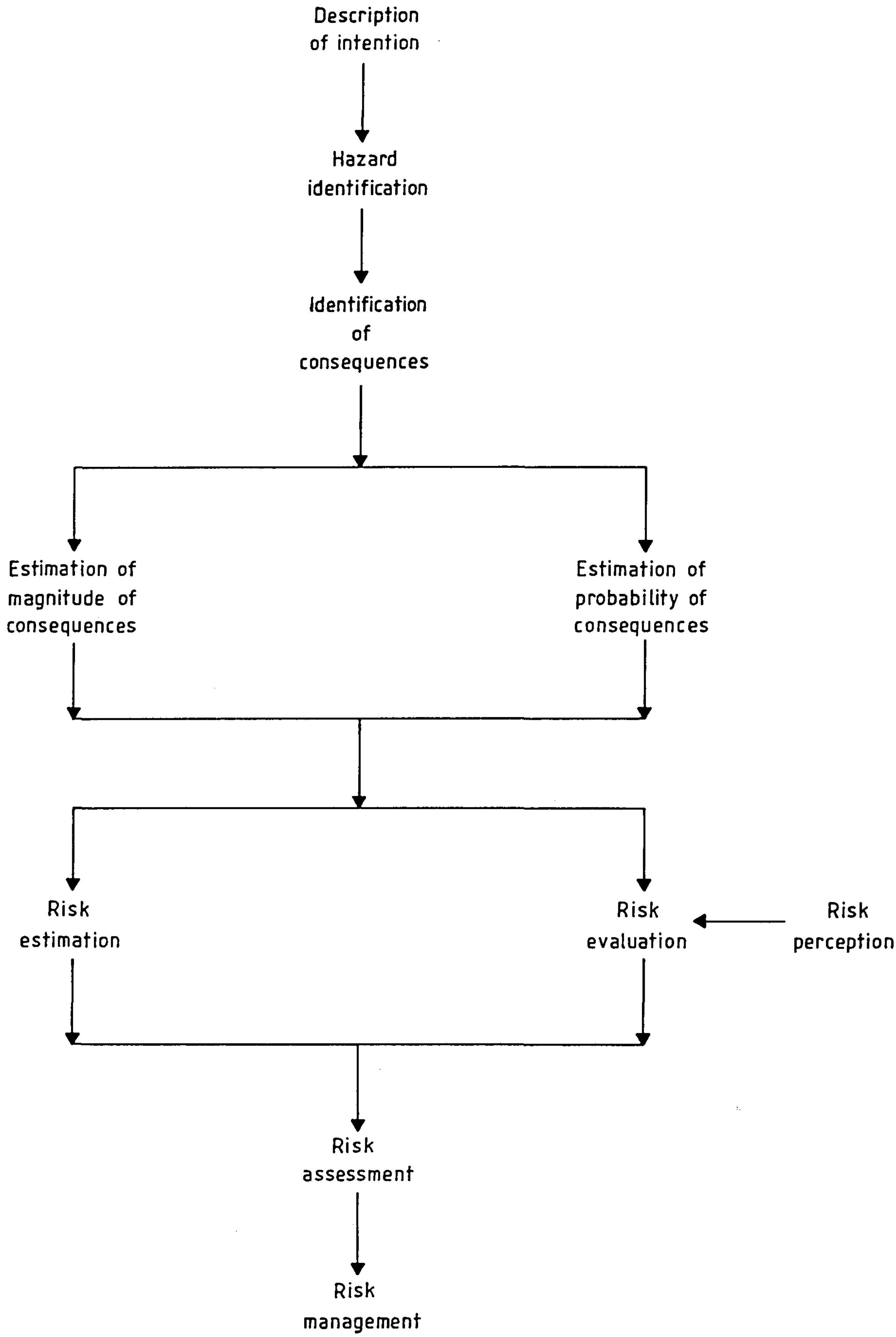


Diagram 1: From intention to risk management

2.1.3 Identify the Consequences

- List all the hazards identified in 2.1.2 and consider the consequences for the system under consideration if these hazards are realised either individually or jointly.

- What are the modes of operational or process failure which lead to the realisation of the hazard(s) under consideration? (Fault tree analysis may be considered here to help to understand the individual events or combination of events which lead to the realisation of the hazard(s) under consideration).

- What are the consequences for the aquatic environment and/or the users of the resource should the hazard(s) under consideration occur? (Event tree analysis may be considered here to help to understand the consequences of a particular hazard having been realised and also the consequences with and without mitigatory actions and the influence of external factors such as climate conditions).

- Consider the exposure routes if a particular substance or organism is being reviewed.

Note: The outcome will depend on the combination of the hazard and the characteristics of the potential receiving aquatic environment that are relevant to the particular hazard. These characteristics may be climate-based, geographical, use-based, organism/ecosystem-based and so on.

2.1.4 Estimate the Magnitude of the Consequence

- Consider the magnitude of each consequence and whether it is feasible to quantify it or even assign a monetary value to it. Typically probability of occurrence rather than the magnitude of the consequence itself is more readily quantifiable though this is also difficult in many cases (see 2.1.5).

- If the magnitude of the consequence cannot be sensibly quantified, categorise it according to the categories given below:

Severe: a significant change in the numbers of one or more species, including beneficial and endangered species, over a short or long term. This might be a reduction or complete eradication of a species, which for some organisms could lead to a negative effect on the functioning of the particular ecosystem and/or other connected ecosystems.

Moderate: a significant change in population densities, but not a change which resulted in total eradication of a species or had any effect on endangered or beneficial species.

Mild: some change in population densities, but without total eradication of other organisms and no negative effects on ecosystem function.

Negligible: no significant changes in any of the populations in the environment or in any ecosystem function.

Effects on humans would require another set of definitions which would be more stringent e.g.:

Severe: effects which lead to one or more fatalities or the likelihood of causing illness or sickness for one or more persons for longer than 24 hours.

Moderate: effects which lead to illness or sickness for one or more persons for less that 24 hours.

Mild: effects which cause nuisance to persons for a period of longer than 24 hours e.g. odour, taste.

Negligible: effects which cause nuisance to persons for a period of less than 24 hours e.g. odour, taste.

2.1.5 Estimate the Probability of the Consequences

- Use of fault and event tree analysis can result in quantification of the probability of a given consequence. Try to quantify as much as possible but be aware of the limitations of the fault and event tree analyses in that the data to be used in the analysis must have a high degree of confidence attached to it. Otherwise the results of the analysis will be extremely suspect.

- Probabilities are most usefully used when seen in relation to other probabilities (for example in considering the consequences of several alternative options) rather than as absolute figures in themselves.

- When quantification is not possible (in practice most of the time) the probability should at least be expressed as within ranges of order of magnitude for a specified number of events or time period such as 100 years e.g. high, medium, low and negligible (See also Table 1 below).

TABLE 1 : ESTIMATION OF RISK FROM CONSIDERATION OF MAGNITUDE OF CONSEQUENCES AND PROBABILITIES

	Magnitude of Consequences			
Probability	**Severe**	**Moderate**	**Mild**	**Negligible**
High	high	High	medium/low	Near zero
Medium	high	medium	low	Near zero
Low	high/medium	medium/low	low	Near zero
Negligible	high/medium/low	medium/low	low	Near zero

2.1.6 Estimate the Risk

- For each separate hazard, combining the magnitude of the consequences from 2.1.4 and the probability of the consequences from 2.1.5 gives an estimation of the risk. Simplistically risk can be considered as the product of probability and magnitude (severity) of a given consequence i.e. $R = P \times M$.

- For cases where the components have not been able to be quantified a simple matrix can be used as a focus for decision (see Table 1).

- For cases where there is more than one hazard, the overall risk is the combination of the risks arising from individual hazards. If these risks have been quantified and occur reasonably independently of one another, a fault tree approach can again be used to determine the value of the "top event" or overall risk.

- Where the risks have not been quantified, logic and judgement must be used to combine the risks into an overall risk. The fault tree logic may provide useful guidance even if the risks have not been quantified as it enhances understanding of how the risks may act in combination with each other.

2.2 Risk Evaluation

2.2.1 Evaluate the risk i.e: what is the significance of the risk estimated to those concerned or affected, if the hazard is realised? (See Table 2)

- List your assumptions;

- Consider whether a monetary value can be given to the likely damage;

- Consider whether sustainability is affected;

- Take note of the precautionary principle;

- Take note of the differing perceptions of risk versus benefit;

- Take note of differing perceptions of what constitutes a "tolerable risk";

- Carry out a sensitivity analysis with different assumptions to see how sensitive the evaluation is to a given set of assumptions.

2.3 Risk Assessment

2.3.1 Take the risk estimation and evaluation for each hazard and combine them into an overall risk assessment for the intention under consideration.

2.3.2 Are the risks to human health and the environment from the intention intolerably high, or lower than some level judged to be acceptable, or falling into a tolerable region between these levels?

Note this question should be posed in relation to risks arising from individual hazards as well as for combinations of hazards to avoid a low risk in one respect masking an unduly high risk in another. (See Table 2 for guidance on what might be considered "acceptable").

2.3.3 Consider interactions in the process if the risk is not low enough to be deemed at least tolerable, or for cost saving reasons, if the risk can be allowed to increase from a very low level to a level which is still tolerable. Take into account issues such as BATNEEC, BPEO etc. as this may modify the interactive process.

2.3.4 Consider the "Do nothing" option in relation to changes to the basic intention or the means of realising it.

2.3.5 Implement decisions about tolerating or altering the risk i.e. implement risk management.

2.3.6 Carefully note the basis of all decisions taken to avoid future accusations of bias and to allow future re-assessments to take place (for example in the event of new technology becoming available).

TABLE 2 : RISK CRITERIA TABLE

AREA AT RISK	DESCRIPTION OF RISK	HAZARD CATEGORY					
		1 VERY LOW RISK	2 MINIMAL	3 MEDIUM	4 CRITICAL	5 VERY CRITICAL	6 CATASTROPHIC
PLANT	Large Plant Eml R X 10^4	0,1	1,0	1 To 10	10 To 100	100 To 1 000	1 000
	Small Plant Eml R X 10^4	0,01	0,1	1	1 To 10	10 To 100	100 To 1 000
	Effect On Personnel	Near Miss Incident	Minor Injury Only	Injuries	1 To 10 Chance Of Fatality	Fatality	Multiple Fatalities
WORKS	Damage	None	None	None	Minor	Appreciable	Serious
BUSINESS	Business Loss	None	None	None	Minor	Severe	Total Loss Of Business
PUBLIC	Damage	None	None	Very Minor	Minor	Appreciable	Widespread
	Effects On People	None	None (Smell's)	Minor	Some Hospitalisation	1 In 10 Chance Of Public Fatality	Fatality
	Reaction	None	None/Mild	Minor Local Outcry	Considerable Local And National Press Reaction	Severe Local And Considerable National Press Reaction	Severe National (Pressure To Stop Business)
GUIDE VALUES OF PUBLICLY ACCEPTABLE FREQUENCIES		10/Year (10)	1/Year (1)	1/10 Years (0,1)	1/100 Years (0,01)	$1/10^3$ Years (0,001)	$1/10^4$ Years (0,0001)
LOSS	Large Plant R1 X 10^3	1 000	1 000	1 000	1 000	1 000	1 000
RATE/YEAR	Small Plant R1 X 10^3	100	199	100	100	100	100

3. Case Study for the Vaal Barrage Catchment

3.1 Introduction

It was agreed that in order to test the effectiveness of the guidelines developed that a case study should be conducted for the Vaal Barrage catchment area. Any problems in applying the methodology developed were to be highlighted.

The Vaal Barrage was examined from an industrial point of view only i.e. mining and power generation were excluded. A theoretical case was taken of a major brewing company wishing to build a new plant in the Kliprivier drainage region C221.

3.2 Background

The Vaal Barrage Catchment area, probably the most heavily industrial area in South Africa contains about 250 separate premises using more that 50 m^3/d, carrying out 32 distinct industrial activities.

3.3 Example Point Source Pollution Risk Assessment

3.3.1 Risk Estimation

3.3.1.1 Describe the intention

The intention is to construct a new malt brewery to be commissioned in 1997 with a production level of 105 000 h*l*/wk in the Kliprivier catchment area C221 of the Vaal Barrage catchment. The brewery is planned to operate at a water to beer ratio of 6:1 and an effluent to water percentage of 67%. Data on effluent quality for a similar brewery are given in the table below:

FINAL EFFLUENT ANALYSES							
COMPOSITE SAMPLE ANALYSIS	11/8-12/8 S – M	12/8-13/8 M - T	13/8-14/8 T - W	14/8-15/8 W - T	15/8-16/8 T - F	16/8-17/8 F - S	17/8-18/8 S - S
No of sub samples	63	101	143	119	119	104	61
COD (Total) mg/*l*	3170	3600	3920	3720	4630	1630	180
COD (Soluble) mg/*l*	2640	3160	3020	2410	2650	1430	100
OA (Soluble) mg/*l*	286	314	336	340	396	172	12
TOC (Soluble) mg/*l*	720	880	930	790	765	370	49
TIC (Soluble) mg/*l*	59	60	57	10	38	78	30
Suspended solids mg/*l*	710	930	1500	3010	2120	270	320
Settleable Solids m*l*/*l*	3,5	8	16	25	35	2	1,2
Conductivity (mS/m)	72	100	90	110	91	91	85
Total Solids mg/*l*	2120	2740	3340	4600	3590	1340	980
TDS mg/*l*	1420	1810	1840	1600	1480	1070	660
TKN mg/*l* as N	4,5	3,2	10,1	37,5	1,3	0,1	ND
Nitrate mg/*l* as N	3,6	5,1	4,9	8,2	2,5	0,7	ND
Phosphate mg/*l* as N	3,0	3,1	3,0	3,1	1,9	1,4	0,9
Chloride mg/*l* as C1	48	280	187	277	203	121	236
Calcium mg/*l* as Ca	38	40	44·	44	38	32	42
PH	9,2	6,5	6,6	5,4	4,9	9,3	7,2

ND = Not determined

The effluent is characterised as high in COD, suspended solids, TDS and phosphate. The pH varies widely as does the quality, with time. No effluent treatment is proposed.

Assumptions: It is assumed that a) the brewery achieves its intention to operate regularly at the water to beer ratio of 6:1 and the effluent to water percentage of 67%; b) that the effluent figures taken from another brewery will closely match those of the new brewery. Both of the assumptions will in practice have to be verified by monitoring when the brewery becomes operational.

System characteristics before fulfilling the intention: A highly stressed catchment with many industries. All the formal industrial discharges are to two municipal sewage works which are at the limit of their capacity or already overloaded. The water quality in the Kliprivier is generally good but there is a trend apparent for a number of years for increasing TDS levels in this river. Current levels stand on average at 500 mg/*l*.

Individual steps required to fulfil the intention:

- a construction phase;
- a commissioning phase;
- an operational phase;
- a maximum production phase.

What is the outcome of the intention?

A major brewery discharging approximately 42 200 m^3 of effluent per week, containing 74 t/week of COD, 32 t/week of suspended solids, 67,2 t/week of total dissolved solids and 56 kg/week of phosphate. The pH could vary between 4,9 and 9,3. The variation in pH is largely due to the use of caustic soda for bottle washing.

System characteristics after fulfilling the intention:

A grossly overloaded municipal system with a major contribution of TDS and phosphate to the Kliprivier from the new brewery. A completely unacceptable situation as it stands.

3.3.1.2 Identify the hazards

The identified hazards are:

- high organic load (COD) overloads the municipal sewage works;
- high TDS and phosphate pass through the sewage works and overstress the river system;
- high suspended solids which could disrupt the sewage works operation;
- spillage of caustic soda during delivery in the operational phase;
- spillage of hydrochloric acid (used for vessel preparation) in the construction phase;
- highly erratic discharges of effluent during the commissioning phase.

3.3.1.3 Identify the consequences

Hazard	Consequence
- High organic load	- Municipal sewage works unable to cope
- High salt load	- Increase in river salinity
- High phosphate level	- Increase in eutrophication potential
- High suspended solids load	- Disruption of sewage works
- Spill of caustic soda	- Disruption of sewage works
- Spill of hydrofluoric acid	- High risk of loss of sewage works (biomass)
- Erratic discharge	- Short-term disruption of sewage works

3.3.1.4 Estimate of magnitude of the consequences/probability of the consequences

Consequence	Magnitude Of Consequences	Probability
- Municipal sewage works unable to cope	Moderate	High
- Increase in river salinity	Moderate	Medium
- Increase in eutrophication potential	Mild	Medium
- Disruption in sewage works	Mild	Medium
- Disruption in sewage works	Mild	Low
- High risk of loss of sewage works (biomass)	Severe	Low
- Short-term disruption of sewage works	Negligible	High

3.3.1.5 Estimate the risk

Using the table in Section 2.1.5, the risk is estimated as follows:

Hazard estimate	Consequence	Risk
- High organic load	- Municipal sewage works unable to cope	High
- High salt load	- Increase in river salinity	Medium
- High phosphate level	- Increase in eutrophication potential	Low
- High suspended solids load	- Disruption in sewage works	Low
- Spill of caustic soda	- Disruption of sewage works	Low
- Spill of hydrofluoric acid	- High risk of loss of sewage works (biomass)	High
- Erratic discharge	- Short-term disruption of sewage works	Near zero

It can be easily seen that the key risks as estimated from this example are due to the hazards:

- high organic load;
- high salt load;
- spill of hydrofluoric acid.

This should not be taken to mean that the other hazards identified are acceptable and each should still be evaluated for appropriate mitigation.

Taking the project as a whole, the estimated risk is deemed to be high to the aquatic environment.

3.3.2 Risk Evaluation

Key Risks Estimated	Significance (Evaluation)
• High organic load	**High** - works unable to meet legislated performance, ongoing
• High salt load	**Medium** - contributes to a gradual deterioration of water quality
• Spill of hydrofluoric acid	**Medium** - works unable to meet legislated performance, short term

What is the public perception of such risks? Probably low at least in the medium term as these impacts will not be apparent to the public. The high organic load risk may receive higher and more immediate public attention.

3.3.3 Risk Assessment

For each key risk estimated, are the risks to human health and water quality intolerably high?

Risk Estimated	Risk Assessment
• High organic load	Intolerable without mitigation
• High salt load	Tolerable - benefits outweigh negatives
• Spill of hydrofluoric acid	Intolerable without mitigation

What are the benefits? - jobs, foreign exchange.

What is the environmental cost? - probably best quantified as the cost of building a new sewage works though this does not take into account the costs due to a further increase in salinity of the river system.

Consider the "do nothing" option - not feasible as the risk can be reduced to tolerable levels in favour of economic growth.

Recommended risk management actions in order to convert the two "intolerable" risks to "tolerable" would be:

- assist the Municipality to construct a new sewage works to cope with the organic load;
- implement on-site effluent treatment (this should be subjected to a HAZOP study);
- develop management procedures to manage the organic effluent situation;

- survey the brewing process for opportunities to lower the organic load going to effluent e.g. high gravity brewing requiring fewer vessel washouts; provide, when hydrofluoric acid is being used in the construction phase for vessel preparation, a separate means to collect this effluent i.e. do not discharge to sewer at all;
- develop construction project management procedures to ensure that this is implemented.

Obviously, in the course of this worked example simplifications have been incorporated. In practice many of the questions posed could only be adequately answered by commissioning specialist studies to investigate the issues thoroughly. A decision needs to be made regarding the cost of the risk assessment itself versus the risks to be assessed.

ANNEX 1: Some Techniques for Failure Analysis

1. This annex illustrates two techniques by worked examples:

   (i) for setting out the combination of circumstances that could lead to particular outcomes; and

   (ii) for calculating the probability of the outcomes.

   Both techniques use a diagram to demonstrate the logic of possible combinations of circumstances and of the calculation of the probabilities of the various outcomes (see Figures 1 and 2 at end of Annex). The first example is an "event tree" and the second is a "fault free". Both are based on examples in the Health and Safety Commission's *Major hazard aspects of the transport of dangerous substances.*

Example 1. Event tree for liquified gas transfer spill

2. Figure 1 illustrates the calculation of the probability of a number of different outcomes that could stem from a spill of liquified gas during the transfer of the gas from a cargo vessel to a terminal facility.

3. The possible events whose probabilities are analysed have been condensed into a simplified set of eight possibilities comprising: 20, 10, 5 or 2 minute full bore flows or 20, 10, 5 or 2 minute leaks.

4. The events depend on whether

   (i) there is a ranging failure or a connection failure;

   (ii) the operator is incapacitated;

   (iii) the operator reacts immediately, defined as within one minute of the rupture; and

   (iv) the emergency shut down (ESD) system is effective.

5. The probabilities for each branch of the event tree are necessarily based on expert judgement. However, sensitivity tests have shown that uncertainty in the branch probabilities does not seriously affect the overall results.

6. Referring again to Figure 1, it can be seen that it is built up logically from the left across to the results on the right. Various events are possible and whether they occur is answered by "Yes" or "No" (shown in the figure by an upward or downward branch respectively). Each answer has an effect on the outcome. Thus, the upper part of the figure leading to the top three results reflects the nature of a ranging failure in that:

   (i) it always leads to a full bore spill but cannot lead to a 20 minute full bore spill;

   (ii) the potential result of a 10 minute full bore spill can be reduced to a 5 minute full bore spill provided the operator is not incapacitated; and, granted that proviso,

(iii) the result will be reduced to a 2 minute spill if the ESD system is effective.

7. The chain of events that is shown by highlighting in Figure 1 illustrates the case when

- the transfer of spill is caused by a connection failure (0,94); and
- does not result in a full bore rupture (0,90).
- the operator is not incapacitated (0,97);
- the operator does react immediately (0,50); and
- the ESD is effective (0,90).

where the relevant probabilities are shown by the figures in brackets.

8. This is the combination of requirements for achieving the least bad result of a 2 minute leak. The probability of the outcome is calculated by multiplying the independent probabilities together:

$$0,94 \times 0,90 \times 0,97 \times 0,50 \times 0,90 = 0,369$$

Example 2: Fault tree for a small leak from a liquified petroleum gas (LPG) tanker during short-term stops

9. Figure 2 illustrates the calculation of the probability of a small leak from a liquified petroleum gas (LPG) road tanker during short - term stops. The probability is that of the occurrence of a sustained small leak and is calculated per hour that the road tanker is stopped.

10. Figure 2 shows the various faults that could occur and which separately or in combination lead to a sustained small liquid LPG spill. The figure is no more than a systematic description of possible faults, set so that the calculation proceeds from the bottom to the top. It shows how the various faults can or must combine before there is a spill. As with the first example, the probabilities assigned to each item of the fault tree are necessarily based on expert judgement. The diagram makes use of two symbols shown in the legend (the "Or" gate and the "And" gate) which can best be understood by those unfamiliar with the jargon by reference to the top part of the figure as explained in paragraphs 11 and 12 below.

11. The second row of boxes deals with three possible causes of spills and shows their respective probabilities (given in brackets below):

- leak from pad gaskets ($1,9 \times 10^{-9}$);
- leak from liquid delivery system ($1,3 \times 10^{-11}$, equivalent to $0,013 \times 10^{-9}$); and
- leak from manway gasket ($6,4 \times 10^{-10}$, equivalent to $0,64 \times 10^{-9}$).

Any leak from any of the three sources (pad gasket, liquid delivery system, <u>or</u> manway gasket) could lead to the sustained small liquid LPG leak shown in the topmost box and each is therefore linked to it by an "Or" gate. The probability of each separate cause combines additively to the overall probability of the final event. Thus:

$$1,9 \times 10^{-9} + 0,013 \times 10^{-9} + 0,64 \times 10^{-9} = 2,553 \times 10^{-9}$$

which, rounded, is the overall probability of $2,6 \times 10^{-9}$ shown for a sustained small liquid LPG spill.

12. The figure shows that before there can be a leak from the liquid delivery system (the central box in the second row) two conditions (shown in the third row) must occur in combination: those conditions are that there is a source of leak after (downstream of) the foot valve and that the foot valve is passing liquid. These two events are therefore shown linked to their consequence by an "And" gate. The probability of each separate cause combines multiplicatively to the overall probability of the consequence event. Thus:

$$1,1 \times 10^{-8} \times 1,2 \times 10^{-3} = 1,32 \times 10^{-11}$$

which, rounded, is the overall probability of $1,3 \times 10^{-11}$ a leak from the liquid delivery system.

13. Many of the faults and their associated probability of occurrence are themselves the result of a similar calculation. Thus a fault tree calculation would underlie the probability of occurrence of the faults associated with the three valves shown in boxes on the left of the figure.

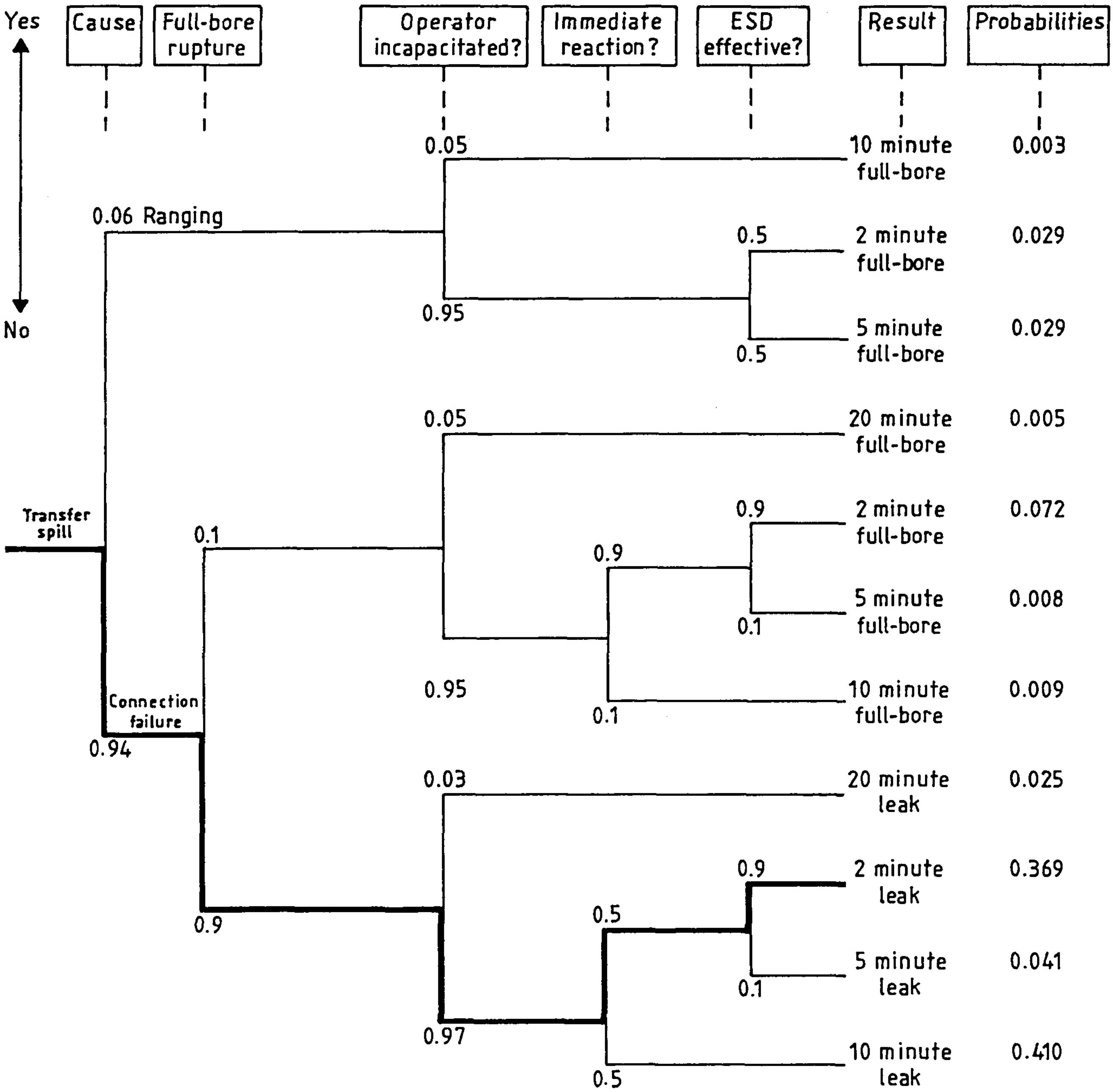


Figure 1: Example event tree for liquefied gas transfer spill

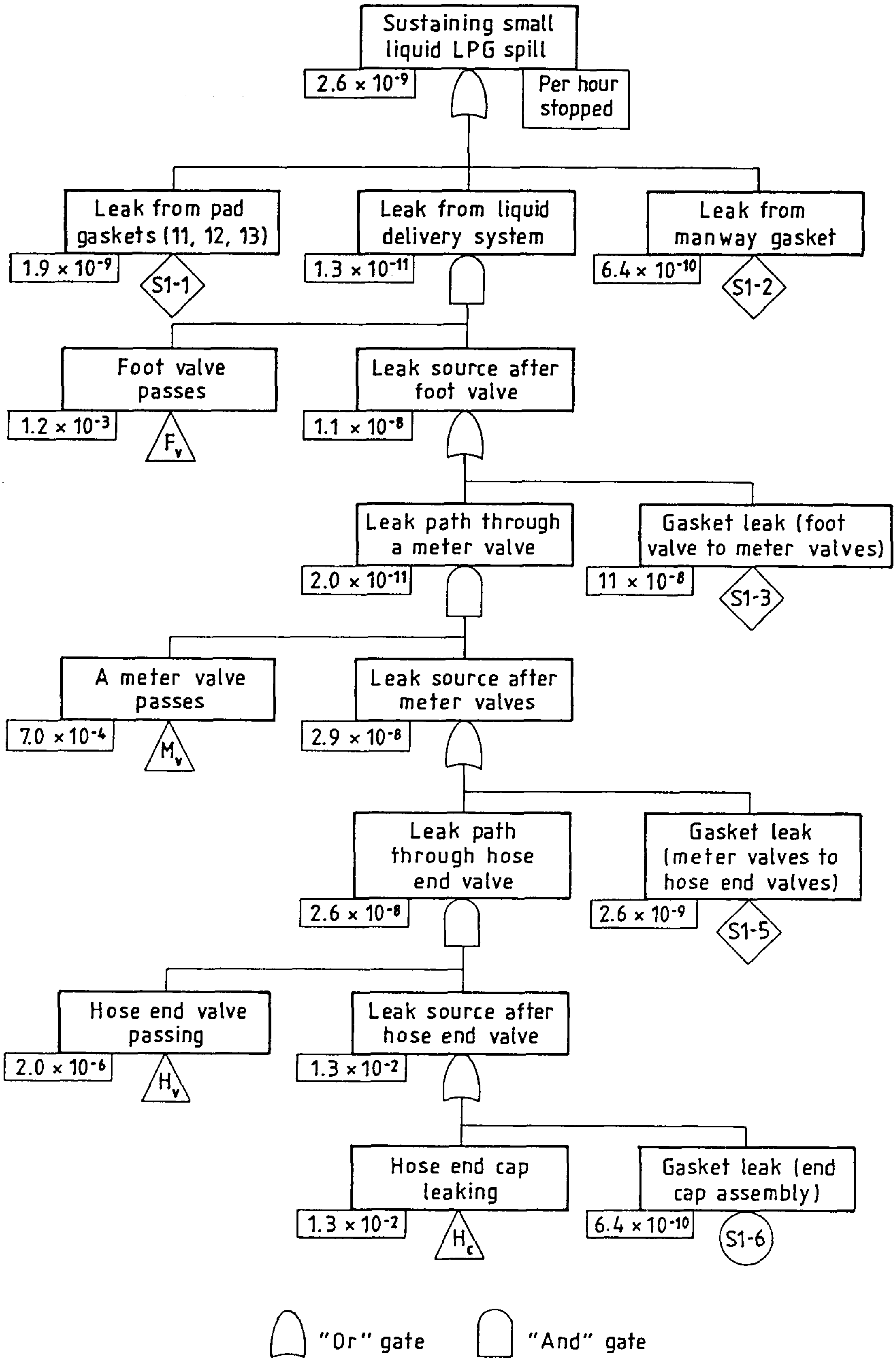


Figure 2: LPG road tanker small leak fault tree.
Leaks applicable to short term stops. Units: per hour stopped.

ANNEX 2: Assessing the Potential Environmental Risk for a Household Product: A Simplified Example

1. A fabric washing formulation is a typical example of a household product containing some toxic components. For such a product, this annex illustrates the assessment of the potential risk to the aquatic environment of the principal toxic component, namely, the surface active agent or surfactant. In this illustration, the risk is treated in isolation: no account is taken of synergistic effects.

2. After the washing process, water from a washing machine is normally discharged to the household drainage system, which in most cases then passes via a main sewer to the sewage treatment works, where purification takes place. The purified effluent from the works is then commonly discharged to a river.

3. To estimate the magnitude of the consequences arising from this discharge of surfactant to the aquatic environment, we need to

(i) identify the hazards, which are

- toxicity to aquatic organisms; and
- degradability of active agents (which is not dealt with in this annex); and

(ii) estimate the environmental concentration, given by

- the information on the quantities discharged;
- the removal of the surfactant by sewage treatment; and
- the dilution afforded by the surface waters receiving the treated sewage works effluent.

4. The likely environmental concentration of the surface active agent in effluents as they are discharged to surface waters can be predicted from the following data (applicable to the UK):

(i) Surface active agent annual usage: 80 000 tonnes (industry data)

(ii) Percentage removal by sewage treatment: 98 (monitoring and experimental data)

(iii) Population: 55×10^6

(iv) Average daily flow to sewage treatment: 200 *l*/head (water industry data includes for population, inflow etc.)

5. Assuming discharges are spread over 365 days in the year, the concentration of unchanged surfactant in the effluent, the emission concentration, EC, is calculated from the expression:

$$EC = \frac{(i) \times [100-(ii)]}{(iii) \times (iv) \times 100} = \frac{(80\,000 \times 10^{9}) \times [100-98]}{(55 \times 10^{6}) \times (200 \times 365) \times 100}$$

$= 0{,}4$ mg/*l* (where, 10^9 converts tonnes to milligrams.)

Note that the assumption that discharges are spread uniformly over the 365 days of the year is explicit and the calculation could readily be refined by applying an estimated factor for the ratio of the peak concentration for a shorter period to the average concentration over a year.

6. Since sewage effluents are normally discharged to a river, the second step is to take account of the dilution afforded to sewage effluent discharges. For modelling purposes, this dilution factor is assumed to be 10:1 (although in the UK the dilution factor is often greater than 10:1) thus giving a predicted environmental concentration, PEC_{local} of <u>0,04 mg/*l*</u>. Again, the assumptions are explicit.

7. To assess the consequences, the PEC_{local} is compared with the effects data, i.e. the results of testing using for example fish, water flea and algae as the target organisms. The particular surfactants used in European washing powders when tested using the water flea as the test organism tend to result in a no observed effect concentration (NOEC) in long terms of about 1 mg/*l*. The same order of NOEC has been found with fish.

8. Since for practical reasons, the number of species tested is limited, a commonly used approach is to extrapolate the test results to cover whole ecosystems by the application of a safety assessment factor. The factor is also needed to take account of variations in sensitivity between species and, when appropriate, extrapolation between acute and chronic sensitivity. The assessment factors recommended for use in the characterisation of aquatic risk are given in the Technical Guidance Document accompanying the European Commission Directive 93/67/EEC on the evaluation of the potential risks of new notified substances. The guidance for this case would be to use a factor of 10 which is applied to the lowest value of the NOEC obtained from tests with fish, daphnia and algae.

9. The value of the NOEC for the most sensitive species tested is divided by the factor to give a predicted no effect concentration, PNEC. This is not defined as a safe level, but rather one at which adverse effects are not expected to occur. In this example, it is assumed that the water flea was the most sensitive species found in long term-tests with a NOEC of 1 mg/*l*. Applying the recommended value of the safety assessment factor of 10 gives a <u>PNEC of 0.1 mg/*l*</u>. This means that any discharge greater than 0.1 mg/*l* could be expected to give rise to harmful effects to at least some aquatic organisms.

10. If the ratio of PEC_{local} :PNEC<1 then a substance is considered to be of no immediate concern i.e. the magnitude of the consequences is low or negligible. In the example PEC_{local} is 0,04 mg/*l* and hence the ratio to PNEC is less than 1 by a factor of 2½. Therefore the risk arising from the hazard of toxicity to aquatic organisms is low or effectively zero at the estimated market tonnage.

11. It is quite possible that the dilution available on discharge of the effluent from the sewage treatment plant may be considerably greater than that used in the model calculation. This factor may decrease further the value of the predicted environmental concentration and hence the ratio PEC:PNEC. The converse is possible due to a poorly operating sewage treatment works, higher use of the product in a particular area etc.; and at some point the ratio could exceed 1 therefore giving rise for concern and the possible need to refine the estimation of PEC_{local} and hence the magnitude of the consequences.

12. It is interesting to note that the estimate of the environmental concentration is realistic since the actual concentration in rivers of the surface active agent considered is found to be in the range 0,01 – 0,1 mg/*l*.

ANNEX 3: Some Factors Affecting Perceptions of Risk

1. There are a number of factors which are known to affect people's perception of risk: they include familiarity, control, proximity in space, proximity in time, the dread factor and scale.

Familiarity: people tend to underestimate the risks which are familiar to them and to overestimate those that are unfamiliar. Thus the practitioners of soccer and hang gliding have a fair idea of the risks they take but the general public underestimates the risks of an accident in soccer and overestimates the risk of one in hang gliding.

Control: people tend to underestimate the risks from an activity over which they have control compared to one in which they are in other people's hands. Despite published statistics on fatalities, driving a car is often considered to be safer than flying in an aeroplane. Moreover, people tend to demand greater protection from events over which they have no control.

Proximity in space: Although the risk per person in the population near to an activity may be greater than the average risk in the population as a whole, people may overestimate the risks of something which might occur near to them and underestimate those that will occur at a location remote from them. This is one factor in the "Nimby" syndrome.

Proximity in time: People tend to ignore the effects of risks that are going to arise much later in time. Whilst discounting, in the economist's sense of reflecting time consequences, should be standard practice, it should not be duplicated by also taking less account of the risk itself.

The dread factor: people exaggerate the risks associated with phenomena they do not understand. Risks associated with machinery are under-regarded whilst those associated with, say, radiation are exaggerated. Moreover, people tend to demand greater protection from events which they do not understand.

The scale factor: The media are more concerned with one large-scale consequence than a large number of individually smaller consequences which sum to a greater overall consequence. An obvious example is in car accidents where a pile-up causing 50 injuries is more newsworthy than 50 separate accidents each causing an injury. A consequence of the greater media attention to large-scale accidents is that they concern politicians and businesses more.

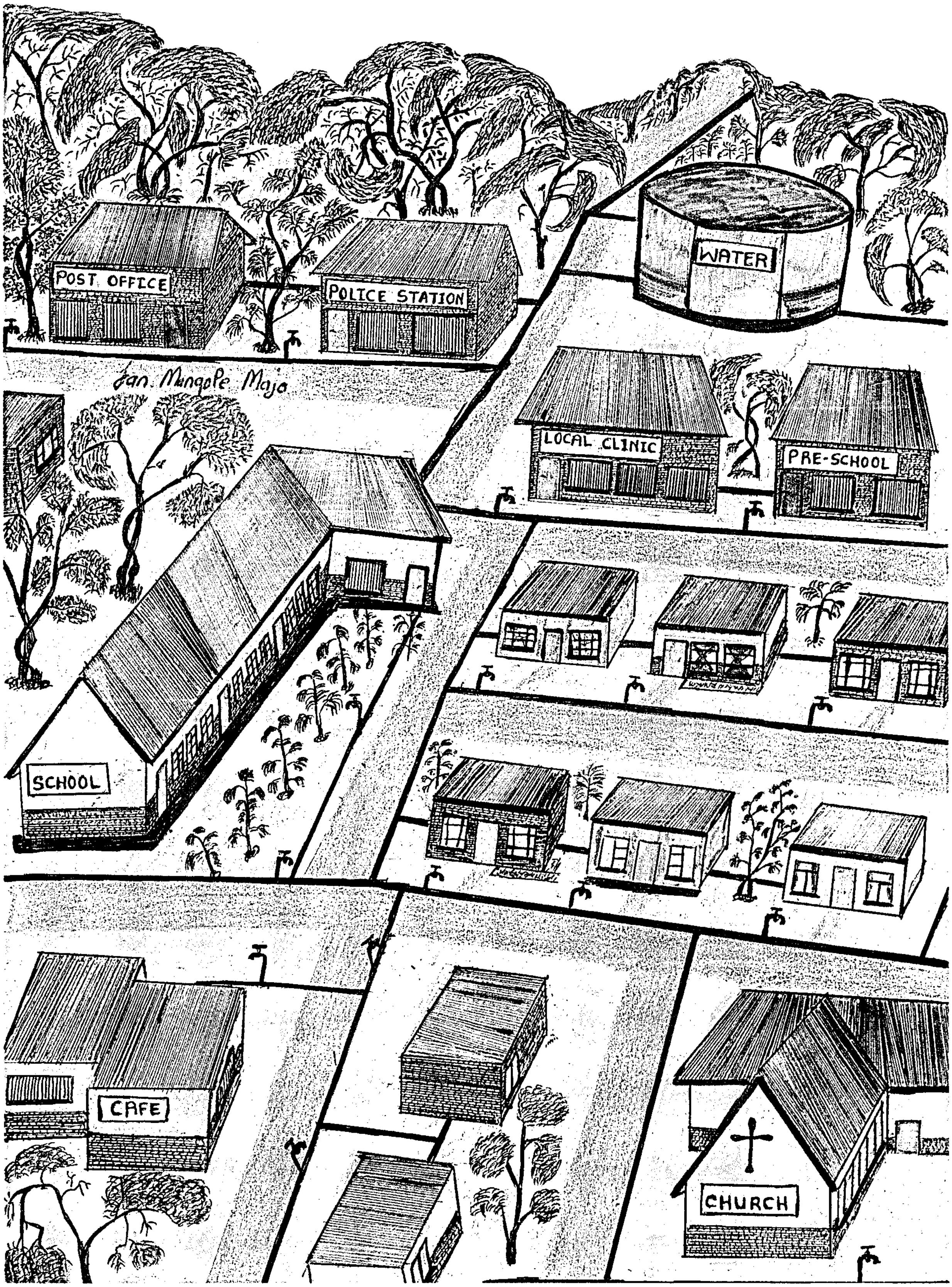
2. There is also some research evidence to show that the public view about the risk associated with a particular intention will depend principally on the consequences: the public will either largely ignore the probabilities or base their view on a significantly incorrect judgement of the probabilities. The expert tends to approach an assessment starting with the probabilities and let this feed through to the risk assessment. Whilst it would be right to ignore misperceptions of probability, it may still be necessary to explain the differences in perception to the public. This process may entail its own cost. It may also be necessary to recognise that there may be significant inaccuracies or lack of certainty in the risks assessed by the experts themselves.

3. Risk policy should reflect the best objective analysis but in the short term, may have to modify the conclusions drawn from that analysis to take account of the perceptions of those who will be affected by the decision. In the longer term it may be possible to educate those affected to a more informed and less troubled perception of some risks. British Nuclear Fuels plc has undertaken a large-scale exercise at its Sellafield site to familiarise and educate those living nearby and the general public who are interested enough to visit the site. The company believes the exercise has been worthwhile in removing misconceptions of the risks associated with its activities and has had the added benefit of allaying local concern and winning goodwill.

4. Whatever objective analysis suggests, there is some research evidence to show that people expect controllable imposed risks - even small ones - to be controlled. Failure to appreciate this point has in the past caused trouble for some regulators when they have placed too much emphasis on what is a significant risk and what is not.

5. There is a tendency on the part of some experts and commentators to draw up league tables of risks, both in terms of magnitude and probability. This may help the non-expert to gauge the magnitude of different risks but, if risk management priorities are based too strictly on position in the league, public support may be lost. Moreover, most risks are additive, whilst league tables give the impression that different risks are alternatives.

Field Guide
Participatory Development Management



AFROSEARCH

FIELD GUIDE

PARTICIPATORY DEVELOPMENT MANAGEMENT (PDM)

AN INTEGRATED AND EMPOWERING DEVELOPMENT APPROACH

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This Field Guide is supplementary to WRC Report No. K5/519, which is the full report to the Water Research Commission on the project:

The Development of Programmes to Combat Diffuse Sources of Water Pollution in Residential Areas of Developing Communities

DISCLAIMER

This report has been reviewed by the Water Research Commission (WRC) and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the WRC, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

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NOTES ON THE USE OF THE FIELD GUIDE

The Field Guide, in its current format, is believed suitable for use by community developers and project developers. To make the best use of it needs some understanding and experience of the development process involved when implementing water, sanitation or waste projects, together with a desire to "add value" to communities. It is hoped that this manual will provide a solid basis for implementing broad-based, participative project development without prescribing "recipes". As such, it aims to describe the milestones that need to be achieved or incorporated to allow participative project development.

The Field Guide is not exhaustive, nor should it be regarded as a development "bible". It is intended to be used together with the many books and manuals on various aspects of participative appraisal, training and development management in underdeveloped contexts, as well as guides and manuals on the technical provision of water, waste and sanitation services.

Contents

MARIA'S STORY

THE PROBLEMS AND DIFFICULTIES I HAVE HAD IN GETTING WATER

Maria Mkari

"I am from the area known as Five Morgen around Winterveldt. The people of Winterveldt have a serious problem in getting water. We first got water from a pit, but this water was not purified.

The pit gave us many problems. Many children fell into the pit and drowned. The lucky ones were rescued before they died. In addition to children, some domestic animals, such as donkeys and dogs, fell in. This led to the non-usage of this pit, except to throw refuse into it.

A private company was called in to install a new pump. The people of Winterveldt were not given any chance to help build this pump, and when it broke down we had to wait for the company to come and repair it. This pump was far from my home and it was difficult to drill. We had to wake up at five o'clock in the morning to fetch water to avoid long queues.

We carried the 25-litre bucket of water on our heads. Sometimes I stumbled and fell, causing the whole bucket to splash over. Then I had to go back to refill it.

We often went to the pump on Saturdays to do some washing. We would spend the whole day with hungry stomachs. On this day cows, donkeys, goats and sheep would be brought in to drink. Some cattle would fight to get water in their mouths. Survival of the fittest was the order of the day as there was shoving and pushing around.

The pump is now broken and there is nowhere to get water. The North-West Star Bus people helped by giving us water from the bus depot. People who are far from the depot are still suffering. They have to walk long distances to get there. Even so there is still a need for more water pumps.

Who can help us?

(Presently, Maria serves as representative member on a water committee and is receiving training in community-based water management as part of the Winterveldt RDP lead project).

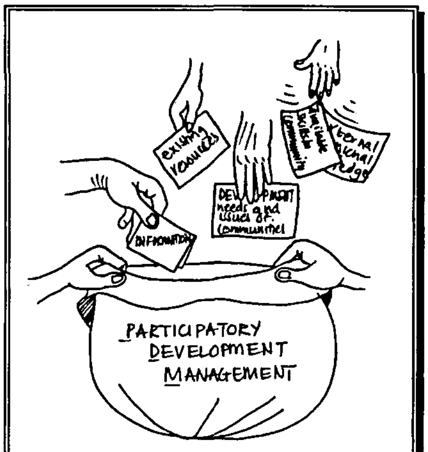
PARTICIPATORY DEVELOPMENT MANAGEMENT (PDM)

INTRODUCTION 1

1.1 BACKGROUND

Participatory Development Management, like its part-parent methodology, Rapid Rural Appraisal, is a systematic and structured activity carried out in the field by a multidisciplinary team. It is designed to:

- Acquire new information on:
  - development needs hypotheses,
  - community development needs and issues, and
  - existing resource bases.
- Bring together:
  - development needs defined by the community groups, and
  - the resources and technical skills of government, donor agencies, and non-governmental organisations (NGOs).
- Integrate in the development process:
  - skills available in the community, and
  - external technical knowledge.
- Implement development processes that are:
  - socially acceptable,
  - economically viable,
  - ecologically sustainable, and
  - participative.



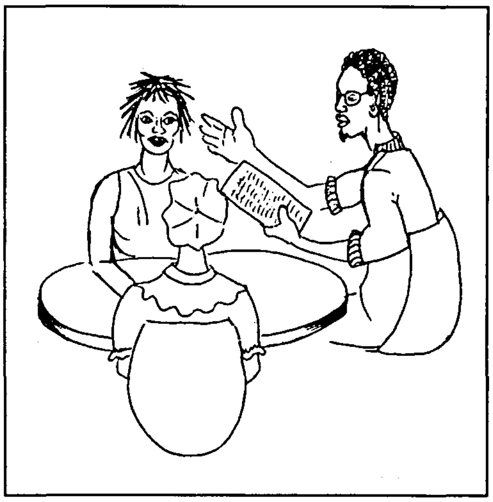
PDM integrates community-based needs, resources and skills

Participatory Development Management assumes that communities need committed local leadership and effective rural institutions to do the job.

1.2 COMPOSITION OF THE PARTICIPATORY DEVELOPMENT MANAGEMENT TEAM

The composition of the Participatory Development Management team greatly influences the quality of information, the analysis and the subsequent management plan. Teams are made up of a team leader and two or three core members from the organising groups, supplemented by technical extension officers (such as water, agricultural, soil conservation or co-operative agents) from the area under review and, when appropriate, village leaders and interpreters.

Team members should include men and women, some with technical and others with social science backgrounds. All should have strong experience working at the local level and a good understanding of rural institutions and processes.



Composition of the PDM team

To ensure full participation by the members of the Participatory Development Management team, all members and their supervisors should be briefed in detail about the methodology. Several experienced Participatory Development Management practitioners should be available to help team members who are less familiar with the methodology.

Under ideal circumstances, Participatory Development Management would be organised and implemented as a single, fully integrated approach to rural development. However, the present system among development assistance agencies, donors, and governments is not structured in such a holistic way. Therefore, for administrative and funding purposes, Participatory Development Management is carried out through individuals who also function in conventional positions.

To ensure maximum integration on the ground, it is recommended that the Participatory Development Management team and community leaders organise a Development Committee or Natural Resources Committee. Such committees can help introduce the Participatory Development Management exercise to the community. They may also help the Participatory Development Management team identify important local leaders and institutions for interaction and organise group discussions to gather and analyse information.

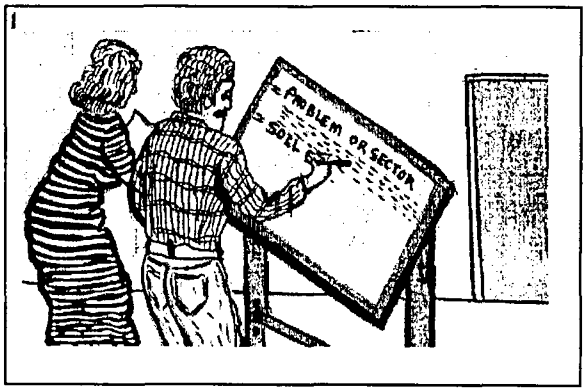
1.3 IMPACT

The Participatory Development Management Approach can assist in:

- renewing Africa's natural resource base with improved policy and action,
- focusing on developing communities, especially those with vulnerable ecosystems,
- linking technical and socio-economic issues when defining problems and solutions, and
- creating a system for participatory development processes, so that donors, government and NGOs, hand-in-hand with communities, can stop and reverse Africa's declining productivity.

Participatory Development Management helps communities to

- define problems,
- mobilise their human and natural resources,
- examine previous successes,
- evaluate local institutional capacities,
- prioritise opportunities, and
- prepare a systematic and site-specific plan of action, known as a Community Resource Management Plan (CRMP), for the community to adopt and implement.



Prepare a systematic plan of action

Using the theme of natural resource management to integrate different sectors of development, Participatory Development Management facilitates collaboration among multiple:

- sectors (for example, agriculture, water resources, forestry),
- disciplines (for example, economics, sociology, engineering, biology), and
- institutions (such as government, NGOs, universities, donors).

1.4 THE FOUR COMPONENTS OF PARTICIPATORY DEVELOPMENT MANAGEMENT

1.4.1 Rapid Assessment and Consultation

(a) Making contact

- Selecting the community
- Preliminary site visit

- Holding the first community meeting(s)
- Review of community situation
- Holding a planning meeting

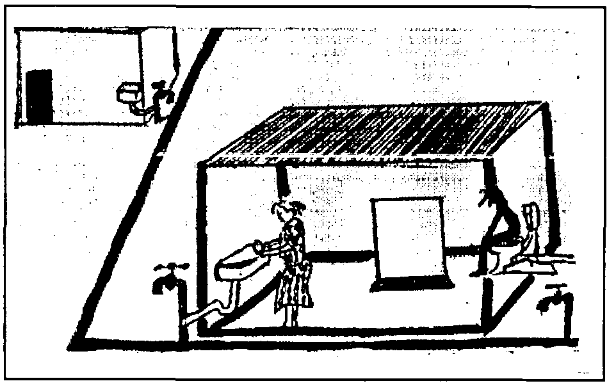
(b) Institutional development

- Identify existing structures
- Evolve into relevant orientation
- Develop democratic structures
- Empower local participants by involving them
- Help to develop the structure of institutions

1.4.2 Information Gathering and Analysis

(a) Data gathering

- Secondary data
- Primary data
  - → spatial data
  - → time-related data
  - → social data
  - → technical data



Siting of taps - technical data

(b) Analysis and listing

- Analyse data
- List issues

(c) Ranking problems and opportunities

- Review process
- Ranking process
- Action step process

1.4.3 Community Resource Management Plan

(a) Develop Community Resource Management Plan

(b) Validate ranking

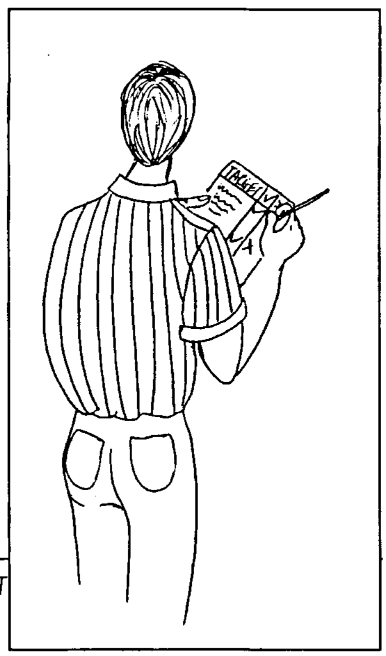
(c) Analyse resources

(d) Develop action plan

1.4.4 Implementation, Monitoring and Evaluation

(a) Implementation process

- Ensure strong leadership
- Financial management
- Natural resource management
- Human resource management



The impact of projects

- Developing community management

(b) Evaluation and monitoring

- Plan the evaluation
- Develop an evaluation framework
- Identify evaluation elements
- Ongoing monitoring and evaluation during implementation
- Ongoing monitoring and evaluation during operations
- Project impact evaluation
- Post-implementation evaluation

2.1 PHASE 1: RAPID ASSESSMENT AND CONSULTATION

ALGORITHM OF THE PDM PROCESS

2

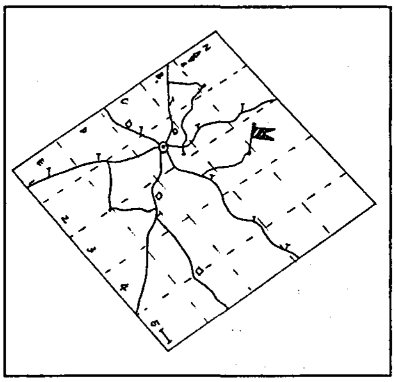
(a) Making contact

Refer Section 3.1.1, on page 17

(i) Selecting the community

Objective
- To select a community that has a need for the Participatory Development Management Process.

Participation
- The Participatory Development Management team, with other relevant expertise, initiate the community selection process.



Select appropriate community

(ii) Preliminary site visit

Objectives

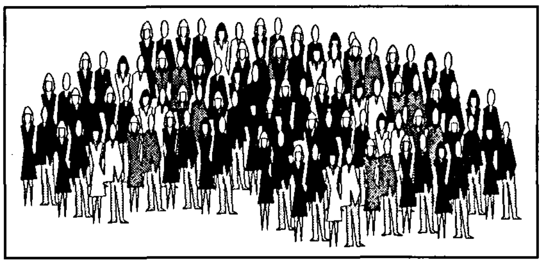
The main objectives of this visit are to
- establish positive relations with the relevant community leaders, and
- organise a broad community meeting.

Participation

A team comprising the:
- core members of the Participatory Development Management team, and
- field workers

should liaise with community leaders and representatives.

(iii) Initial community meeting



Initial community meeting

Objectives

The objectives of the first community meeting are to:

- Introduce and communicate the Participatory Development Management objectives and methodology to a broad representation of the community, including key role players and community leaders.
- Encourage the community to examine past successes carefully in order to understand the root causes of these performances.
- Show the community exactly how their daily lives could benefit from this process.
- Ensure an understanding of the need for, and functions of a Development Committee, if no such committee exists as yet.
- In the case of an existing Development Committee, the team should develop a clear understanding of the functions, composition and focus of the committee.

Participation

The core Participatory Development Management team and the widest possible community representation, leadership, functional and key role players should participate in this meeting. The primary goal is to ensure the widest possible community participation.

(iv) Community review

Objectives

To ensure that the community has ample opportunity to:

- discuss the envisaged process among themselves
- identify process-related issues, and
- indicate their willingness to participate with and support the Participatory Development Management process.

In this manner, the participants can make an informed decision.

Participation

All community-based interested and affected parties, key role players, functional representatives and leaders should participate in the community review.

(v) Public feedback meeting

Objectives
- To provide an opportunity for the community to comment on their understanding of the proposed process.
- To provide confirmation to the Participatory Development Management team if the community wants to participate in the development process.
- To make recommendations on the process and approach.
- To finalise the appointment of the Development Committee.

Participation

All community-based interested and affected parties, key role players, functional representatives and leaders should participate in the public review process.

(vi) Initial planning meeting

Objective

To initiate (with community participation) a database of
- all "expertise" in the community (e.g. school principals, motor mechanics, welders, social workers, etc.)
- ecological, demographic, infrastructural, and other relevant information for use in Rapid Rural Appraisal methods

Participation

The participants in the planning meeting should include:
- The Participatory Development Management team
- Community leaders
- Development Committee
- Concerned and affected community members

There should be wide participation in planning meetings

(b) Institutional development

Refer to Section 3.1.2 on page 22

(i) Identify existing structures

(ii) Evolve into relevant orientation

(iii) Develop democratic structures

(iv) Empower local participants

(v) Institutional structuring

Election of committee members must be democratic

Institutional development has to do with empowering appropriate structures and the people operating within those structures. No process or policy can be translated into action unless there are adequate and appropriate structures for implementing it.

Building community-based problem-solving capacity, with the appropriate structures, is time-consuming. If such structures are not adequately developed and empowered, the odds are that the development process will fail.

Objectives

- To enhance the capacity of the local people, on both individual and institutional levels, to become involved in analysing and implementing development actions in their own communities.
- To identify existing institutional structures.
- To evolve these (if necessary) into appropriate development structures best suited to meet local needs.
- To empower members of the institutional structures.
- To evolve appropriate functional committees.
- To develop broad-based democratic structures.

Participation

- The election of committee members should take place in a community-wide and democratic manner.
- The training and facilitation experts of the Participatory Development Management team should participate in this process, together with all affected community members.

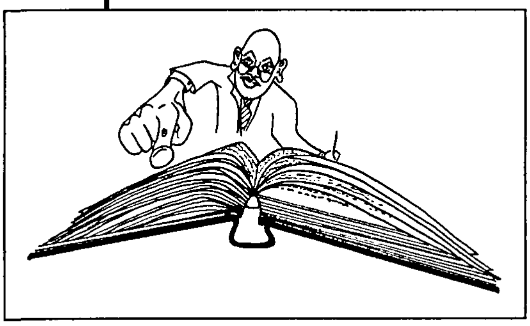
2.2 PHASE 2: INFORMATION GATHERING AND ANALYSIS

(a) Data gathering

Refer to Section 3.2.1, on page 24

Both Rapid Rural Appraisal and Participatory Development Management are "data-economising" or "data-optimising" approaches. This means that they can be used to collect limited data that produces useful results quickly and without great expense. Their objectives are not scientific perfection, but flexible and appropriate programme and project design, with full and extensive community participation. The speed of the Participatory Development Management approach, however, does not lead to an incomplete or shallow collection of data.

(i) Secondary data



Gathering secondary data

Objectives

- To enable an initial overview of the study area and yield general information on natural resource management, specifically the
  - → source base,
  - → land use,
  - → problems,
  - → opportunities, and
  - → past experiences.
- To develop a basic understanding of the local conditions and overriding constraints experienced in the community. This enables the Participatory Development Management team to address the specific needs and potential range of options available to the people.
- To be able to place the project process within a larger regional perspective.

Participation

- The Participatory Development Management team collects this information.
- The community and relevant external institutions may help identify sources of information.
- The Development Committee may facilitate community participation in helping to collect some of the local data.
- Involving the local community in this process greatly increases their sense of ownership and participation.

(ii) Primary data

Objectives

Field data gathering is intended to:

- Encourage community residents to think systematically about their problems and possible solutions.
- Help the Participatory Development Management team comprehend the region's conditions and circumstances.
- Analyse problems and present options for addressing them.
- Incorporate these findings into an integrated situation analysis.

Participation

Each technique is designed to maximise local participation in data collection and analysis.

Spatial data	Time-related data	Social data	Technical data
• Village maps • Transect sketches • Farm sketches	• Time-lines • Trends • Seasonal calendars	• Household interviews • Institutional studies for people-related information	• Technical data incorporates detailed data on water, infrastructure, services, etc.

Household interviews

(b) Analysis and listing

Refer to Section 3.2.2, on page 27

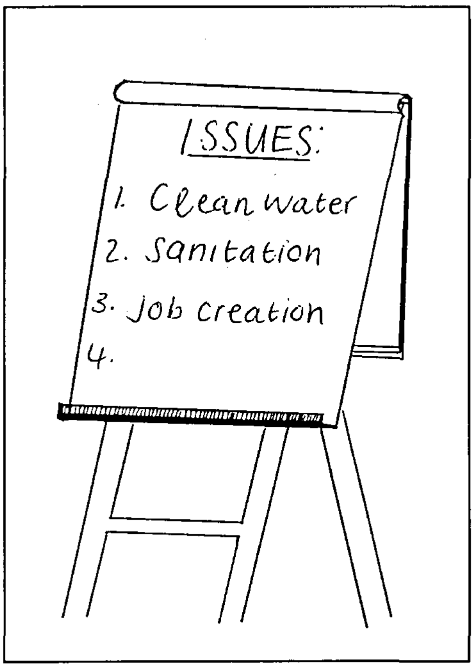
(i) Data analysis

Objectives
- To initiate an interactive process, integrating and analysing the data results, between the community and the Participatory Development Management team, so that a Community Resource Management Plan can be prepared.
- To organise the segregated information into manageable structures for the community to assess and rank.

Participation
The participants in the data analysis and listing should include:
- The Participatory Development Management team.
- Community leaders.
- Affected and informed residents.
- Technical officers.

The critical importance of community participation in the process cannot be stressed enough.

(ii) List issues



Issues should be listed

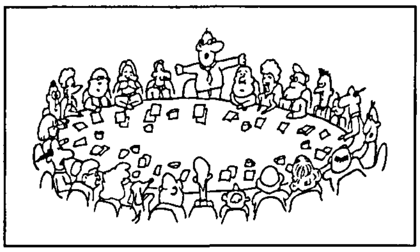
(c) Ranking problems and opportunities

Refer to Section 3.2.3 on page 28

Once problems and opportunities have been listed, the major task of ranking them remains. This may be the most important step in Participatory Development Management since it enables village leaders, local development committees, representatives of key institutions, and others to join with technical officers, NGO staff, donors and other interested parties to discuss and agree upon priorities.

(i) Review process

(ii) Ranking process



Everybody must participate in ranking the issues

(iii) Action step process

Objectives

- To rank community and technical issues in order of priority, to serve as a basis for developing the Community Resource Management Plan, and its eventual implementation.
- To create community awareness of an information base oriented toward them and their needs. This is vital if any informed decision making is to take place.
- To increase community knowledge and understanding of technical information for specific problems, awareness of funding mechanisms available to village communities, and the understanding that effective resource management can be carried out by communities acting primarily on their own initiative.
- To increase knowledge of the community's natural resource management issues.
- To assign priorities, because financial, labour and other resources are limited, and development projects must be tailored to make best use of these limited resources.

Participation

- A large village meeting provides the setting in which community members first prioritise the identified problems and then rank the opportunities that address the most crucial of these. This process should include at least the:
  → Participatory Development Management team,
  → technical officers,
  → village leaders (both formal and informal), and
  → village residents (both women and men).

Information Requirements

Ranking is based on locally accepted criteria, as well as on such externally identified categories as:

- environmental sustainability,
- stability,
- equity,
- productivity,
- cost,
- time to benefit,
- social feasibility, and
- technical feasibility.

The list of problems and opportunities that was compiled during the information-gathering process is the core component of the ranking process.

2.3 PHASE 3: COMMUNITY RESOURCE MANAGEMENT PLAN

(a) Develop Community Resource Management Plans

Refer to Section 3.3.1 on page 30

↓

(i) Validate ranking

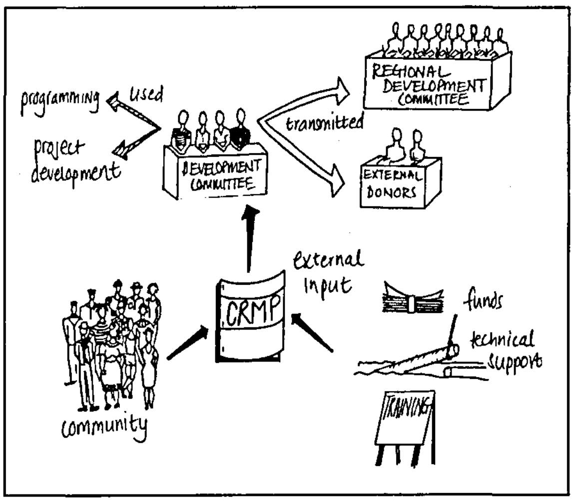
↓

(ii) Resource analysis

↓

(iii) Action plan

↓



Everybody should be involved in developing the CRMP

The final and possibly the most concrete output of the entire study is a Community Resource Management Plan (CRMP).
The CRMP is a record of all the community's development priorities and potential and is used as a basis for development.

Objectives

- To serve a variety of purposes and audiences, i.e.:
  - → The Development Committee uses the document for programme and project development and transmits it to the District or Regional Development Committee (or RDP Forums) for possible funding.
  - → The plan can also help external donors and implementing agencies to determine whether the community's common development goals are in line with their own priorities.
- To finalise an action plan supported by all actors, which will facilitate the scheduling and execution of duties, report-back procedures and monitoring of progress within a "learning process" approach.

Participation

- The community should take the lead in developing the Community Resource Management Plan.
- The extension staff and the research team act as facilitators and make technical information available to the community to help them come to rational decisions.
- It is preferable to involve NGOs and donor agencies in this activity. In many cases, external input, especially funds, technical support and training, may be critical for the success of the Community Resource Management Plan. If these groups are present while the plan is being prepared, they may be more likely to help implement it.

Information requirements

The CRMP covers several issues. These are:

- Development priorities, agreed on by the community.
- Proposed actions and requirements.
- Duties and responsibilities for individuals and groups.
- Work schedules.
- Identification of areas where the community needs external assistance.

2.4 PHASE 4: IMPLEMENTATION, MONITORING AND EVALUATION

(a) Implementation process

Refer to Section 3.4.1, on page 31

Implementation is directly related to the objectives and programmes of the project. As such, implementation processes are guided by the project details. For this reason, it is difficult to identify a specific implementation process, as this may differ from project to project. Some key areas, however, do need attention. These key areas are indicated in (i) to (v) below.

(i) Leadership

(ii) Financial management

(iii) Natural resource management

(iv) Human resource management

(v) Development of community management

Objectives

To ensure that:

- community structures have a firm organisational base,
- felt needs are addressed,
- local capacity is used to the full,
- accountability and self-reliance are developed,
- project objectives are achieved.

Participation

- The maximum number of local participants must be involved in implementation.
- While the community should be assisted by the Participatory Development Management team, the community should accept final accountability and responsibility for implementation.
- A sense of ownership and achievement is critical for any sustained development process.

Ensure maximum local participation in implementation

(b) Evaluation and monitoring

Refer to Section 3.4.2, on page 33

(i) Evaluation planning

↓

(ii) Develop an evaluation framework

↓

(iii) Identify evaluation elements (Key Performance Indicators (KPIs)

↓

(iv) Ongoing monitoring and evaluation during implementation process

↓

(v) Ongoing monitoring and evaluation during operations

↓

(vi) Project impact evaluation

↓

(vii) Post-implementation evaluation

Objectives

It is essential that evaluation takes place. The objectives of this process are primarily concerned with evaluating and enhancing efficiency, effectiveness and potential impact. Specific objectives are:

- To measure and analyse progress.
- To learn from mistakes.
- To ensure adherence to objectives.

Participation

Participants to the monitoring and evaluation process should include:

- External evaluators.
- Social researchers.
- Internal staff.
- Field interviewers, who:
  - → should preferably be able to speak the local language, and be selected from the project area itself;
  - → must undergo appropriate training to ensure that they understand the process, and have the right orientation and attitude towards the project and its participants.
- Relevant participants.
- Affected parties.

It is preferable to use external evaluators, especially in the impact evaluation, as this ensures a degree of impartiality.

Supervisors should be appointed to assist the field interviewers as needed. The supervisor needs to be an experienced person, with appropriate skills.

Field team members should work as an integrated team to draw on their multidisciplinary resources.

It is critical to build community participation into the monitoring process. As with their involvement in data gathering, this ensures that the participants become involved and develop a basis for informed decision making.

METHODS OF THE PDM PROCESS

3

3.1 PHASE 1: RAPID ASSESSMENT AND CONSULTATION

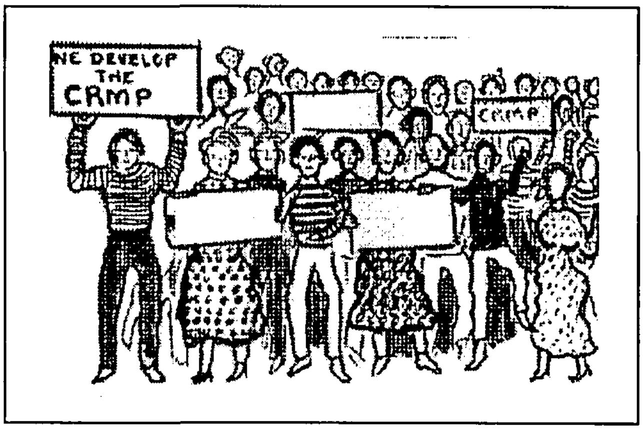
3.1.1 Making Contact

(a) Selecting the community

The selection of the community can be accomplished in two ways:

- either a government extension officer or other field worker identifies a community that needs development assistance, or
- an organised community requests assistance.

A few examples include:



Communities may request assistance

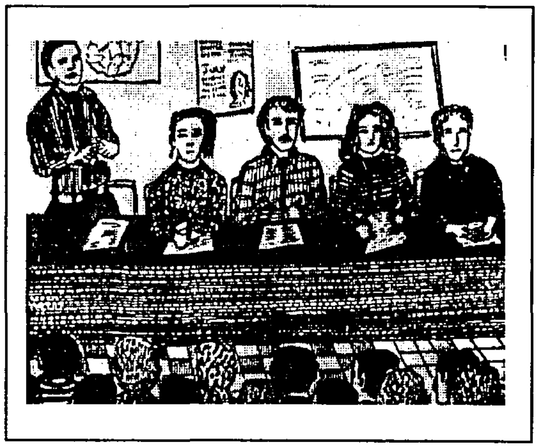
- A community with a specific problem, such as deforestation, may ask for help based on its familiarity with work that a Participatory Development Management Process has initiated in a nearby community.
- A village committee or leader may see Participatory Development Management as a way to mobilise community institutions or to attract funding for village projects from a donor or government agency.
- The Community Development Assistant or a water engineer may recommend the Participatory Development Management approach for an area that has unique problems that require special attention.

(b) Preliminary site visit

After selecting the target community, a preliminary site visit should take place. This encompasses the following:

- The members of the organising agencies should clarify the nature of the Participatory Development Management Process to the appropriate community leaders. Care must be taken to ensure that the aims of the envisaged process are clear, and that these aims address local perceptions.

- After meeting the community leaders, the Participatory Development Management team should be introduced to the community by civic or traditional leaders, or other community workers.
- If the community remains interested, an invitation to conduct the Participatory Development Management Process should be formalised by a letter of request from the appropriate local official, authority or leadership.
- The district/regional authority should also be visited to ensure technical and institutional backing. The necessary information on other development organisations active in the area can also be sourced there.



The PDM team must be introduced to the community leadership

- Information about the request and the team's visit should be communicated to all concerned individuals, institutions and functional representatives in the community and district. This should include (at least) representatives from:
  - → social groups (i.e. youth and women's groups),
  - → church groups, educational leaders, and the
  - → relevant political party representative, etc.

(c) Initial community meeting

Before this meeting the Participatory Development Management team should begin collecting information on:

- completed or ongoing development activities[1] that have worked effectively in the community or in nearby villages, as well as
- proposals submitted by the village to external institutions for support.

The community leadership must be approached to arrange a community meeting. This should preferably be done in writing.

The Participatory Development Management team must prepare appropriate agendas and deliver these to the community leaders some time before the envisaged meeting. This serves to prepare and focus the participants at the public meeting.

1 Examples of some of these existing activities could include projects that have improved water supplies, agricultural activities, soil conservation, reforestation, school expansion, road and transport development, income generation, and health care.

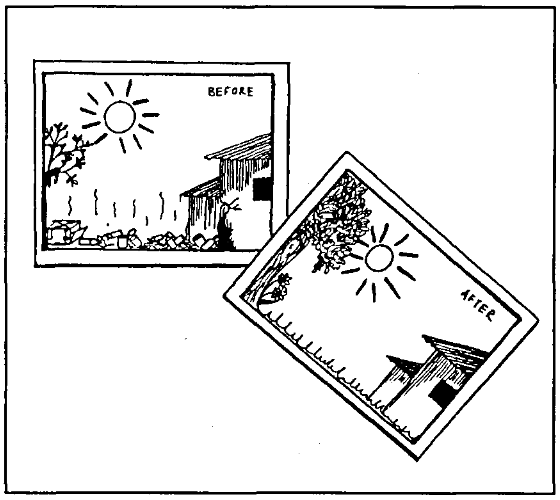
Arrange a community meeting

It is recommended that the participants at the community meeting elect their own chairperson. This ensures a measure of ownership of the proceedings. The idea of a rotating chairperson may be considered.

The Participatory Development Management team should emphasise that the purposes of the PDM exercise are to:

- gather information to help the community prepare a Community Resource Management Plan,[2]
- improve local resources management, and
- mobilise community efforts to implement the identified activities.

Several techniques can be used to communicate the objectives and advantages clearly. These include:



Before – and –after pictures can enhance scenario sketches

- Photographs of before-and-after scenes where Participatory Development Management Processes have been implemented.
- Scenario sketches of before-and-after Participatory Development Management, enhanced by pictures.
- A person from another village where Participatory Development Management has been implemented can make a valuable contribution in communicating the value of the programme in terms of real-life experience.

2 Such a Community Resource Management Plan will enable community leaders and concerned residents to achieve their development expectations and needs with minimal dependence on external resources and agencies. It also helps the community strengthen its internal development capacities and to communicate its need for external resources. This delicate balance between bolstering self-sufficiency and marshalling external assistance is essential to sound development.

- Clear and simple information handouts describing the aims and objectives of the process.
- A process must be initiated to elect a Development Committee (if none exists yet) to assist the Participatory Development Management Process.

The need for, functions, composition and focus of such a Development Committee must be discussed with the community.

This can take place at the same meeting, or at the public feedback meeting (discussed in Section (e) below) after the community has had an opportunity to discuss the issue among themselves.

The Participatory Development Management team should take effective minutes. These should be provided to the local community leaders as a record of the proceedings and decisions taken.

It is important to be open and transparent and to make an effort to understand and recognise the perceptions and traditions of the specific community. The Participatory Development Management team should listen carefully to the participants, neither influencing the proceedings, nor jumping to early conclusions.

(d) Community review

After the initial community meeting, community leaders and members should meet in private to consider the Participatory Development Management Process.

They may need a period for full and open discussion among themselves to review their understanding of the process and confirm interest in proceeding with the programme.

There may be a need for someone to explain certain unclear aspects for the community.

(e) Public feedback meeting

The Participatory Development Management team must approach the community leadership to arrange the public feedback meeting. It is advised that these arrangements be confirmed in writing.

The Participatory Development Management team should prepare appropriate agendas and deliver these to the community leaders some time before the envisaged meeting.

It is recommended that the participants at the community meeting elect their own local chairperson.[3]

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3 It is recommended, that the chairperson of the Development Committee also chair the public meetings. This would ensure continuity and focus. The use of rotating chairpersons can also be considered.

The appointment of a Development Committee (if none exists) should be finalised. This can take place by a:

- voting procedure during the meeting, or
- if the community has already elected a Development Committee, presentation of the Development Committee members to the participants at the public meeting.

The Participatory Development Management team should finalise communication procedures, contact personnel and project procedures with the participants[4].

The Participatory Development Management team should keep effective records of all decisions taken. These should be provided to the Development Committee as confirmation of the decisions taken.

The arrangements for the planning meeting should be finalised during this meeting.

(f) Initial planning meeting

If the Participatory Development Management Process is accepted, a formal planning meeting should be organised in which all concerned parties go over the details and work plan of the Participatory Development Management exercise.

Full and dynamic community participation is necessary

This step initiates three processes:

- Dialogue among the parties concerning all aspects of village problems and possible actions.
- Full and dynamic community participation.
- An integrated approach to development involving local residents and multi-sectoral government extension personnel.

The fact that information is generated by local people should be respected. Their permission is needed to document, remove and use information.

4 A case in point might be an agreement that all fieldworkers first contact the community leadership before working in the community to ensure that everybody is aware of the proceedings.

3.1.2 Institutional Development

(a) Identify existing structures

The Participatory Development Management team, in close consultation with the Development Committee,[5] should identify all existing institutional structures.

These could include local government, management, development, water and sanitation committees, women's groups, youth groups, etc.

Meetings must be arranged with the existing structures to determine their functions, foci and *modus operandi*. Areas of integration and overlap should be identified.[6]

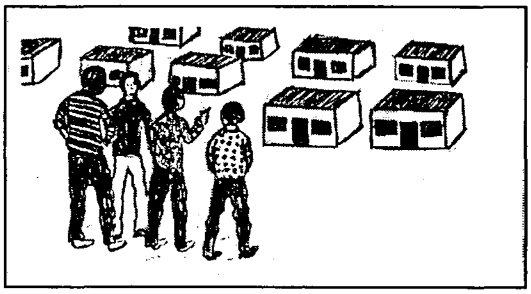
(b) Structure organisations realistically

Organisations must be carefully structured to enable representative and democratic decision making. This would enable them to mobilise collective action, to meet goals with the maximum participation.

If no water and sanitation committees exist, the development of constitutions for these should be facilitated with the help of the Development Committee and community leadership.

This process could include additional community meetings to elect the members of the various institutional structures.

It is recommended that the various water and sanitation committee chairpersons form part of the Development Committee[7]. This would facilitate effective management and good co-ordination.



Demarcate the village into blocks

(c) Develop democratic structures

The block democratisation process must be facilitated.

The total village should be demarcated into blocks, with the assistance of the Development Committee.

Each block must elect a block action group, consisting of a chairperson (block representative) and community representation.[8]

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5 The Development Committee is elected by the community during the first community meeting.

6 The Participatory Development Management Process indicates that existing structures be utilised, and evolved into project appropriate structures.

7 It must be stressed that the Development Committee has a strong co-ordinating function.

The block representatives form part of the Development Committee, and assist the committee in:

- identifying block needs,
- analysing potential solutions (with the necessary expertise),
- making recommendations on block issues, and
- implementing specific issues.

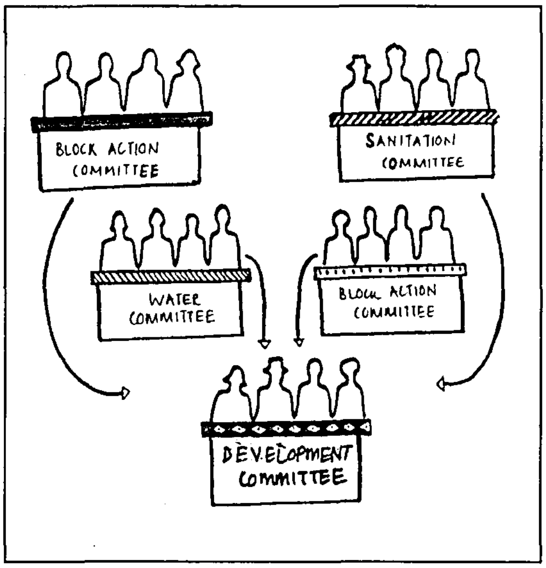
(d) Empowerment of local participants

There is an obvious need for committees to be trained in administrative and management skills. Members of the various structures should receive appropriate training to empower them within the institutional environment. Unless this happens, little long-term success can be expected.

This empowerment would include training workshops to define their committee structures, functions, responsibilities, management procedures, etc.

(e) Institutional structuring

It is anticipated that the Development Committee would consist of an Executive Committee, with representatives of the various subcommittees, including water and sanitation, as well as representatives from the block action groups.



Appropriate responsibilities should be delegated to subcommittees

Relevant government officials may have observer status on the Development Committee.

The following steps can facilitate building effective organisations:

- Committees should develop constitutions, as a way of institutionalising democratic processes. These constitutions should be simple and address people's perceptions of how things should happen.
- Appropriate responsibilities should be delegated to subcommittees. For example, water and sanitation responsibility is

8 The block action group must be representative of both the community and functional structures active in that block.

delegated from the Development Committee to the water and sanitation subcommittee. In this manner other, often marginalised, role players can be accommodated in the managerial process.

The concept of a rotating chairperson could be considered. This idea is foreign to many communities. A possible approach may be to create a token role such as "Chief Executive" or "President", to be occupied by those leaders or officials that are often automatically elected as chairperson, with managerial power remaining with the rotating chairperson.

The participation of women appears to increase the effectiveness of any process significantly. Care should be taken that women are present and participating in the development proceedings.

3.2 PHASE 2: INFORMATION GATHERING AND ANALYSIS

3.2.1 Data Gathering

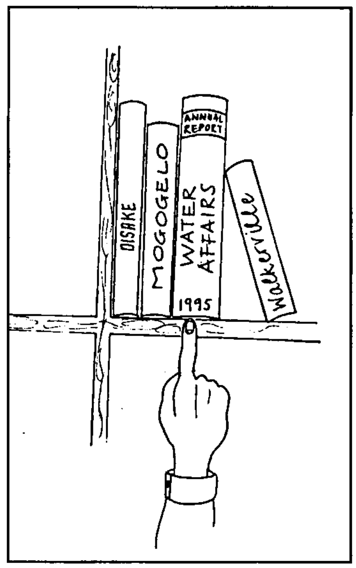
(a) Secondary data[9]

(i) Method

Secondary data gathering should start after the community has indicated the desire to proceed with the process, but prior to the planning workshop.

It is helpful to gather and summarise whatever secondary data are already available, from:

- easily available published and unpublished information. Sources most often used are annual reports, national census results, and project documents,
- maps, aerial photographs and satellite imagery, which, although sometimes expensive, are helpful for data collection,
- other project activities near the Participatory Development Management site.



Getting secondary data

9 Secondary data are data that are freely available from a number of existing sources. They would normally form part of a desktop approach to source available information.

Sources to be consulted include technical officers, public map agencies, RDP officers, universities, NGOs and international organisations active in the appropriate areas.

Visit the regional capital and its institutions. This is valuable to:

- obtain important information about the project area and activities in the area,
- get clearance from the relevant authorities, and
- establish the extent to which the Participatory Development Management team can count on support from these institutions.[10]

All relevant data are entered into a database.

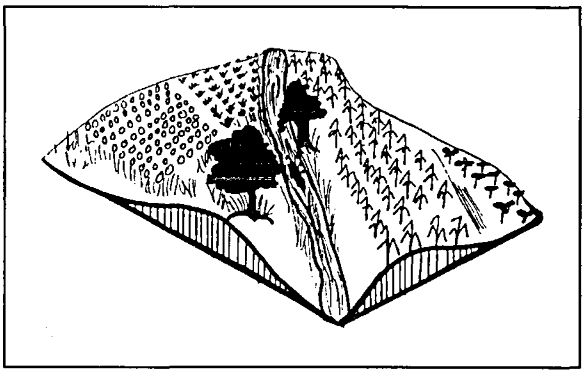
The secondary data review need not be exhaustive and should not jeopardise or replace fieldwork.

Information collected should be analysed and presented in simple graphs, tables, charts and reports.

(ii) Information requirements

The most useful information requirements include:

- Topography
- Drainage
- Vegetation
- Ecological zoning
- Production patterns
- Farm and agricultural resource management practices
- Population changes
- Marketing
- Local and regional infrastructure
- Contact person list of:
  - → Markets
  - → successful industries
  - → economically viable agricultural enterprises
  - → regional administrative centre, (i.e. relevant municipalities)
  - → regional social services
  - → regional departments of education and agriculture.



Drainage, vegetation and topographical information can be indicated in sketches

10 Positive relations with these institutions can be invaluable.

- Overall problems, opportunities, and other issues.

(b) Primary (field) data

Most of the spatial information is obtained through direct observation.

The team members who are recording the information should note field conditions and objects, processes (such as erosion), and relationships (such as the allocation of land to food or cash crops) while walking or travelling through the site.

To conduct the exercises and collect the data, the Participatory Development Management team may work most effectively as:

- a single unit, or
- groups of two to three individuals with specific responsibilities.

In some circumstances it may be more constructive for one group to prepare the necessary transects, while another prepares the seasonal calendar or other data table.

In other circumstances, it may be better for two groups to work independently to prepare separate transects of the same area.

The composition of these groups can vary from exercise to exercise or from day to day to facilitate team interaction.

At the end of each day, the entire Participatory Development Management team should gather to present group findings, discuss inconsistencies, and identify information gaps for follow-up actions.

At the end of the day the PDM team should gather to present findings

Some other common data collection techniques include

- ranking exercises
- decision-making trees
- resource profiles
- production flow diagrams, and
- cartooning.

In addition, combinations of spatial and time-related techniques, such as historical transects and historical-seasonal calendars, have often produced valid results. Some techniques are used to collect highly specific information (for instance on skin fold, height, weight and other human characteristics, in order to determine the local health and nutrition situation).

Unlike most conventional research methodologies, Participatory Development Management uses a diversity of sources, including the assembled lore of the villagers themselves, to ensure that comprehensive information is collected. Investigating the community's situation through a variety of means makes it possible to cross-check the data and increases the accuracy of the analyses.

Principal findings are presented in a simple visual form for rapid communication and comprehension to encourage lively discussions and debate. [11]

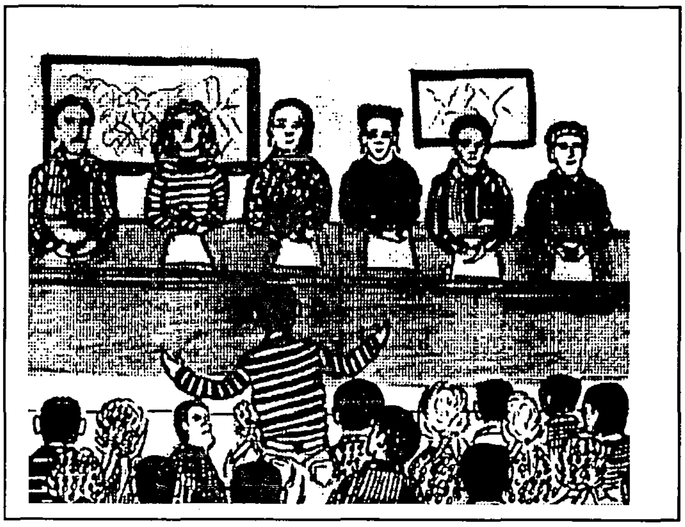
3.2.2 Analysis and Listing

(a) Data analysis structure

Once data are gathered, a structure for analysis must be established. It is recommended that the Participatory Development Management team meet alone (or perhaps with one or two village leaders) to draw up preliminary lists of problems and opportunities.

First review the information collected in the above exercises, then use this as the basis for a village meeting.

Consider the issues that the community has identified by reviewing all the sources of data collected. These should be discussed by all team members to assure a comprehensive compilation of possible problems and options.



All participants must take part in the analysis process

(b) Listing of issues

The most effective way to compile a list of problems, and their possible solutions, is for the Participatory Development Management team to review the basic issues identified during the exercise and to base a draft list on those.[12]

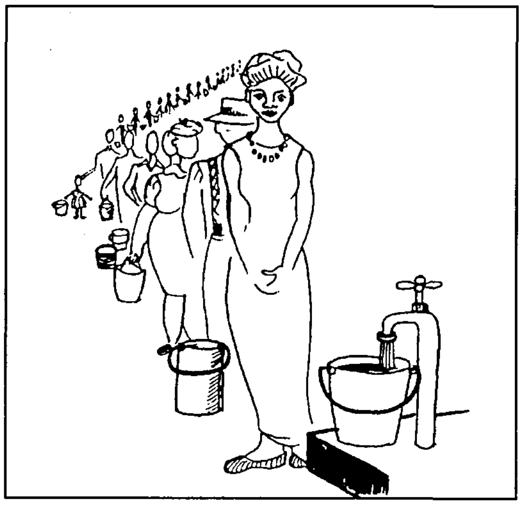
The options may include issues that the village groups and leaders have identified, as well as aspects that extension and other technical staff may suggest. These options should be as specific as possible.

11 Both Participatory Development Management and Rapid Rural Appraisal include a repertoire of more than 30 tools for collecting information and ensuring local participation.

12 They can go through their notes, matching opportunities to the problems.

There is no magic formula for compiling lists of problems and opportunities. Problems or opportunities can be found among the following categories (for example):

- specific programmes
- soil erosion
- availability of water
- diseases
- declining productivity
- deforestation, etc.



Availability of water

Complex issues that relate to two or three problems can be listed more than once.

At this stage, the data should be organised but no attempt should be made to weight or rank the information. A visual format (written lists, tables or diagrams) can be used in community discussions about the issues. Leave space for the villagers to edit and amend the list of problèms and options compiled by the team.

3.2.3 Ranking Problems and Opportunities

(a) Review process

Review the process of gathering data, the types of information that the community has provided to the team and the key changes/trends emerging in the community. It may be useful to present and discuss briefly the time-line, seasonal calendar, transect and other techniques for gathering data.

Display the preliminary problem and potential solution charts prepared by the Participatory Development Management team. Carefully review the information on the charts with the community to verify the issues. New information can be included and corrections made.

It may be up to the Participatory Development Management team to introduce such concepts as:

- sustainability,
- equity, and
- productivity.

(b) Ranking process

The ranking process may be carried out using a variety of approaches. A number of options are available. It is important to keep the process simple and ensure that community participants understand both:

- the need for ranking, and
- the ranking process itself.

Assemble community leaders and the participants. It may be best to meet in a large room in a church or school. There may be more than 30 or 40 people who will form the primary decision-making body. Plan a whole day or the equivalent over two days.

A large group of people may form the primary decision-making body

Discuss criteria to be used for ranking options with the group. The criteria used to prioritise problems may be quite different from those used to rank actions.

The villagers may identify such criteria as the

- relevance of cost
- social and technical feasibility, and
- time it takes for benefits to be realised.

When the initial list of criteria for ranking options has been established, review it with the group. The community should be given another opportunity to amend the set either by adding new criteria or deleting existing criteria from the list.

Prepare a short list of the most pressing problems in the village. This is usually not difficult because in many communities a few problems stand out clearly to all village members. In many cases it is not necessary to develop a precise ranking. Often a grouping of the top three to five points is enough.

(c) Ranking action steps

The next step is to identify specific actions that can be taken to solve each priority problem.

These steps must be ranked in order of implementation.

The outcome of the action-ranking activity should be agreement on the priorities for community action.

3.3 PHASE 3: COMMUNITY RESOURCE MANAGEMENT PLAN

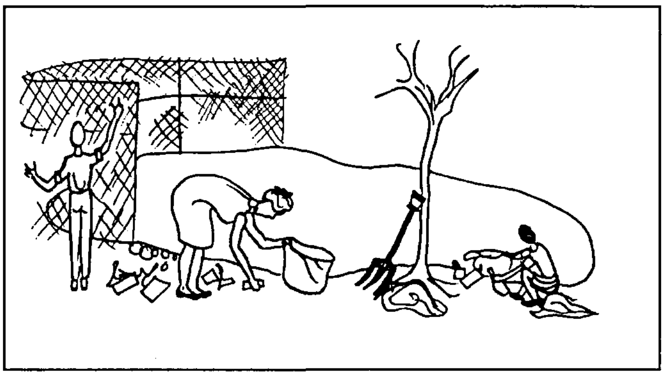
3.3.1 Develop Community Resource Management Plans

(a) Validation process

After the team leader has explained the process and importance of creating a formal plan, the first step is to validate the ranked priorities on the list of issues and potential solutions. On the basis of the rankings, the community recommends specific actions to accomplish the objective.

(b) Resource analysis

The villagers identify local resources and labour that can be mobilised within the community. There is a great deal of dialogue and consultation during this session. Decisions should be made democratically.



People rehabilitating a water source

For each activity identified (for example, rehabilitating a water source), duties are assigned to specific individuals or institutions. These may include tasks for the water engineer, for community groups, for an NGO, etc.

The appropriate technical officer advises on material inputs and estimated costs.

If additional training is required, specify what it will be and how it might be obtained. Be as specific as possible.

If outside resources are needed, indicate:

- which external institution will provide them,
- who will be responsible for ensuring that these resources are secured, and
- when they will be needed.

List likely sources or ways of obtaining support, including fund-raising activities within the community, proposals to donor or NGO groups, church sources, etc. If donors and NGOs are included in the Participatory Development Management Process, they may immediately accept certain responsibilities in the Community Resource Management Plan.

(c) Action plan

A schedule should also be set, linking duties and roles to a time frame that will help villagers and others evaluate their performance to date.

At all stages, emphasise that implementing and monitoring the progress of the Community Resource Management Plan is the responsibility of the community. Since the end result for the Participatory Development Management Process is to have communities in charge of their own natural resource management, this point is of paramount importance.

The finalisation of an action plan must be supported by all actors to facilitate the scheduling and execution of duties, report-back procedures and monitoring of progress within a "learning process" approach.

When the initial Community Resource Management Plan activities have been completed, it will be up to the community to develop or ask for help to develop follow-up CRMPs for continued progress.

3.4 PHASE 4: IMPLEMENTATION, MONITORING AND EVALUATION

3.4.1 Implementation Process

(a) Leadership

Leadership is critical. One or more formal or informal local leaders will be needed to organise work groups, follow up when schedules slide, ensure that materials are being gathered, co-ordinate activities with extension officers and maintain contact with division and district administrative officials.

While this work is normally carried out by the chairperson of a Development Committee, or the secretary of a local government body, it may also be a leader of a farm co-operative, an active member of a women's group, a political leader, a member of the clergy, etc.

The involvement of local leadership is critical

At another level, commitment and backing is required from government officers, especially at the District and Division level. Those concerned with follow-up need to keep administrative officers informed of progress and to enlist their help as needed.

(b) Financial management

Support from private foundations and bilateral and multilateral agencies is helpful as the community begins the search for funds to implement the Community Resource Management Plan.

It is helpful to provide strong support or guidelines to help a few community leaders, such as the school principal, a retired civil servant, or the clinic nursing sister, to learn how to raise village development funds from agencies already supporting regional or local resource management activities.

The Community Resource Management Plan is in a form that many development assistance agencies consider an acceptable proposal.

Often there are NGOs that can be contacted, and there are increasingly larger amounts of local development funds available through regional development offices. Churches may also have funds, as do the various bilateral donors and international agencies.

(c) Natural resources management

Natural resources management should be undertaken by a village and/or development subcommittee. In some cases the Participatory Development Management Committee can be tasked with monitoring and managing processes in natural resource management projects. An elected environmental committee at the district or division level representing several development sectors and including members from NGOs can also be tasked with this responsibility.

It may be important to ensure that technical officers, village leaders, and members of community groups can visit nearby sites where effective resource management is underway.

It is critical to ensure that the community receives relevant training in natural resources management.

(d) Human resources management

Participatory Development Management focuses on maintaining effective community participation. It is therefore of vital importance to train community leaders how to use human resources optimally.

Attention should be given to:

- The knowledge, and contact network, of institutions that can assist in training and developing local skills, especially agriculture, water management, technical and maintenance skills and basic financial management.
- The role of women in the community, as an available labour force, in areas where many men are forced to seek employment in metropolitan areas.

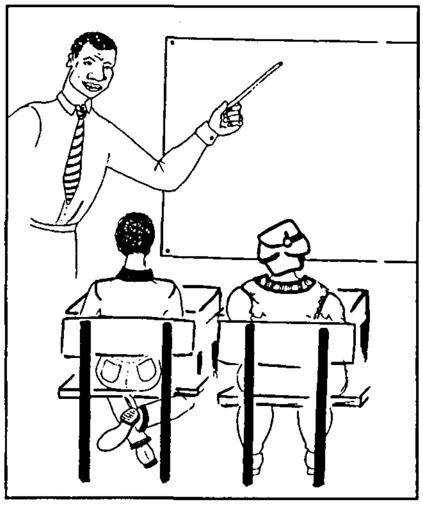
- Developing and encouraging entrepreneurial skills.

(e) Development of community management

Those planning to carry out Participatory Development Management and then to implement a Community Resource Management Plan need to consider the importance of preparing local groups for the task. All participants should be well trained.

Indications are that no implementation process, no matter how innovative, can succeed unless there are adequate and appropriate structures for implementation.

The need for organisation-building (indicated during the institutional development phase) is the essence of the development process. Effective organisational capacity-building can ensure that the goals of self-reliance, community mobilisation and empowerment of people are achieved.



All participants should be well trained

3.4.2 Evaluation and Monitoring

(a) Evaluation planning

The evaluation process has to be planned during the early phases of the project planning process.

The project objectives, inputs, activities and envisaged results (discussed in the next section) must be broken down into measurable elements, until each element is sufficiently detailed to be separately assessed in the field.

Evaluation elements and subgoals must be agreed upon by all the project participants, to ensure that all clearly understand and agree on what is expected from the process, both in the short and longer term. Specialised expertise should be appointed to evaluate specific project components.

The PDM project team should provide logistic support and guidance.

The number of interviewers required is critical. The evaluation process should not take so long that it inhibits project progress. Should the team be too large, it becomes unwieldy and logistically unmanageable.

Where possible, interviews should be undertaken by a male/female team.

(b) Objectives, inputs, activities and results

(i) Objectives:

Project objectives are indicated on two levels. These are:

- Goals (longer-term focus)
- Project goals are the overall reason why the project is implemented.

  Examples include:

  → economic improvement[13]

  → social improvement[14]

  → health improvement[15]

  → community improvement[16]

  → environmental improvement.[17]

Water supply could be an element within a larger objective

- Purposes (shorter-term focus)

  The project purposes indicate what needs to be achieved to attain project goals. This could include aspects of how the community should participate, how maintenance can take place, etc.

  Typically, purposes can include:

  → improved water supply[18]

  → adequate sanitation[19]

  → adequate solid waste disposal[20]

  → better hygiene education[21]

  → good financial management[22]

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13 Such as increased income.

14 Including equitable distribution of benefits, improved quality of life, etc.

15 For example, reduced water and sanitation-related disease levels.

16 Such as community capacity-building, empowerment, better community organisation, etc.

17 Examples include conservation of water and natural resources, improved environmental quality, etc.

18 Water quality and quantity standards.

19 Sanitation unit performance levels.

20 Performance of collection services.

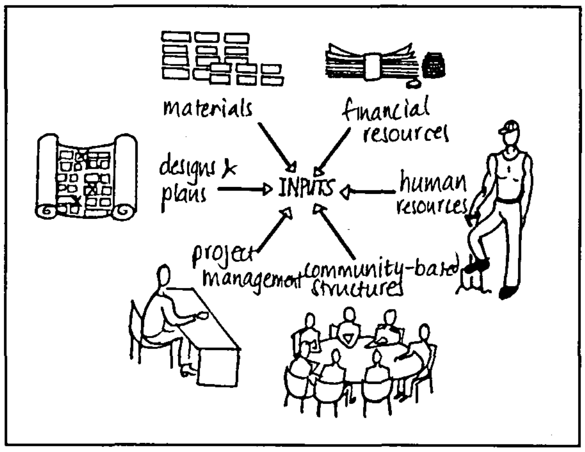
21 Long-term improvements in personal and household hygiene.

22 Achievement of expenditure and financial viability targets, etc.

→ human resources development.[23]

(ii) Inputs

Inputs are those things used in the project. Actual inputs are often compared to planned inputs, with the divergence evaluated as a measure of efficiency and effectiveness. Inputs include:



Project inputs

- financial resources
- human resources[24]
- materials
- designs and plans
- project management
- local community-based structures (institutional processes).

(iii) Activities

Activities are actions that use project inputs to achieve project results or outputs. These can be divided into a number of categories, including:

- project planning and preparation[25]
- institutional development[26]
- construction[27]
- operation and maintenance[28]
- project administration.[29]

(iv) Results (outputs)

Outputs of projects are often experienced as the physical results, the services provided and the institutional development that is achieved. Examples of results may include:

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23 Performance of trained and participating community members, committee members, maintenance teams, etc.

24 Including professional, semi-skilled and unskilled labour

25 Examples include drafting project documentation, defining the work programme, etc.

26 Examples include in-job training courses, facilitation of committees, etc.

27 Construction of facilities or infrastructure.

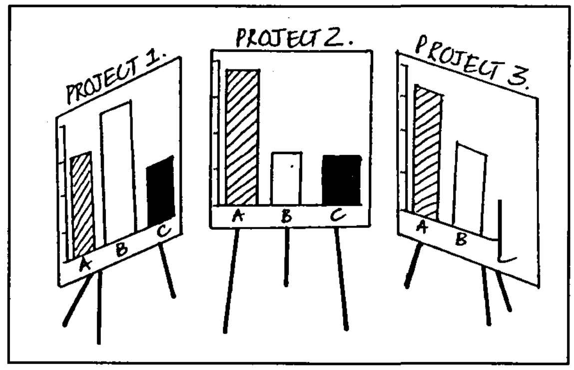
28 Examples include controlling chlorine levels in water supply, repairing hand pumps, etc.

29 These include the allocation of financial, human and physical resources to meet delivery and planning requirements.

- new or improved facilities[30]
- better financial management[31]
- enhanced education[32]
- institutional development.[33]

(c) Develop an evaluation framework

After completing the evaluation and monitoring planning process, an evaluation framework should be determined.



Evaluation framework

During any evaluation process, a large number of parameters can be measured, with as many factors influencing these measurements. Unless set out in a logical framework, the evaluation process can be extremely complex and daunting.

The Logical Evaluation Framework (LEF) indicates the reasons why the project is undertaken, what the project is to achieve and what the expected impact is. The evaluation framework provides the structure in terms of which monitoring can take place.

There are several advantages in using the LEF, some of which are listed below. The LEF:

- Interprets all evaluation elements within a systematic framework.
- Indicates the levels of project objectives and the evaluation process to assess fulfilment of these objectives.
- Provides a framework within which to evaluate efficiency, effectiveness and impact.
- Facilitates the comparison of a number of different projects.

(d) Identify evaluation elements (Key Performance Indicators (KPIs))

The means of measurement must be determined, and can take the form of Key Performance Indicators (KPIs)

The Logical Evaluation Framework indicators are dependent variables that indicate the measure of success in achieving the project goals, objectives and results. Any such indicators must be:

- objective[34]

30 In terms of the number of households serviced, number of taps, pipes, etc.

31 Accounting and management systems installed.

32 Appropriate education and training programmes established and implemented.

33 Water and sanitation committees formed, development forums constituted.

- accurate
- quantifiable, and
- replicable[35]

The indicators must relate to the objectives, the efficiency, effectiveness and impact of the project processes.

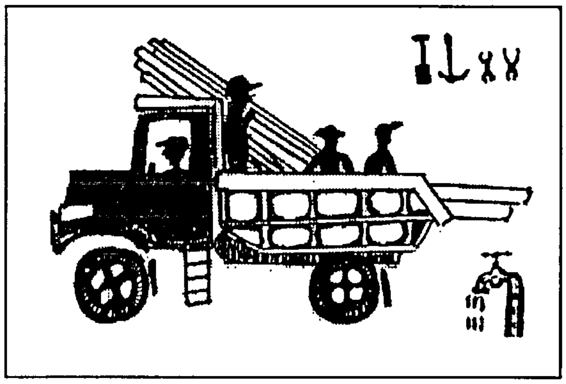
While some key performance indicators can be used in almost any project or process, there is no standard set of indicators nor a standardised measurement criterion. Language, culture and customs will have an obvious impact on the phrasing and understanding of indicators in different socio-economic circumstances.

KPIs should ideally be:

- relevant to the project and associated processes[36]
- able to accommodate project changes
- cost-effective[37]
- focused[38] and
- timely.

Examples of KPIs can be:

- Economic, e.g.:
  - → Time savings in collecting water.
  - → Increased agricultural production.
  - → Job creation.
  - → Increased income levels.
- Social, e.g.:
  - → Creation of recreation facilities.
  - → Empowerment of committees.
  - → Empowerment of women.
  - → Increased self-esteem.



Job creation is an example of a KPI

34 This implies that in using them, the same conclusion should be drawn, even if different evaluators carry out the evaluation.

35 Replicable implies that the process should be capable of producing the same results, though not necessarily the same products.

36 It should actually measure what it is supposed to measure.

37 The results should be worth the resources invested.

38 KPIs should be used for their specific purpose. KPIs for effectiveness can not be used to measure impact, and *vice versa*.

- → More effective community leadership.
- Health, e.g.:
  - → Reduction in measurable diseases.
  - → Improvements in nutrition.
  - → Lower levels of contamination.
  - → Latrine usage and hygienic conditions.
  - → Mortality rates.
  - → Anthropometric analysis.[39]
- Community, e.g.:
  - → Increased self-help ability.
  - → Increased participation in development management.
  - → Increased mobilisation.
  - → Better participation.
- Environmental, e.g.:
  - → Improved water quality.
  - → Improved environmental awareness.
  - → Better resource utilisation.
  - → Aesthetic quality.

Better resource utilisation

(e) Ongoing monitoring and evaluation during implementation

It is important to evaluate the efficiency, effectiveness and impact in parallel with the implementation process, and with each other.

Efficiency and effectiveness evaluations are distinctly different, although they may sometimes overlap. Efficiency and effectiveness evaluations are carried out during the project process. These types of evaluation are discussed below:

- Project Efficiency Evaluation
  - → Project efficiency evaluation is concerned with how results are obtained.
  - → The number and quality of results are compared to the resources used.
  - → The central concern of an efficiency evaluation is to determine how well the process and resources have been used and managed.

39 Anthropometric analysis measures and evaluates different weight, age and height ratios to determine general levels of nutrition and malnutrition.

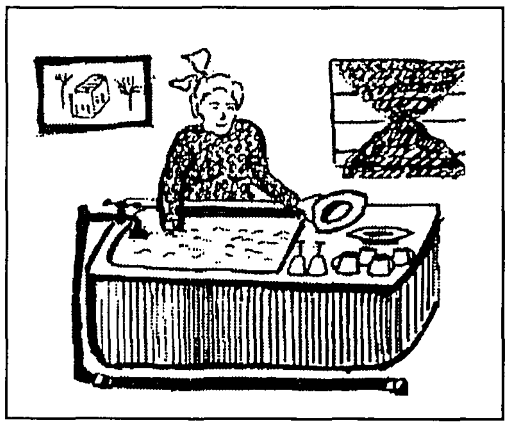
- → Data for efficiency evaluations are usually taken from project reports and then verified in the field.
- Project Effectiveness Evaluation
  - → Project effectiveness evaluation is concerned with the achievement of specific purposes.
  - → It often indicates whether the facilities are used fully and are working well.
  - → Information for the effectiveness evaluation must be obtained from the project team, recipient communities, and observation of the physical installations.
  - → The evaluation team often uses questionnaires, structured discussions and observation techniques.

(f) Ongoing monitoring and evaluation during operations

The operation and maintenance of project facilities and processes must be monitored on an ongoing basis. Regular inspections and audits should be undertaken to determine efficiency and effectiveness.

(g) Project impact evaluation

Project impact evaluation takes place on completing the implementation process, or after a period of operation. The process measures the effectiveness, as well as the impact of specific actions. In this process, the project results are compared to the planned outputs.



What was the impact on the community?

Impact evaluation indicates the effect that the project has had on the participant communities. Impacts can be positive and/or negative, foreseen or unforeseen. It aims to answer questions about whether the project brought about the intended effects, and if not, why not.

The information needs for the impact evaluation are determined through observation, structured conversation, household surveys and laboratory analysis.

(h) Post-implementation evaluation

After the project is completed, an evaluation report is drawn up. This evaluates the impact of the project on the participants, the environment as well as their socio-economic circumstances.

The impact analysis takes place as indicated above.