

Conflict Prevention and Cooperation in International Water Resources - Hand Outs

► WaterNet, CCR, ISRI, Catalic,
UNESCO-IHE Delft, UZ



PCCP Publications 2001-2003

1. Frederick M. Lorenz, *The protection of water facilities under international law*, UNESCO-IHP, 46 p.
2. Sergei Vinogradov, Patricia Wouters and Patricia Jones, *Transforming potential conflict into cooperation potential: The role of international water law*, UNESCO-IHP, 106 p.
3. Stefano Burchi and Melvin Sprell, *Institutions for international freshwater management*, UNESCO-IHP, 51 p.
4. K.D.W. Nandlal and Slobodan P. Simonovic, *State-of-the-art report on systems analysis methods for resolution of conflicts in water resources management*, UNESCO-IHP, 127 p.
5. Ali M. Yali, Sree N. Sreenath and Gundo Suslarjo, *An educational tool to examine the development constraints in the Limpopo river basin*, UNESCO-IHP, 50 p.
6. Fekri A. Hassan, Martin Reuss, Julie Trotter, Christoph Bernhardt, Aaron T. Wolf, Jennifer Mohamed-Katerere and Pieter van der Zaag, *History and future of shared water resources*, UNESCO-IHP, 150 p.
7. Yona Shamir, *Alternative dispute resolution approaches and their application*, UNESCO-IHP, 43 p.
8. Branko Bošnjakovic, *Negotiations in the context of international water-related agreements*, UNESCO-IHP, 50 p.
9. Philippe Barret, Alfonso Gonzalez avec les contributions de Yannick Barret et Céline Olivier, *Société civile et résolution des conflits hydriques*, UNESCO-IHP, 78 p.
10. Ti Le-Huu and Lien Nguyen-Duc In cooperation with Apichart Anukularmphal, Do Hong Phan, Khammone Ponkeao, Pech Sokhem and Zhang Hai-Lun, *Mekong Case Study*, UNESCO-IHP, 56 p.
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13. Peter Nachtnebel, *Danube case study*, UNESCO-IHP (to be published)
14. Álvaro Carriño Vaz and Pieter van der Zaag, *Sharing the Incomat Waters: Cooperation and competition in the balance*, UNESCO-IHP, 102 p.
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20. Aaron T. Wolf, Shira B. Yoffe and Mark Giordano, *International waters: indicators for identifying basins at risk*, UNESCO-IHP, 30 p.
21. Pal Tamas, *Water resource scarcity and conflict: Review of applicable indicators and systems of reference*, UNESCO-IHP, 29 p.
22. Jerome Dellì Priscoli, *Participation, consensus building and conflict management training course*, UNESCO-IHP, 179 p.
23. WaterNet, CCR, ISRI, Catalic, UNESCO-IHE Delft, UZ, *Basics of water resources -Course book*, UNESCO-IHP, 97 p.
24. WaterNet, ISRI, Catalic, UNESCO-IHE Delft, ZU, *Basics of water resources -Reader*, UNESCO-IHP, 66 p.
25. WaterNet, ISRI, Catalic, UNESCO-IHE Delft, ZU, *Conflict prevention and cooperation in international water resources - Course book*, UNESCO-IHP, 269 p.
26. WaterNet, ISRI, Catalic, UNESCO-IHE Delft, ZU, *Conflict prevention and cooperation in international water resources - Reader*, UNESCO-IHP, 211 p.
27. WaterNet, ISRI, Catalic, UNESCO-IHE Delft, ZU, *Conflict prevention and cooperation in international water resources - Hand outs*, UNESCO-IHP, 84 p.
28. WaterNet, CCR, ISRI, Catalic, UNESCO-IHE Delft, UZ, *Advanced mediation skills - Course book*, UNESCO-IHP, 83 p.
29. William J. Cosgrove (compiled by), *Water security and peace: A synthesis of studies prepared under the PCCP - Water for Peace process*, UNESCO-IHP, 108 p.
30. *A summary of PCCP publications 2001-2003*, UNESCO-IHP, 34 p.
31. Janos Bogardi and Saskia Castelein (eds.), *Selected papers of the International Conference From Conflict to Co-operation In International Water Resources Management: Challenges and Opportunities*, UNESCO-IHE Delft, The Netherlands, 20-22 November 2002, UNESCO-IHP, 600 p.



Conflict Prevention and Cooperation in International Water Resources

Handouts

Course B



UNESCO-IHE
INSTITUTE FOR WATER EDUCATION



CATALIC
Advice & Management in International Cooperation

“Conflict prevention and cooperation in international water resources”

Hand outs

Table of Contents 10 day course

Part 1: Water

Fishing game

Fishing game – handout p.1

Fishing game – forms p.7

Part 4: Practice

Prisoners dilemma

The water message game p.25

Mutare case

Mutare – 1995 - hand out p.28

Pungwe – 1995 - handout p.34

Part 6: Roleplay

Incomati Negotiation roleplay

Incomati roleplay – roles p.44

Incomati river basin – 2001 p.68

Incomati river basin – 2002 p.79

Evaluation form

Table of Contents 5 day course

Part 4: Practice

Prisoners dilemma

The water message game p.25

Mutare case

Mutare – 1995 - hand out p.28

Pungwe – 1995 - handout p.34

Evaluation form

WaterNet / CCR / ISRI / Catalic / UNESCO- IHE Delft / UZ *for* UNESCO

The Fishing Game

A Common Pool Resource Game

Source: EDI/RDV Core Course
Washington, D.C., December 7-11, 1998

Instructions

Introduction

This game is a simulation of a renewable common pool resource such as an offshore fishery. As participants in this game, you may imagine that you are fishermen, fishing for fish.

Each of you has been assigned randomly to one of two groups. Each of the two groups is a fishing an identical, but distinct fishery. The number of persons in your group is: _____

If you have not already done so, write your name at the top of your identification sheet and at the top of your individual record sheet. Once you have done this, hand in your identification sheet to the monitors.

In this game, you will have the opportunity to earn cash benefits. What you earn will depend upon the decisions that you make and upon the decisions that others in your group make.

This game consists of six rounds, each round corresponding to one “fishing season”. At the end of the sixth round, the cash benefits that you have earned in all six rounds will be totaled and will be paid to you in privacy.

If you have any questions as we go through these instructions, feel free to raise your hand and to ask your question. Do you have any questions so far?

Ordering Tokens

In each round, you will place an order for tokens on the order sheet with which you have been provided for that round. You may consider that each token represents, say, one ton of fish. Therefore, the number of tokens that you order represents the quantity of fish that you, individually, decide to harvest from the fishery in that season.

In each round, the **net benefits** that you earn from the number of tokens that you order will be equal to the difference between (1) the **gross benefits** that you receive from “selling” the fish that you harvest in that round and (2) the **total costs** that you incur in harvesting this quantity of fish:

$$\text{Net benefits} = \text{Gross benefits} - \text{total costs} .$$

In each round, your token orders will be anonymous, known only to yourself and to the monitors. Similarly, the net benefits that you earn will be private information to you and to the monitors. That is, throughout this game, no one else in your group will know how many fish you harvested in each round or how much you earned from harvesting this quantity of fish.

Gross Benefits from Ordering Tokens

In each round, the **gross benefits** that you will receive from the number of tokens that you order will be given in the table (at the end of this instruction), entitled “Schedule of Benefits”.

For example, if you order 6 tokens, your gross benefits from ordering 6 tokens will be _____. If you order 12 tokens, your gross benefits will be _____.

Study this table carefully. Every participant has received the same table. In every round of this game, every participant will earn gross benefits according to this same schedule. If you have any questions about this table, please raise your hand at this time.

Costs of Ordering Tokens

In each round, the **costs** that you will incur from the number of tokens that you order will be equal to the product of (1) the **number of tokens** that you order and (2) the **average cost** of each token:

$$\text{Total token cost} = \text{No. of tokens} \times \text{Average token cost.}$$

Fishing is an increasing cost industry. Therefore, the **average token cost** of ordering tokens will increase as you and the other members of your group order more and more tokens.

After each fishing round, the monitor will announce the average token cost.

If you would know the total number of tokens ordered in your group, you can also calculate the average token cost yourself:

The first token that your group orders will have a **base cost** of \$0.01. Then, the second token that your group orders will cost \$0.02. And, the third token will cost \$0.03, and so on. That is, each additional token will cost \$0.01 more than the previous token ordered.

For example, suppose that your group orders 30 tokens in a given round. The total cost of all the tokens ordered by your group will equal:

$$\$0.01 + \$0.02 + \$0.03 + \dots + \$0.30 = \$4.65.$$

But you do not need to perform this calculation. To calculate **your total costs**, you only need to know the **average token cost** of the 30 tokens, which is easily calculated as follows: Average token cost = (Cost of the first token + Cost of the last token)/2 =

$$= (\$0.01 + \$0.30)/2 = \$0.155.$$

In every round, your **average token cost** will always be half way between the base cost of \$0.01 and the cost of the last token ordered, and your **total token cost** will always equal **the number of tokens** that you order multiplied by this **average token cost**. In this example:

$$\text{Total token cost} = \text{No. of tokens} \times \text{Average token cost} = 6 \times \$0.155 = \$0.930 .$$

Net Benefits from Ordering Tokens

In each round, the **net benefits** that you will earn from ordering tokens is given by:

$$\begin{aligned}\text{Net benefits} &= \text{Gross benefits} - \text{Total token cost} \\ &= \text{Gross benefits} - (\text{No. of tokens ordered} \times \text{Average token cost})\end{aligned}$$

To conclude the above example, in which you ordered 6 out of the 30 tokens ordered by your group:

$$\text{Your net benefits} = \$4.31 - (6 \times \$0.155) = \$4.31 - \$0.930 = \$3.38.$$

This is summarized in the following table:

Round					
No. of Tokens Ordered	Total Gross Benefit	Base Token Cost	Average Token Cost	Total Token Cost	Net Benefit
6	\$4.31	0.01	\$0.155	\$0.930	\$3.38

Two More Practice Examples

In the first round of the game, suppose that you place an order for 10 tokens and the other members of your group order 56 tokens -- for a total group order of 66 tokens. What would be your **net benefit** from this round?

Round 1					
No. of Tokens Ordered	Total Gross Benefit	Base Token Cost	Average Token Cost	Total Token Cost	Net Benefit
		0.01			

In the fourth round of the game, suppose that you place an order for 2 tokens and the other members of your group order 16 tokens -- for a total group order of 18 tokens. What would be your **net benefit** from this round?

Round 4					
No. of Tokens Ordered	Total Gross Benefit	Base Token Cost	Average Token Cost	Total Token Cost	Net Benefit
		0.01			

Summary

This game will last 6 rounds, corresponding to 6 “fishing seasons”. At the beginning of each round, you will be asked how many tokens you want to order. You will decide how many tokens you want to order and you will write this order (1) on your individual record sheet, and (2) on your order sheet for that round. Once you have written down your order, you will give your order **privately** to one of the monitors.

The “Schedule of Benefits” that you will receive from ordering tokens in the same for all participants. However, the average token cost of ordering tokens will increase as you and the other members of your group order more and more tokens. Each token that you order increases the **average token cost** to you and to all the other members of your group.

Each round is totally separate. You cannot carry tokens from one round into future rounds. After all the participants have placed their orders, then the monitors will quickly tabulate and inform you of (1) the **number of tokens ordered**, (2) the **average token cost**, and (3) the **total net benefits** for each of the groups.

Then, from this information and from the “Schedule of Benefits”, you will calculate for yourself and record the following on your individual record sheet for this round, your:

Total	Average	Total	Net Benefit
Gross Benefit	Token Cost	Token Cost	

At the end of the sixth round, you will add up the net benefits that you have earned in each round in order to derive your total net benefits. As a check, the monitors will also calculate on their computer your total net benefits. In this game (although not in real life!), if you earned negative net benefits in any of the six rounds, this loss will be rounded up to zero. **No one will lose any money in this game.**

Changing the Rules

The fishery that you are harvesting is a renewable resource that is fully replenished at the beginning of each season. Therefore, the base token cost will remain \$0.01 for each round, and the cost of each additional token will also remain \$0.01.

But, in order to help you improve your net benefits in subsequent rounds, the monitors will change the rules of the game between rounds 2 and 3, and again between rounds 4 and 5.

For the first two rounds, the rules of the game are:

**No communication with any other participant,
either in your own group, or in any other group.**

Do you have any final questions before we begin the first round?

Common Pool Resource Fishing Game

Schedule of Gross Benefits

This table displays your total **Gross Benefits** from the number of Tokens that you order

1	\$0.75	21	\$12.89	41	\$19.43	61	\$20.37
2	\$1.49	22	\$13.35	42	\$19.61	62	\$20.27
3	\$2.22	23	\$13.80	43	\$19.78	63	\$20.16
4	\$2.93	24	\$14.23	44	\$19.93	64	\$20.03
5	\$3.63	25	\$14.65	45	\$20.07	65	\$19.89
6	\$4.31	26	\$15.05	46	\$20.19	66	\$19.73
7	\$4.98	27	\$15.44	47	\$20.30	67	\$19.56
8	\$5.64	28	\$15.82	48	\$20.40	68	\$19.38
9	\$6.28	29	\$16.18	49	\$20.48	69	\$19.18
10	\$6.91	30	\$16.53	50	\$20.55	70	\$18.97
11	\$7.52	31	\$16.86	51	\$20.60	71	\$18.74
12	\$8.12	32	\$17.18	52	\$20.64	72	\$18.50
13	\$8.71	33	\$17.49	53	\$20.67	73	\$18.25
14	\$9.28	34	\$17.78	54	\$20.68	74	\$17.98
15	\$9.84	35	\$18.06	55	\$20.68	75	\$17.70
16	\$10.38	36	\$18.32	56	\$20.66	76	\$17.40
17	\$10.91	37	\$18.57	57	\$20.63	77	\$17.09
18	\$11.43	38	\$18.81	58	\$20.59	78	\$16.77
19	\$11.93	39	\$19.03	59	\$20.53	79	\$16.43
20	\$12.42	40	\$19.24	60	\$20.46	80	\$16.08

CPR Fishing Game: Individual Record Sheet

Name: _____

Individual ID: _____

Round 1					
No. of Tokens Ordered	Total Gross Benefit	Base Token Cost	Average Token Cost	Total Token Cost	Net Benefit
		0.01			

Round 2					
No. of Tokens Ordered	Total Gross Benefit	Base Token Cost	Average Token Cost	Total Token Cost	Net Benefit
		0.01			

Round 3					
No. of Tokens Ordered	Total Gross Benefit	Base Token Cost	Average Token Cost	Total Token Cost	Net Benefit
		0.01			

Round 4					
No. of Tokens Ordered	Total Gross Benefit	Base Token Cost	Average Token Cost	Total Token Cost	Net Benefit
		0.01			

Round 5					
No. of Tokens Ordered	Total Gross Benefit	Base Token Cost	Average Token Cost	Total Token Cost	Net Benefit
		0.01			

Round 6					
No. of Tokens Ordered	Total Gross Benefit	Base Token Cost	Average Token Cost	Total Token Cost	Net Benefit
		0.01			

Total: Rounds 1-6					
No. of Tokens Ordered	Total Gross Benefit	Base Token Cost	Average Token Cost	Total Token Cost	Net Benefit
		0.01			

The Fishing Game

A Common Pool Resource Game

Forms

CPR Fishing Game: Individual Record Sheet

Name: _____

Individual ID: _____

Round 1					
No. of Tokens Ordered	Total Gross Benefit	Base Token Cost	Average Token Cost	Total Token Cost	Net Benefit
		0.01			

Round 2					
No. of Tokens Ordered	Total Gross Benefit	Base Token Cost	Average Token Cost	Total Token Cost	Net Benefit
		0.01			

Round 3					
No. of Tokens Ordered	Total Gross Benefit	Base Token Cost	Average Token Cost	Total Token Cost	Net Benefit
		0.01			

Round 4					
No. of Tokens Ordered	Total Gross Benefit	Base Token Cost	Average Token Cost	Total Token Cost	Net Benefit
		0.01			

Round 5					
No. of Tokens Ordered	Total Gross Benefit	Base Token Cost	Average Token Cost	Total Token Cost	Net Benefit
		0.01			

Round 6					
No. of Tokens Ordered	Total Gross Benefit	Base Token Cost	Average Token Cost	Total Token Cost	Net Benefit
		0.01			

Total: Rounds 1-6					
No. of Tokens Ordered	Total Gross Benefit	Base Token Cost	Average Token Cost	Total Token Cost	Net Benefit
		0.01			

CPR Game #1: Individual Identification Sheet

Name: _____

Group ID: 1 Individual ID: 1

CPR Game #1: Individual Identification Sheet

Name: _____

Group ID: 1 Individual ID: 2

CPR Game #1: Individual Identification Sheet

Name: _____

Group ID: 1 Individual ID: 3

CPR Game #1: Individual Identification Sheet

Name: _____

Group ID: 1 Individual ID: 4

CPR Game #1: Individual Identification Sheet

Name: _____

Group ID: 1 Individual ID: 5

CPR Game #1: Individual Identification Sheet

Name: _____

Group ID: 1 Individual ID: 6

CPR Game #1: Individual Identification Sheet

Name: _____

Group ID: 1 Individual ID: 7

CPR Game #1: Individual Identification Sheet

Name: _____

Group ID: 1 Individual ID: 8

CPR Game #1: Individual Identification Sheet

Name: _____

Group ID: 1 Individual ID: 9

CPR Game #1: Individual Identification Sheet

Name: _____

Group ID: 1 Individual ID: 10

CPR Game #1: Individual Identification Sheet

Name: _____

Group ID: 2 Individual ID: 1

CPR Game #1: Individual Identification Sheet

Name: _____

Group ID: 2 Individual ID: 2

CPR Game #1: Individual Identification Sheet

Name: _____

Group ID: 2 Individual ID: 3

CPR Game #1: Individual Identification Sheet

Name: _____

Group ID: 2 Individual ID: 4

CPR Game #1: Individual Identification Sheet

Name: _____

Group ID: 2 Individual ID: 5

CPR Game #1: Individual Identification Sheet

Name: _____

Group ID: 2 Individual ID: 6

CPR Game #1: Individual Identification Sheet

Name: _____

Group ID: 2 Individual ID: 7

CPR Game #1: Individual Identification Sheet

Name: _____

Group ID: 2 Individual ID: 8

CPR Game #1: Individual Identification Sheet

Name: _____

Group ID: 2 Individual ID: 9

CPR Game #1: Individual Identification Sheet

Name: _____

Group ID: 2 Individual ID: 10

Fishing Game	Round: 1	Fishing Game	Round: 1
Group: 1	Individual: 1	Group: 1	Individual: 2
Token Order		Token Order	
Fishing Game	Round: 1	Fishing Game	Round: 1
Group: 1	Individual: 3	Group: 1	Individual: 4
Token Order		Token Order	
Fishing Game	Round: 1	Fishing Game	Round: 1
Group: 1	Individual: 5	Group: 1	Individual: 6
Token Order		Token Order	
Fishing Game	Round: 1	Fishing Game	Round: 1
Group: 1	Individual: 7	Group: 1	Individual: 8
Token Order		Token Order	
Fishing Game	Round: 1	Fishing Game	Round: 1
Group: 1	Individual: 9	Group: 1	Individual: 10
Token Order		Token Order	

Fishing Game	Round: 2	Fishing Game	Round: 2
Group: 1	Individual: 1	Group: 1	Individual: 2
Token Order		Token Order	
Fishing Game	Round: 2	Fishing Game	Round: 2
Group: 1	Individual: 3	Group: 1	Individual: 4
Token Order		Token Order	
Fishing Game	Round: 2	Fishing Game	Round: 2
Group: 1	Individual: 5	Group: 1	Individual: 6
Token Order		Token Order	
Fishing Game	Round: 2	Fishing Game	Round: 2
Group: 1	Individual: 7	Group: 1	Individual: 8
Token Order		Token Order	
Fishing Game	Round: 2	Fishing Game	Round: 2
Group: 1	Individual: 9	Group: 1	Individual: 10
Token Order		Token Order	

Fishing Game	Round: 3	Fishing Game	Round: 3
Group: 1	Individual: 1	Group: 1	Individual: 2
Token Order		Token Order	
Fishing Game	Round: 3	Fishing Game	Round: 3
Group: 1	Individual: 3	Group: 1	Individual: 4
Token Order		Token Order	
Fishing Game	Round: 3	Fishing Game	Round: 3
Group: 1	Individual: 5	Group: 1	Individual: 6
Token Order		Token Order	
Fishing Game	Round: 3	Fishing Game	Round: 3
Group: 1	Individual: 7	Group: 1	Individual: 8
Token Order		Token Order	
Fishing Game	Round: 3	Fishing Game	Round: 3
Group: 1	Individual: 9	Group: 1	Individual: 10
Token Order		Token Order	

Fishing Game	Round: 4	Fishing Game	Round: 4
Group: 1	Individual: 1	Group: 1	Individual: 2
Token Order		Token Order	
Fishing Game	Round: 4	Fishing Game	Round: 4
Group: 1	Individual: 3	Group: 1	Individual: 4
Token Order		Token Order	
Fishing Game	Round: 4	Fishing Game	Round: 4
Group: 1	Individual: 5	Group: 1	Individual: 6
Token Order		Token Order	
Fishing Game	Round: 4	Fishing Game	Round: 4
Group: 1	Individual: 7	Group: 1	Individual: 8
Token Order		Token Order	
Fishing Game	Round: 4	Fishing Game	Round: 4
Group: 1	Individual: 9	Group: 1	Individual: 10
Token Order		Token Order	

Fishing Game	Round: 5	Fishing Game	Round: 5
Group: 1	Individual: 1	Group: 1	Individual: 2
Token Order		Token Order	
Fishing Game	Round: 5	Fishing Game	Round: 5
Group: 1	Individual: 3	Group: 1	Individual: 4
Token Order		Token Order	
Fishing Game	Round: 5	Fishing Game	Round: 5
Group: 1	Individual: 5	Group: 1	Individual: 6
Token Order		Token Order	
Fishing Game	Round: 5	Fishing Game	Round: 5
Group: 1	Individual: 7	Group: 1	Individual: 8
Token Order		Token Order	
Fishing Game	Round: 5	Fishing Game	Round: 5
Group: 1	Individual: 9	Group: 1	Individual: 10
Token Order		Token Order	

Fishing Game	Round: 6	Fishing Game	Round: 6
Group: 1	Individual: 1	Group: 1	Individual: 2
Token Order		Token Order	
Fishing Game	Round: 6	Fishing Game	Round: 6
Group: 1	Individual: 3	Group: 1	Individual: 4
Token Order		Token Order	
Fishing Game	Round: 6	Fishing Game	Round: 6
Group: 1	Individual: 5	Group: 1	Individual: 6
Token Order		Token Order	
Fishing Game	Round: 6	Fishing Game	Round: 6
Group: 1	Individual: 7	Group: 1	Individual: 8
Token Order		Token Order	
Fishing Game	Round: 6	Fishing Game	Round: 6
Group: 1	Individual: 9	Group: 1	Individual: 10
Token Order		Token Order	

Fishing Game	Round: 1	Fishing Game	Round: 1
Group: 2	Individual: 1	Group: 2	Individual: 2
Token Order		Token Order	
Fishing Game	Round: 1	Fishing Game	Round: 1
Group: 2	Individual: 3	Group: 2	Individual: 4
Token Order		Token Order	
Fishing Game	Round: 1	Fishing Game	Round: 1
Group: 2	Individual: 5	Group: 2	Individual: 6
Token Order		Token Order	
Fishing Game	Round: 1	Fishing Game	Round: 1
Group: 2	Individual: 7	Group: 2	Individual: 8
Token Order		Token Order	
Fishing Game	Round: 1	Fishing Game	Round: 1
Group: 2	Individual: 9	Group: 2	Individual: 10
Token Order		Token Order	

Fishing Game	Round: 2	Fishing Game	Round: 2
Group: 2	Individual: 1	Group: 2	Individual: 2
Token Order		Token Order	
Fishing Game	Round: 2	Fishing Game	Round: 2
Group: 2	Individual: 3	Group: 2	Individual: 4
Token Order		Token Order	
Fishing Game	Round: 2	Fishing Game	Round: 2
Group: 2	Individual: 5	Group: 2	Individual: 6
Token Order		Token Order	
Fishing Game	Round: 2	Fishing Game	Round: 2
Group: 2	Individual: 7	Group: 2	Individual: 8
Token Order		Token Order	
Fishing Game	Round: 2	Fishing Game	Round: 2
Group: 2	Individual: 9	Group: 2	Individual: 10
Token Order		Token Order	

Fishing Game	Round: 3	Fishing Game	Round: 3
Group: 2	Individual: 1	Group: 2	Individual: 2
Token Order		Token Order	
Fishing Game	Round: 3	Fishing Game	Round: 3
Group: 2	Individual: 3	Group: 2	Individual: 4
Token Order		Token Order	
Fishing Game	Round: 3	Fishing Game	Round: 3
Group: 2	Individual: 5	Group: 2	Individual: 6
Token Order		Token Order	
Fishing Game	Round: 3	Fishing Game	Round: 3
Group: 2	Individual: 7	Group: 2	Individual: 8
Token Order		Token Order	
Fishing Game	Round: 3	Fishing Game	Round: 3
Group: 2	Individual: 9	Group: 2	Individual: 10
Token Order		Token Order	

Fishing Game	Round: 4	Fishing Game	Round: 4
Group: 2	Individual: 1	Group: 2	Individual: 2
Token Order		Token Order	
Fishing Game	Round: 4	Fishing Game	Round: 4
Group: 2	Individual: 3	Group: 2	Individual: 4
Token Order		Token Order	
Fishing Game	Round: 4	Fishing Game	Round: 4
Group: 2	Individual: 5	Group: 2	Individual: 6
Token Order		Token Order	
Fishing Game	Round: 4	Fishing Game	Round: 4
Group: 2	Individual: 7	Group: 2	Individual: 8
Token Order		Token Order	
Fishing Game	Round: 4	Fishing Game	Round: 4
Group: 2	Individual: 9	Group: 2	Individual: 10
Token Order		Token Order	

Fishing Game	Round: 5	Fishing Game	Round: 5
Group: 2	Individual: 1	Group: 2	Individual: 2
Token Order		Token Order	
Fishing Game	Round: 5	Fishing Game	Round: 5
Group: 2	Individual: 3	Group: 2	Individual: 4
Token Order		Token Order	
Fishing Game	Round: 5	Fishing Game	Round: 5
Group: 2	Individual: 5	Group: 2	Individual: 6
Token Order		Token Order	
Fishing Game	Round: 5	Fishing Game	Round: 5
Group: 2	Individual: 7	Group: 2	Individual: 8
Token Order		Token Order	
Fishing Game	Round: 5	Fishing Game	Round: 5
Group: 2	Individual: 9	Group: 2	Individual: 10
Token Order		Token Order	

Fishing Game	Round: 6	Fishing Game	Round: 6
Group: 2	Individual: 1	Group: 2	Individual: 2
Token Order		Token Order	
Fishing Game	Round: 6	Fishing Game	Round: 6
Group: 2	Individual: 3	Group: 2	Individual: 4
Token Order		Token Order	
Fishing Game	Round: 6	Fishing Game	Round: 6
Group: 2	Individual: 5	Group: 2	Individual: 6
Token Order		Token Order	
Fishing Game	Round: 6	Fishing Game	Round: 6
Group: 2	Individual: 7	Group: 2	Individual: 8
Token Order		Token Order	
Fishing Game	Round: 6	Fishing Game	Round: 6
Group: 2	Individual: 9	Group: 2	Individual: 10
Token Order		Token Order	

The "Water Message" game

Divide a group of around 10 persons into two groups. The two groups communicate with each other through messages written on paper, which are exchanged simultaneously through a neutral facilitator. In total seven times messages are exchanged, so the game consists of seven rounds. No other means of communication are allowed, except after round 3 and after round 6, when each group may decide to negotiate with the other party and nominate a negotiator. However, this negotiation can only proceed if both groups decide to negotiate.

The messages that are exchanged concern the use of a shared water body such as a lake or an aquifer. Each message round starts afresh, and is independent of any message sent earlier.

In explaining the message game below, the two groups are called "Us" and "Them".

For each round of negotiation, we send a message: either XX or XY or YY.

Our possible messages:

XX = We invest fully in water supply infrastructure (e.g. dams), as a result our water use may increase to the full; and therefore our economic growth will be high.

XY = We do not invest in water supply infrastructure (e.g. dams), as a result the increase of our water use is constrained, and therefore our economic development.

YY = We invest moderately in water supply infrastructure (e.g. dams), but we also invest in water demand management; our water use may increase moderately but securely; and therefore our economic development.

Our message (either XX or XY or YY) is combined with the message of the other party (them). These two messages form a combination. The combined result of our and their message are:

Message	Score	Explanation
Us Them	Us Them	
XX XX	= -20 -20	We both lost: we both invested heavily, our water demand increased, but there is not sufficient water.
XX XY	= +20 -20	We invested, got our water and achieved economic growth; they lost as we took all the water and they did not invest.
XX YY	= +40 -40	We invested and got even more water, because they also invested in demand management; they lost much because despite of their investments they had little water.
XY XX	= -20 +20	We lost as they took all the water and we did not invest; they invested, got their water and achieved economic growth.
XY XY	= 0 0	We both gained nothing.
XY YY	= +20 -20	We won, because we did not invest yet we gained some extra water because they invested in water demand management; they lost: they invested while we took their water.
YY XX	= -40 +40	We lost much because despite of our investments we had little water; they invested and got even more water, because we also invested in demand management.
YY XY	= -20 +20	We lost: we invested while they took our water; they won, because they did not invest yet they gained some extra water because we invested in water demand management.

YY YY = +20 +20 We both invested in supply schemes and demand management, we both achieved moderate but sustained economic growth; therefore we both won.

The "Water Message" game

Summary of Scores

To determine our points for each transaction, combine the two messages and refer to the table below.

Message		Score	
US	THEM	US	THEM
XX	XX	-20	-20
XX	XY	+20	-20
XX	YY	+40	-40
XY	XX	-20	+20
XY	XY	0	0
XY	YY	+20	-20
YY	XX	-40	+40
YY	XY	-20	+20
YY	YY	+20	+20

The "Water Message" game

Score sheet

			OUR	RESULTS	THEIR	RESULTS
Round	Our message	Their message	Our result this round	Our cumulative score	Their result this round	Their cumulative score
No. 1						
No. 2						
No. 3						
No. 4			× 5		× 5	
No. 5						
No. 6						
No. 7			× 10		× 10	

WATER FOR MUTARE, 1995

A case study

Notes on the case study:

1. The case study has been based on an article written by Bekithemba Gumbo and Pieter van der Zaag of the Department of Civil Engineering, University of Zimbabwe: “Water losses and the political constraints to demand management: the case of the City of Mutare, Zimbabwe”; as well as the Pungwe Basin Negotiation Role-play by Pieter van der Zaag (unpublished).
2. The information regarding the Pungwe water scheme is factual. However, the characters in this case study as well as the meetings portrayed are completely fictional.
3. The case study was prepared to be used in a conflict management training environment. For this purpose a specific selection of information and relevant stakeholders was made, reducing somewhat the complexity of the actual case. The case study should therefore not be seen as a completely accurate reflection of the historical situation.

Tina Hove gives a deep sigh as she goes through the documentation once more. The crucial meeting between the City Council of Mutare and a number of key stake-holders is scheduled to begin within two hours. “How did I get into this”, she mumbled to herself with a wry smile, remembering all too well how excited she and her partners were when their independent consultancy firm was contracted by the City Council of Mutare to prepare an independent report on the Pungwe water scheme. She remembered distinctly how Mr. Mudzore, a City Councillor and close confidante of the Mayor, explained to her what they expected. “It is really plain sailing, Miss Hove”, Mr. Mudzore said. “The advantages of the Pungwe scheme are overwhelming. It will be good for everyone. But you know how these environmentalists have the habit to make nuisances out of themselves. They are really a very small group, but they make a lot of noise and we have to be sensitive to public opinion. Therefore, we want you to look objectively at the facts, compile a report and present it to a meeting between the City Council and other stake-holders that will take place next month. We are confident that a report, coming from such a respected and independent source as yourselves, will allay all these unnecessary anxieties. We are sure you will not disappoint us”, he added in a slow and emphatic tone.

At first glance it indeed looked like plain sailing. The intended Pungwe scheme had distinct advantages. Tina pulls a document from her file that contains all the basic information. She reads through it once more, although by now she can almost recite it verbatim:

The City of Mutare is the fifth largest city in Zimbabwe. It is situated in the province of Manicaland, in Eastern Zimbabwe, of which it is the capital and administrative centre. The city lies a few kilometres from the border with Mozambique. The 1992 population census gave a total population of 131,400 (69,600 in 1982). The existing main sources of water supply for Mutare are the Odzani and Smallbridge dams, located on the Odzani river, which is part of the Save catchment. The combined full supply capacity of the reservoirs is 21 Mm³, with an estimated yield of 20 Mm³/a. Over the 8 year period July 1983 to June 1991, water abstraction from Odzani water works grew by an average of 9,600 m³/month. This growth is mainly explained by the increase in population (6.35 % per year over the period 1982-1992) and increase in economic activity (GDP in Zimbabwe grew some 3.6% per year over the period 1982-1991). Crude per capita water consumption (total treated water divided by the city population) averaged 8.9 m³/capita/month over the period September 1983-September 1989, and tended to increase from around 7.5 to 10 m³/capita/month. Water abstraction peaked during the period September 1990 and August 1991, at 1.50 Mm³/month (or 18 Mm³/a, close to the yield of the water supply sources then in place).

The disastrous drought of 1991/92 resulted in the combined storage to drop to an all time low of 375,000 m³ in November 1992, an amount that would have been consumed within a week at predrought consumption levels! This forced Mutare to adopt drastic water conservation measures. As a result water abstraction during January-December 1992 averaged only 0.47 Mm³/month; i.e. less than one third of the previous year. From April 1992 to March 1993 gross per capita water consumption was only 3.0 m³/capita/month. This significant reduction is explained by the massive campaigns, rationing, borehole drilling and tariff increases by the city council.

Three options to deal with the water crisis were considered during 1994-95. The first was a relatively small dam on the Odzani River, augmenting the storage capacity of the two existing dams on the same river. This option was the cheapest in terms of capital investment (US\$ 5 million) but would also yield relatively little water (13 Mm³/a).

The second option was taking water from the just completed Osborne dam (storage capacity 400 Mm³) on the Odzi river, 30 km north-west of Mutare. The Department of Water Development, which owns the dam, had reserved 28 Mm³/a for Mutare and had already constructed the intake works for a 28 km pipeline to Mutare. This Osborne-Mutare pipeline-

cum-treatment works project was estimated to cost US\$ 37 million, of which 5% had already been spent. The technical advantages of this option were: (1) it would yield sufficient water to cater for the needs of Mutare for the next two decades, (2) this option could be implemented fast, since the dam had already been built, as well as the intake works.

The option also had two disadvantages: (1) raw water would have to be pumped, whereas the current sources allow water to gravitate to the water treatment works; (2) treatment costs would increase since Osborne water is relatively turbid compared to Odzani water. So this option would involve relatively high recurrent operational costs.

The third and preferred option involved taking water from the Pungwe river which is not part of the Save catchment. The advantages of this option were:

1. the water would gravitate through a 4 km tunnel and a 46 km pipeline to the existing treatment works at Odzani, from where it would further gravitate to the city; this option would therefore not require any pumping; since the source is perennial, no storage works were required either;
2. the water drawn from the Pungwe would be pure, hardly requiring any treatment; and
3. the pipeline would be owned by the city.

The disadvantages were:

1. its secure yield (16 Mm³/a) fell short in providing a supply solution for the coming 15 years;
2. it would be expensive to build (US\$ 100 million); much more than the next expensive option, which would have a much higher yield;
3. it could create problems with Mozambique, as Beira entirely depends on Pungwe water; and
4. it could negatively impact on the pristine ecology of the Pungwe catchment.

Tina puts the document down. Her mind goes back to a social function that one of the civil engineering firms, interested in obtaining the contract for the construction of the Pungwe scheme, held. It was one of those jovial social gatherings. With a small plate of snacks in hand she introduced herself to two persons in animated discussion. As it turned out one of them represented a civil engineering firm and the other a financial bank with a deep interest in funding the scheme. They drew Tina into the discussion. "You know, Tina", the engineer said, "this project will be just the sort of injection that the economy of this area needs. Imagine the number of jobs that will be created during the construction phase. Imagine the injection into the local economy of a huge construction project of this nature. Mutare residents will benefit from the spin-offs for a long time to come." Following further subtle probing by Tina he added: "Of course this is a very sexy thing for us. The engineering challenges offered by the project are very exciting. This is the stuff we engineers live for. It is an opportunity to apply our knowledge and skills to the full." The banker, who was nodding his agreement, added: "Look at it this way, Tina. The project has indeed a high price tag. We are talking of a

figure of roughly US\$100 million. But it is attractive. The demand for water is steady. Residents will always need water and they have to buy it from the City Council. It is therefore a vital product, controlled monopolistically because there is only one supplier. From our perspective this is an ideal situation.”

The aspect of the high cost was a major concern for Tina. She made an appointment with Mr. Mudzore to seek his opinion on the matter. Mr. Mudzore was quite emphatic. “Look, Miss Hove”, he said. “Despite the high figure you mentioned this is the cheapest option for the city. You must remember that this is the alternative with the lowest running cost. We should be able to access government loans at 15% on the usual local authority borrowing terms. The interest on these loans is lower than the current inflation rate of 20%. In spite of the initial investment costs, the Pungwe scheme provides us with the lowest recurrent operational costs. How can you beat this? And let me tell you something else: in this way we as Mutare City will be fully in charge of our own water system and not be dependent on central government. You know that we in Mutare have always been proud of our independence and skeptical of central government control, and that some very influential and important politicians come from this area.”

Tina remembers how she felt convinced by all these arguments. But she had to meet with Dr. Ndlovu before she could formulate any final recommendations. Dr. Ndlovu was a highly respected scientist at the University of Zimbabwe and an outspoken critic of the Pungwe water scheme. She wrote a number of letters to the press, voicing her objections. She was enthusiastically supported by a group of environmentalists, but seemed unable to make a great impact on the opinion of residents. Tina met Dr. Ndlovu in her office at the university. “We are fighting a losing battle, Miss Hove”, she said with a tired expression on her face. “But the basic fact is that we do not need the Pungwe scheme. The major problem with Mutare’s water supply is not that it is insufficient, but that there are inadequate measures to ensure optimum use. Put simply: too much water is lost or unaccounted for. If we reclaim that water Mutare will have sufficient water, at least in the short term. Do you realise that the restriction measures during the drought reduced water use to a third of what it was before the drought and that even today Mutare’s use is below that of the pre-drought period? It shows clearly that Mutare has been using water unwisely. Put more explicitly: water is being wasted unnecessarily. The average gross loss, i.e. the unaccounted-for water, is estimated at 52% of the water produced at Odzani. During the treatment of water some 4,5% of the water is lost. As much as a third of all unaccounted-for water may be caused by the bad condition of pipes. Furthermore, bulkmeters are not functioning. Many industries have non-functioning water meters and are billed at nominal quantities. Mutare Board and Paper, for examples, is believed to use 5-10% of all treated water, but five of its eight meters are not working. They are billed for a fraction of actual water consumption. You see, Miss Hove”, she said, becoming a bit agitated as she saw incomprehension in Tina’s eyes, “what the City Council has to do first is to get a proper grip on its management of existing sources. Proper conservation, optimal use through minimum leakage, and appropriate billing to prevent excessive use are fairly straight-forward measures to conserve water. But, of course, these are not sexy things to do. As politicians you are much more in the limelight and popular if you an point to grandiose schemes than when you have to instill discipline into municipal officials to do proper maintenance and, even more difficult, instill discipline on water users in general to use

water sparingly. The industries have to be disciplined as much as the people who vandalise public taps, but this is, of course a nightmare for politicians. Throw in the bankers and the engineers, who of course want to do business and get involved in grand schemes, and you have an unholy alliance, pushing for a project that is unnecessarily costly and damaging to the environment. Are you aware of the fact that the small-scale farmers in the Honde Valley have been threatened with eviction? Why? Because they expressed their concern that the envisaged extraction from the Pungwe river will dry up their part of the river.”

Tina stood up to take leave to Dr Ndlovu’s office. The older woman took her hand, but then said: “Miss Hove, before you make up your mind on this issue, you have to go and talk to the Mozambicans. If I were you, I would travel to Beira to talk to their City Council officials.” They greeted and Tina left. Tina was by this time aware that the Mozambicans had a stake in the way the Pungwe issue would be resolved. She knew that especially the city of Beira depended on the water of the Pungwe. The middle Pungwe river basin on the Mozambican side of the border was less densely populated, as many areas were abandoned during the civil war and the level of development was much lower than in the other parts of the basin. But further down the river, in the Pungwe’s flood plains, there were two major water users: the City of Beira and the Mafambissa sugar plantation. The City of Beira was struggling to deal with all the post-civil war challenges. A small minority of residents of Beira are served with treated water, mainly because the system was developed during the colonial period for certain parts of the city only, and no proper maintenance was carried out since. The system suffered from very high leakages. It urgently needed to be rehabilitated and extended. There have been serious cholera epidemics in Beira, probably caused by the lack of coverage in combination with heavy flooding. There was no sewage treatment facility in Beira; sewage is let out through open channels directly to the sea. The Mafambissa sugar plantation is fed from a pumping station on the Pungwe river for purposes of irrigating some 3,000 ha sugar cane. The intake was located within the 80 km long stretch of the river affected by saltwater intrusion during the dry season. Salt concentrations reached unacceptable levels several times during a normal low-flow season.

Tina decided to follow Dr Ndlovu’s advice. She met with Beira’s City Engineer, Mr. Zunguza, in his office in Beira. “I am glad you have come, Miss Hove”, Mr Zunguza said. “You seem to have all the basic facts. However, what you should understand is that we are still on our knees after all these years of war. We want to develop this city. We need to invite and settle industrialists. Our tourism has to pick up. Yet, we feel vulnerable. We know that we need a regular supply of clean water from the Pungwe. At this stage, however, our projections are tentative and uncertain. We suffer as much from drought as from flooding. We shall have to build a dam upstream to assist with the management of flows. We have to balance needs of residents with that of the sugar growers. They also need reassurance of a steady supply of water. Amidst all this the environmentalists tell us our prawn population in the estuary is under threat because they depend on the brackish quality of the water, which is vulnerable to any drastic change in the outflow of the Pungwe. We have to negotiate a deal with the Zimbabweans, but we do not feel ready for it and fear that we may end up with a deal that will damage our long-term interests. Politically, as you know, it will be difficult for us to withstand pressure from Zimbabwe. We are fortunately protected by the SADC

Protocol signed earlier this year (1995) that prevents unilateral decisions regarding water use of shared rivers, but does this Protocol have any teeth?" On her flight back to Zimbabwe Tina could see from the sky the small silver stream that is a lifeline and source of hope to so many people. Yet, yet it looked so small and vulnerable from the sky and the areas dependant on it so vast.

Tina again gives a deep sigh. Within two hours she has to make her recommendations to the meeting of stake-holders. What must she say to them?

The Pungwe River Basin, 1995

Compiled by Pieter van der Zaag; 1 August 2000

1. Physical data

The Pungwe or Púngoè river is shared by Zimbabwe and Mozambique (Figure 1). The length of the river is nearly 400 km of which 340 km is in Mozambican territory. The Pungwe river drains an area of 31,000 km². Only 5% of the basin is situated in Zimbabwe. Since this part of the basin receives generous rainfall, it contributes considerably to the Pungwe discharge. (Figure 2).

The Pungwe river rises from the foothills of Mount Inyangani in eastern Zimbabwe, flows into Honde Valley where it crosses into Mozambique. This part is considered the middle Pungwe, up to the point at Bué Maria where it reaches the plains, considered the lower part of the basin. Downstream of Bué Maria the river divides in several streams, of which the Dingue Dingue is the most important, because through it the main discharge in the dry period is transported. The streams join again near the bridge over the Pungwe river on the EN6, which is situated some 100 km from the estuary mouth, in the zone under tidal influence. At the estuary the Pungwe waters enter the Indian Ocean. This is some 20 kilometers north-west of the City of Beira.

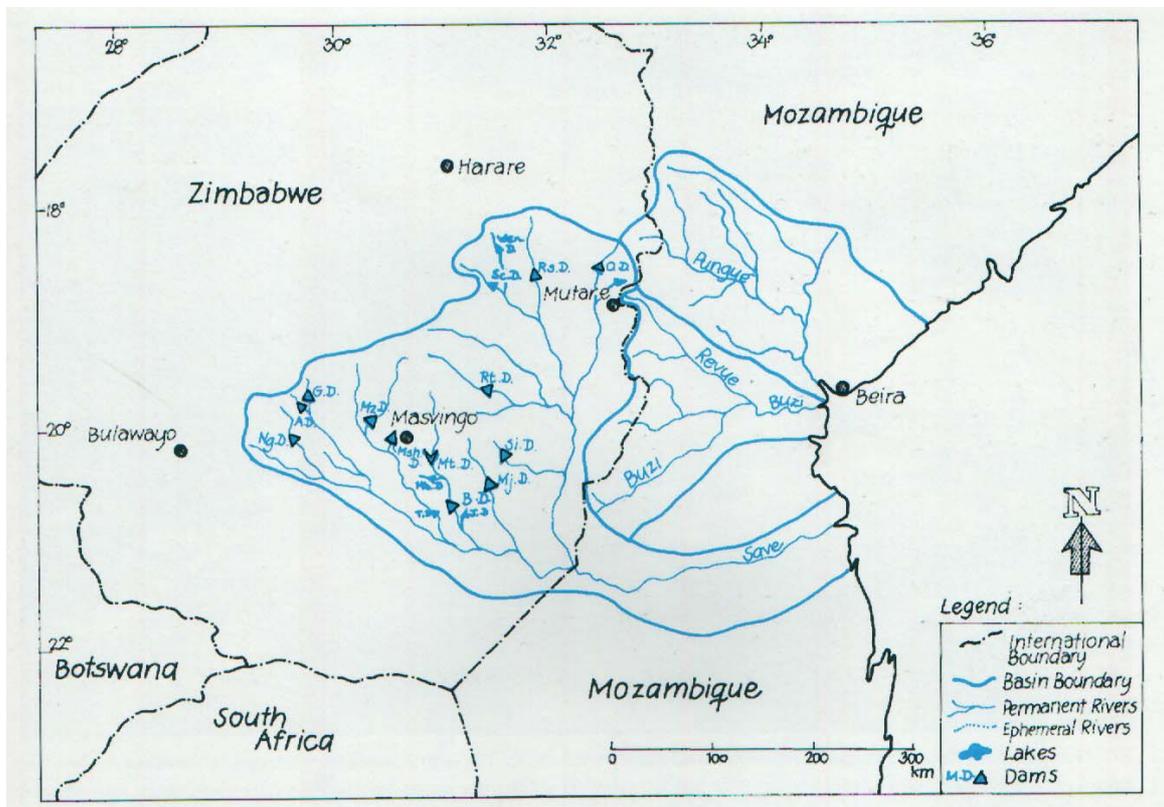


Figure 1: The Pungwe basin with neighbouring basins (Revue, Buzi, Save etc)
(source: Pallett, 1997)

The discharge at Bué Maria plays an important role in pushing back the salt sea water intruding through the estuary, which is crucial for the City of Beira's water supply intake. The 10% low flow (i.e. the flow with a chance of occurring of 0.10; with a return period of 10 years) at Bué Maria has been established at 8.8 m³/s (Zanting et al., 1994). A flow of 10 m³/s is considered the minimum flow to safeguard the intake of fresh water for Beira (Chamuço, 1997)

2. Uses of Pungwe waters

The uses of the Pungwe waters are summarised in Table 2. The table looks like a 'mirror', since in both Zimbabwe and Mozambique the Pungwe waters are used for similar types of needs.

Table 2: Uses of Pungwe water, 1995

Zimbabwe	Sector	Mozambique
- rainfed - irrigation	Agriculture – large scale	'Farmeiros' are coming: - rainfed - irrigation
- rainfed - irrigation, eg Mtarazi	Agriculture – small scale	- rainfed - irrigation eg Gorongosa
- tea - coffee - exotic forests	Agriculture – plantations	- sugarcane - citrus
Public water supply schemes, boreholes, etc.	Rural	Individual arrangements, such as wells; public schemes in a few growth points etc.
None	Urban	Beira - domestic - commercial (eg harbour) - industrial
Nyanga NP	Parks/tourism	Gorongosa NP
Certain fish and tree species	Ecology	Mangrove and prawns
Pungwe Sub-Catchment Council	Management Institution	ARA-Centro

2.1 Zimbabwe

The part of the Pungwe river situated in Zimbabwe is relatively densely populated and substantially developed in terms of agriculture and tourism. It is likely that in future water consumption will increase further. Currently, the main water consumers in the

upper part of the catchment are forest plantations of exotic trees which are known to affect negatively river discharge significantly; and tea and coffee estates near the border with Mozambique for irrigation. Other consumptive uses include smallholder irrigation and primary uses by communal farmers in the Honde Valley. It is likely that irrigation development in the area of both smallholder and estate will continue, and that water demand for irrigation will increase. The three principal non-consumptive uses in this part of the basin are: national park/environment; tourism; and fisheries.

The ecology of this part of the Pungwe basin is considered pristine. The Pungwe river hosts a variety of rare freshwater fish species such as the Mountain Catfish (*Amphilis uranoscopus*), Barred Minnow (*Opsaridium zambezenze*), African Mottled Eel (*Anguilla bengalensis labiatal*) and the Pungwe Chisel Mouth (*Varicorhinus pungweensis*), among others. At the Pungwe Falls, the river supports spray dependent vegetation largely comprising Yellow Wood (*Podocarpus milanjanus*), Cape Breech (*Rapanea melanophloeos*), including creeping ferns such as *Pleopeltis excavata*. A new undescribed pendulous *Aloe* was discovered recently (Magara & Tapfuma, 2000)

Table 3: Water uses of the Pungwe within Zimbabwe, 1995

Non-consumptive uses:

National park (Nyanga)
Tourism (such as canoeing)
Fisheries (very limited)

Consumptive uses:

Rural water supply for primary uses (including cattle, gardens etc.) (amount not known)
Wetland cultivation (amount not known)
Smallholder irrigation (amount not known)
Large-scale irrigation

- Katiyo Estate (government owned and managed by ARDA; water used not more than 1 m³/s)
- Aberfoyle Estate (owned by Eastern Highlands Plantation, a private company; water used not more than 1 m³/s)

Other large scale uses:

- Forestry plantations of exotic trees (mainly pine, but also eucalyptus and wattle)

Mutare

The City of Mutare has some 180,000 inhabitants, and requires some 0.6 m³/s of water. The water supply system of Mutare consists of two storage dams in the Odzani catchment which is part of the Save basin (Lake Alexander and Smallbridge Dam, with a combined capacity of 21 Mm³), a treatment works at Odzani not far from these dams, a 23 km pipeline to the city, and the usual distribution infrastructure within the city.

Figures 4 and 5 show the dramatic impact of the 1991/92 drought, when water stored in both dams dropped to an all time low of 375,000 m³ in November 1992, an amount that would have been consumed within a week at pre-drought consumption levels! This forced water consumption in Mutare to be reduced dramatically; water abstraction during January-December 1992 averaged only 0.47 Mm³/month; i.e. less than **one third**

of the amount abstracted during 1990/91. From April 1992 to March 1993, gross per capita water consumption was only 3.0 m³/month. This significant reduction can be explained by the massive campaigns, rationing, borehole drilling and tariff increases by the City of Mutare.

It is worthwhile to observe that water abstraction during 1999 did not yet reach the levels of those during 1990/91. Monthly raw water abstraction during the period April 1999-March 2000 averaged 1.34 Mm³/month.

Nevertheless, by 1995 it became clear that Mutare required an additional source of water. Two alternative options presented themselves, and are briefly described below.

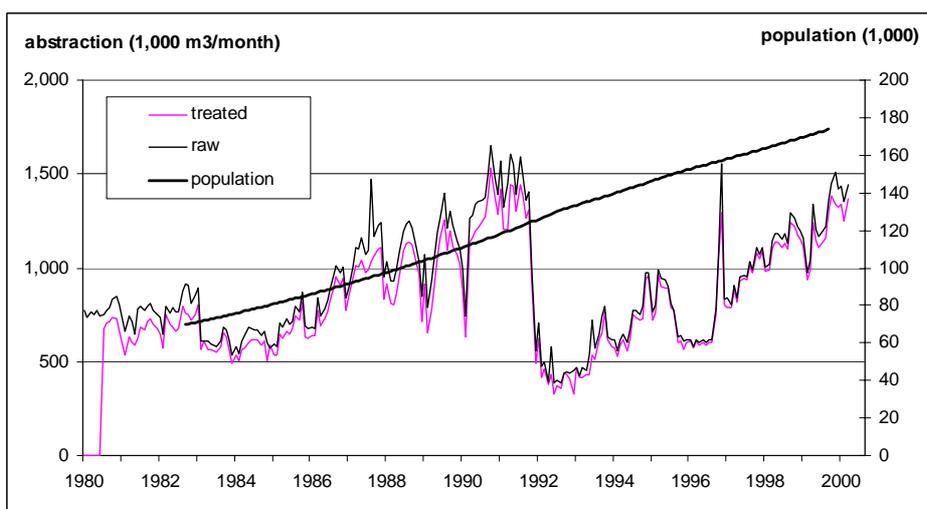


Figure 4: Raw and treated water abstraction from Odzani Water Works for Mutare; and city population (interpolated from 1982 and 1992 censi and 1995 survey)

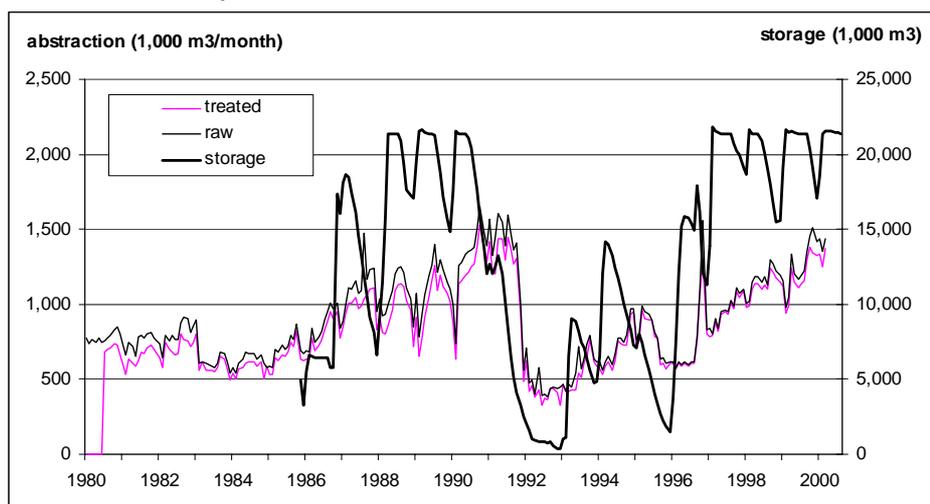


Figure 5: Water stored in Smallbridge and Alexander dams, and raw and treated water abstraction from Odzani Water Works, Mutare; 1980-2000

The Department of Water Development of the government of Zimbabwe had developed the option of taking water from the recently built Osborne dam, drawn from a pickup point on the Odzi river, in the Save river basin, and pumped through a 28 km pipeline to the City. Department of Water Development had already started constructing the headworks for the river intake.

Meanwhile, the Mutare City, together with Swedish contractors, developed an alternative proposal for a tunnel into the Pungwe gorge, plus a permanent 80 km pipeline to the City (Figure 6). This effectively meant an interbasin transfer of water, namely from the Pungwe river basin into the Save river basin, where Mutare is situated.

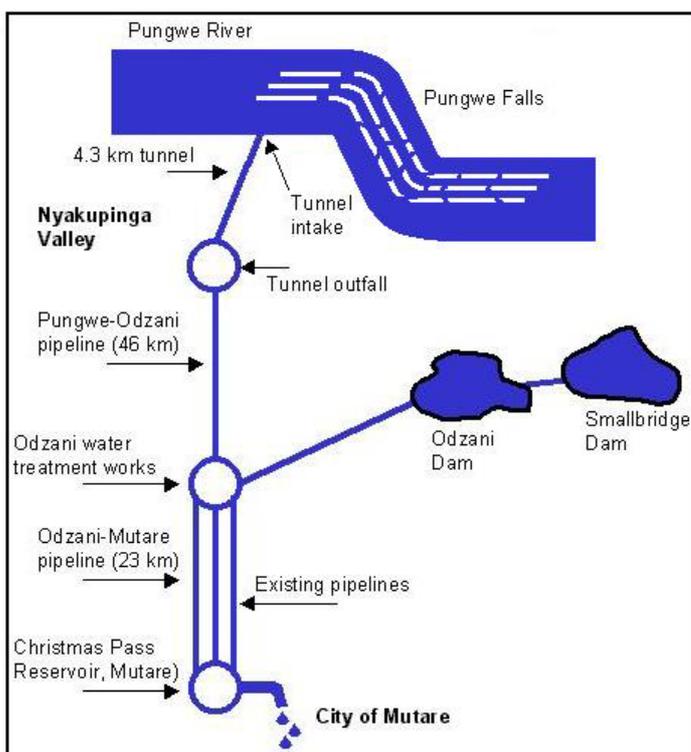


Figure 6: The proposed Pungwe-Odzani basin transfer scheme for Mutare
(source: <http://www.flowtite.com/literature/pungwe-mutare.htm>)

An economic dilemma

At the time the two alternatives were appraised in early 1994, the Osborne/Odzi scheme would cost Z\$ 197 million, of which Z\$ 9 million had already been spent, leaving a balance of Z\$ 188 million. Construction of the Pungwe scheme was estimated to cost Z\$ 418 million (which increased to Z\$ 620 million at the time the project went out to tender). However, the recurrent costs of the Osborne/Odzi scheme were high, due to the water having to be pumped, and the water requiring quite some treatment. The recurrent costs of the Pungwe option were low, since the water would reach the city by gravity and treatment costs would be minimal due to the high quality of the Pungwe water.

The two options thus presented a classic case of choosing between high initial capital costs and low running costs or low capital costs and high running costs. The appraisal therefore rested on assumptions about inflation and the choice of the discount rate for the calculation of net present values. With a relatively low discount rate the future

(running) costs would be valued higher, favouring the Pungwe option. A higher discount rate would dwarf the present value of future costs, and would favour the Osborne option.

Since the City of Mutare would, for either project, receive a concessionary loan from Government, the City of Mutare used a discount rate of 12% per year, while at that time inflation was around 20% per year. This means that Mutare used in fact a *negative* discount rate, which would value future costs and benefits higher than present one's. Unsurprisingly, for Mutare the Pungwe option was therefore much more attractive.

However, what was good for Mutare, may not have been good for Zimbabwe as a whole, since it was unlikely that Government would be able to get loans for this project at such concessionary terms. Zimconsult (1996) maintains that at a more acceptable (=higher) discount rate, the Osborne/Odzi alternative would always have been preferable. A project of this magnitude, involving significant deployment of national resources, should not have been appraised just from the viewpoint of Mutare, but of the nation as a whole. To compound the problem, the Pungwe option would, and indeed did, raise more serious environmental and international water rights concerns with Mozambique, than the Osborne/Odzi scheme.

Hydrological impact

The impact of diverting 0.7 m³/s out of the upper reaches of the Pungwe is significant in this part of the catchment, amounting to some 16% of the mean annual runoff at the diversion point. The impact during the low flow season is much larger (50% of mean runoff during September, the month of lowest flow). However, since at the border with Mozambique the discharge of the Pungwe is much larger due to the much larger catchment area (622 km² compared to 86 km²), here the impact is considered to be relatively small (some 3% of the mean annual runoff; though higher during the low flow season).

This new source is considered sufficient to cater for Mutare's water needs up to the year 2015. However, some controversy exists on the risk of failure of the combined water sources of the city, i.e. lakes Alexander, Smallbridge and the Pungwe. The risk of failure of the Pungwe river supplying 0.7 m³/s may be higher than the generally accepted 4%.

2.2 Mozambique

The middle Pungwe river basin on the Mozambican side of the border is less densely populated, as many areas were abandoned during the civil war and the level of development is much lower than in the other parts of the basin. Little information currently is available concerning demography, land use, environmental and infrastructural conditions. The Gorongosa national park is situated in this part of the basin. This used to be an important tourist attraction until it became the headquarters of Renamo during the late 1980s. Apparently the park has opened again, but the wildlife has reportedly been decimated in the park.

Further down the river, in the Pungwe's flood plains, there are two major water users: the City of Beira and the Mafambissa sugar plantation.

As of early 1998, only 15-20% of the population of Beira was served with treated water, mainly because the system was developed during the colonial period for certain parts of the city only, and that no proper maintenance was carried out since. The system suffers from very high leakages. It urgently needs to be rehabilitated and extended. There have been serious cholera epidemics in Beira, probably caused by the lack of coverage in combination with heavy flooding. There is no sewage treatment facility in Beira; sewage is let out through open channels directly to the sea. (Nilsson & Shela, 1998)

The Companhia de Aguas da Beira (Beira water supply company) abstracts about 0.3 m³/s from the canal supplying water to the Mafambissa sugar plantation, fed from a pumping station on the Pungwe river. The pumps deliver 1 m³/s total discharge, and 0.7 m³/s is used on average for irrigating sugar cane over an area of some 3,000 ha. The intake is located within the 80 km long stretch of the river affected by saltwater intrusion during the dry season. Salt concentrations reach unacceptable levels several times during a normal low-flow season (Zanting et al., 1994; Nilsson & Shela, 1998). As stated earlier, the chance of the flow at Bue Maria being less than 10 m³/s (considered the minimum flow to guarantee fresh water at Beira's intake) is larger than 10%.

Beira plans to establish an industrial free zone north of Beira, which would also use Pungwe for its water supply. The total use of water is expected to be 1.5 m³/s and the intake will be 5 km upstream of the present intake in order to avert salt problems at higher intake levels. (Nilsson & Shela, 1998)

Table 4: Water uses of the Pungwe within Mozambique, 1995

Non-consumptive uses:

National park (Gorongosa)

Salinity control at the intake for City of Beira water supply near the estuary (8-10 m³/s required)

Fisheries

Consumptive uses:

Rural water supply for primary uses (including cattle, gardens etc.) (amount not known)

Water supply for the City of Beira (410,000 inhabitants in 1992; of whom in 1998 only 15-20% were connected to the water supply system; currently using 0.3 m³/s; to increase to 1.5 m³/s)

Wetland cultivation (amount not known)

Smallholder irrigation (amount not known)

Large-scale irrigation

- Mafambissa sugar estate with 2,620 ha (using 0.7 m³/s; to increase to 5.5 m³/s for 8,500 ha)

Excess water during the wet season is as much a problem as water scarcity during the dry season. Floods inundate extensive agricultural lands while damaging properties and settlements. The floods of February 1998 displaced many people and affected 45% of sugar cane production at Mafambissa estate. Floods and water scarcity are both the limiting factor for expanding irrigation for sugar cane and rice.

Out of 40 potential dam sites, the Bué Maria just west of the plains area is considered the best solution for solving the problems related to seasonal flow variations. The most important function of this dam would be to regulate the downstream flow in order to control salt intrusion during the dry season and floods during the wet season. The dam would also be used as a storage reservoir for irrigation, water supply and possibly hydropower. (Nilsson & Shela, 1998)

One environmental concern in the coastal area is the dependency of prawn cultivation on brackish water conditions; any drastic change of the Pungwe flow, including silt load, will have a detrimental impact on the habitat. (Nilsson & Shela, 1998)

3. Institutional set-up

The current institutional set-up is very new and not yet fully operational. Before the establishment of the Pungwe Sub-Catchment Council in Zimbabwe and ARA-Centro in Mozambique, one could hardly speak of any institutional arrangement which manage the Pungwe waters.

The Zimbabwean part of the Pungwe basin is officially managed by the Department of Water Development. In July 1999, the Pungwe Sub-Catchment Council was established, which forms part of the Save Catchment Council. Under the new Water Act and ZINWA Act, both of 1998, these Councils will regulate the uses of water in the basin. Representatives of different water user sectors are represented on the Pungwe Sub-Catchment Council. Currently, there are 7 Councillors, representing Communal, Commercial and Indigenous Commercial farmers, the Mutasa Rural District Council, traditional leadership, and the City of Mutare. The Pungwe Sub-Catchment Council is not yet fully operational.

On the Mozambican side, ARA-Centro, a regional body of the Water Affairs Department DNA, has the Pungwe basin under its responsibility. ARA-Centro was established in 1998, and is starting to become fully operational.

Both countries are members of SADC and signed in 1995 the Protocol on Shared Watercourse Systems in the SADC region. Zimbabwe ratified the Protocol, but Mozambique refused to do so.

As at 1995, no Joint Water Commission concerning water resources of interest common to both Mozambique and Zimbabwe existed. As at 1995, no other agreements had been signed by both governments concerning the uses of the water resources of the Pungwe river basin.

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Incomati Negotiation Roleplay

Draft, 13 November 2002

Roles

Mozambique	South Africa	Swaziland	Facilitation team
Official Ministry of Foreign Affairs Mozambique	Official Ministry of Foreign Affairs South Africa	Official Ministry of Foreign Affairs Swaziland	Facilitator SADC Lawyer Gaborone, Botswana
Official Ministry of Water Mozambique	Official Ministry of Water South Africa	Official Ministry of Water Swaziland	Facilitator SADC Hydrologist Gaborone, Botswana
Official Ministry of Environment Mozambique	Official Ministry of Environment South Africa	Official Ministry of Agriculture Swaziland	
Official Ministry of Finance Mozambique	Official Ministry of Finance South Africa	Official Ministry of Finance Swaziland	
Official Ministry of Commerce Mozambique	Official Ministry of Agriculture South Africa	Official Ministry of Environment Swaziland	

Country brief South Africa, 1990

The apartheid era is near collapse; Nelson Mandela has just been released. It is clear that the times are changing. Majority rule seems inevitable. This context influences the position of the South African delegation when negotiating the waters of the Incomati.

First and foremost, South Africa wants the Komati Basin Development Plan, the joint plan with Swaziland on developing the Komati river, to go ahead. This joint plan took more than 10 years to negotiate with Swaziland. The planned new dams (Maguga in Swaziland and Driekoppies in South Africa) will allow a substantial increase in irrigation within South Africa, notably for the sugar cane. Sugar cane is an economically important industry for South Africa.

The main stake of South Africa in negotiating the Incomati river basin is as follows:

South Africa wants to proceed with the Komati Basin Development Plan as agreed with Swaziland, and built Driekoppies Dam. As South Africa wants to be seen as a good neighbour, it wishes to get a statement of no-objection from the Mozambican delegation concerning the planned Driekoppies Dam. However, South Africa is prepared to go ahead with constructing the Driekoppies Dam even in the absence of Mozambique's agreement.

South Africa also wants to get additional water from Maguga Dam (situated in Swaziland).

Individual brief South Africa

1.1 Official Ministry of Foreign Affairs

- *Main objective:* to respect as much as possible all existing formal and informal agreements.
- You wish to smoothen relations with neighbouring countries, in the face of impending changes in South Africa.
- You do not want to upset the environmental lobby groups inside the country, since these have strong linkages with western and international environmental lobby groups. Antagonising these groups would create (unnecessary) complications for South Africa's foreign policy.
- *Personally:* You are a senior and seasoned diplomat and want to ensure that you survive the impending change in government. You therefore want to be seen to be "progressive"; you see a political opportunity to support the small-scale farming sector (which has in the past been marginalized and hardly benefited from government subsidies). Making sure that a considerable part of new irrigation will be allocated to smallholders has an added advantage, in that the large-scale commercial farming sector will not be exposed to revolutionary claims for land resettlement, as has happened in a neighbouring country to the north.
- There is a dispute with the Ministry of Water on the leadership of the delegation. Traditionally the Water Ministry has been in charge of these negotiations, but your minister is taking the view that the broad scope of the agenda warrants a stronger role for Foreign Affairs. Many national interests are at stake. You are instructed to claim that position. You see as your personal strength that you have proven your effectiveness as a chairperson of a number of complex negotiations in the environmental field. You know how to promote decision making even under difficult circumstances. You know also that your admirers sometime find you manipulative.

Individual brief South Africa

1.2 Official Ministry of Water

- *Main objective:* to implement the Komati Basin Development Plan as agreed with Swaziland, including the construction of the envisaged Driekoppies dam (251 Mm³, inside South Africa) and Maguga dam (332 Mm³, inside Swaziland); but at the least water cost (i.e. minimise the surrender of water to Mozambique).
- You are under pressure from the large-scale commercial farmers union, as well as the sugar industry to provide cheap water for irrigation in the Komati, Lomati and Sabie catchments.
- You are aware that some water has to be released from the Upper Komati into Swaziland; but you need a similar commitment of sufficient flow from Swaziland into the Lower Komati.
- You are aware of the many illegal weirs that commercial farmers have constructed in the Lower Komati, without requesting permission from your ministry. You know that this contributes to the drying up of the Komati at Komatipoort/Ressano Garcia, but you cannot say this openly.
- *Personally:* you are the longest serving member on your country delegation. You know your Swazi and Mozambican counterparts of water personally. You have a great knowledge on the water availability in the Incomati basin, since you are one of the pioneers in water resources modelling; and the most honoured designer of dams in South Africa. You hold the view that additional dam construction is the only serious option to deal with water scarcity in the Incomati.
- You have heard via informal channels that the Ministry of Foreign Affairs is trying to hijack the function of delegation leader. Your minister is happy with the excellent support Foreign Affairs is rendering to international water negotiations, but you have convinced him that this type of negotiations should remain under the leadership of those who really understand what is going on in the sector: the engineers. You are worried that your minister will not make this issue an item for discussion in the council of ministers. On the other hand you are confident that you, with your impressive track record as a delegation leader and often as chairperson in water negotiations, will not seriously be challenged by Foreign Affairs.

Individual brief South Africa

1.3 Official Ministry of Environment

- *Main objective:* to launch the very new concept of “Environmental flow requirements” in the Incomati basin
- You are under immense pressure of conservationists and environmental groups to mitigate the effects of large water abstractions in the most heavily committed rivers (lower Komati, Crocodile and Sabie).
- You are also under pressure from colleagues in the Ministry of Parks to ensure that the rivers flowing through the Kruger National Park are not drying up each year because of upstream abstractions. You have just heard of the initiative of the Peace park concept, which would combine among others the Kruger park with the adjacent area in Gaza province, Mozambique
- *Personally:* You have the ambition to be seen to be “modern” in the eyes of the environmental community, and see the issue of environmental flow requirements as an opportunity to develop a "green" political profile. You are proud that South Africa is a world leader in this new emerging field of environmental flow requirements.
- You see these negotiations as a excellent opportunity to further the objectives of your ministry in conjunction with the demands from the environmental community in your country. You want to move the environmental agenda forward since a lot of time has been lost as a result of political tension in the sub region. You are keen on making forceful statements on the needs for introduction of the new concept of “Environmental flow requirements” during the meeting with colleagues in preparation of the national position paper. You were very disappointed that your colleagues in the country delegation were skeptical about your concept note that you circulated earlier in preparation of the upcoming Incomati negotiations. You have experienced resistance before and you are not the person to give up resign easily.

Individual brief South Africa

1.4 Official Ministry of Finance

- *Main objectives:* to ensure that money is invested in sectors which have a good rate of return; especially in terms of export value; and to increase the economic role of South African business interests in the region; but your budget is extremely limited because of the many challenges that the new south Africa will face.
- You see investing in dams as potentially sound long-term investments
- You may make available at least some US\$ 200 million; of which 50 Million may be made available for co-financing Swaziland's Maguga dam (provided South African farmers get access to part of its water); and US\$ 100 million for Driekoppies dam.
- You are under pressure by sugar lobby to provide that sector with more (and specifically: more secure) water, which will enhance sugar production and sugar export.
- *Personally:* You are a Harvard graduate, and believe in the international monetary institutions, such as IMF and World Bank. You have close ties with senior officials of the International Finance Corporation.
- Within your country delegation, you plan to point out in detail what strategic options you see and how South Africa's economic role could be promoted during the negotiations. Though your colleagues always value your good judgements you fear that it will be difficult to convince some members in the delegation who may not entirely share your objectives.

Individual brief South Africa

1.5 Official Ministry of Agriculture

- *Main objective:* to increase the economic role of South African agricultural business interests both within South Africa and in the region
- You see the impending de-privatisation of previously nationalised industries in southern Mozambique, such as the sugar mills at Xinavane and Maragra, as an interesting opportunity of the South African sugar industry to get a foothold in Mozambique, and access to scarce water for irrigated sugarcane;
- *Personally:* You are a real net worker. You have close ties with some large-scale farmers in the basin, as well as with the sugar industry. You also have close ties with the minister of finance from Swaziland.
- You plan to operate carefully during the preparation meeting of your delegation. Your preference is to move diplomatically with respect for all the positions on the table. In your experience good cooperation leads to good results. Friction should be avoided.

Country brief Swaziland, 1990

Sugarcane production is the mainstay of Swaziland's economy, the leading foreign currency earner and largest private sector employer. It is in the interest of Swaziland to further increase and sustain its sugar industry. Whereas the major sugarcane producing areas are in the South (on the Great Usutu river), sugar cane production in the north is also important, where two major sugar mills are situated. The planned Komati Downstream Development Project envisages to develop 6,000 ha new irrigated sugarcane, which will benefit smallholder producers. This project will give the King and the ruling party important political mileage. The project will also require the expansion of the existing Mhlume Sugar Mill in order to accommodate sugarcane produced by the new farms. For this development project, water is the limiting factor, a second limiting factor being capital.

For these developments to go ahead, the Komati Basin Development Plan is key, as it will increase water availability in Swaziland. This joint plan with South Africa, took 10 years of negotiations!

The main stake of Swaziland in negotiating the Incomati river basin is as follows:

To implement the Komati Basin Development Plan, and the related Komati Downstream Development Project. This implies the construction of Maguga dam, so as to ensure that c. 73 Mm³/a of additional water is made available.

As Swaziland does not have the required funds (US\$ 80 million); two external sources of finance are possible:

- **funds from south Africa; which will lead to co-ownership of South Africa of Maguga dam, as well as a share of the yield of this dam for South Africa**
- **a soft loan from the International Finance Corporation IFC; but IFC has made it a condition to have an agreement of Mozambique of the construction of Maguga Dam**

Individual brief Swaziland

2.1 Official Ministry of Foreign Affairs;

- *Main objective:* to respect as much as possible all existing formal and informal agreements.
- Swaziland's regional policy is to slowly liberate itself from the firm grip of South Africa (Swazi economy is very dependent on South Africa).
- You have been very active in all kinds of SADC meetings, and are a fervent supporter of further regional integration.
- *Personally:* You have more sympathy for Mozambique than for South Africa; you actually feel that the South Africans treat the Swazi's as small guys, which you dislike. You are happy that Nelson Mandela has finally been freed, and you fully agree with your country's policy to strengthen ties with other countries in the region, so as to loosen the economic and political grip of South Africa on your country.
- There is a dispute with the Ministry of Water on the leadership of the delegation. Traditionally the Water Ministry has been in charge of these negotiations, but your minister is taking the view that the broad scope of the agenda warrants a stronger role for Foreign Affairs. Many national interests are at stake. You are instructed to claim that position. You see as your personal strength that you have proven your effectiveness as a chairperson of a number of complex negotiations in the environmental field. You know how to promote decision making even under difficult circumstances. You know that your admirers sometime find you manipulative.

Individual brief Swaziland

2.2 Official Ministry of Water

- *Main objective:* build the Maguga dam to full size (332 Mm³) with an estimated yield of 182 Mm³/a.
- You have been negotiating the Komati Basin Development Plan with your South African colleagues for ten years now. You finally want to see the Plan being implemented.
- You are under pressure from the Ministry of Agriculture to provide more irrigation water to small-scale producers in the Komati.
- You respect earlier agreement reached with South Africa concerning the Komati, meaning that Swaziland has to guarantee flows to downstream South Africa in the Lower Komati. This will guarantee that South Africa will hold its part of the deal, namely to ensure inflows into Swaziland from the Upper Lomati.
- You are not prepared to release additional water to Mozambique from the Komati; you are of the opinion that South Africa should take responsibility for this, since it has over-developed the Lower Komati and Crocodile rivers.
- You want to honour the old Umbeluzi agreement with Mozambique; this means that sufficient Umbeluzi water is left in the river for Mozambique. This however, requires that sufficient water from the Sand River Dam on the Komati continues to be pumped into the Umbeluzi river for irrigation.
- *Personally:* You know your South African and Mozambican counterparts of water personally; but you distrust some of the data that your South African counterpart presents to the JPTC meetings. You are frustrated that you cannot check these figures and data, since your department of water currently lacks sufficient capacity in water resources modelling.
- You have heard via informal channels that the Ministry of Foreign Affairs is trying to hijack the function of delegation leader. Your minister is happy with the excellent support Foreign Affairs is rendering to international water negotiations, but you have always convinced him that this type of negotiations should remain under the leadership of those who really understand what is going on in the sector: the engineers. You are worried that your minister is not inclined to make the issue an item for discussion in the council of ministers. On the other hand you are confident that you, with your impressive track record as a delegation leader and often as chair person in water negotiations, will not seriously be challenged by Foreign Affairs.

Individual brief Swaziland

2.3 Official Ministry of Agriculture

- *Main objective:* to ensure that the Komati Downstream Development Project is implemented without delay.
- You are under immense pressure from the King to provide irrigation water to small-scale producers in the Komati; 6,000 ha new irrigated sugarcane to be established, requiring at least 70 Mm³/a of additional water from the planned Maguga dam.
- At the same time, you need to ensure that current abstractions from the Sand River Dam on the Komati to the Umbeluzi basin (some 128 Mm³/a) is maintained, in order to ensure uninterrupted sugarcane production in that area; and not unduly increase the pressure on the Umbeluzi's water resources.
- You are excited about the plans of your government to expand the irrigated area along the Lower Usutu, part of the **Maputo Basin**, which Swaziland shares with South Africa and Mozambique. This also has to be dealt with by the TPTC.
- *Personally:* You are an accomplished academic with an agronomy background; you have a keen interest in the new emerging field of water demand management. You are currently supporting a small research programme that seeks to increase water use efficiency in irrigated sugarcane from 65% to 85%. You now wish to apply this on a wider scale: To convert to more efficient technology, you need US\$ 2,000 per ha for investments. This would allow an increase in sugarcane area with the amount of water thus saved.
- You see these negotiations as an excellent opportunity to further the plans of your government for the expansion of irrigation schemes. You want to move this agenda forward since a lot of time has been lost as a result of political tension in the sub region. You are keen to promote the application of the new technology by securing financial support through the preparation meeting of the coming negotiations. You found it hard to understand that the other members of your delegation were sceptical about your concept note that you circulated as a written contribution to the preparation of your country's delegation for the upcoming Incomati negotiations. You are not the person to give up easily and it is your firm intention to get it included in the position paper.

Individual brief Swaziland

2.4 Official Ministry of Finance

- *Main objective:* to ensure that Maguga dam is constructed, but you have no money to invest. The dam will cost approximately US\$ 80 Million; of which the International Finance Corporation may finance US\$ 50 million as a soft loan; subject to an agreement of Mozambique. You therefore have a gap of US\$ 30 million, and you are desperately seeking additional funding options.
- You see it as your task to ensure that the country's scarce capital resources are used to the best, and contribute directly to economic development of your country.
- *Personally:* You have close ties with the South African sugar industry, as well as with the South African official of the Ministry of Finance.
- You are the one of Swaziland's most distinguished financial specialists and you see additional dam construction as the only serious option to further the economic interests of your country. You cannot appreciate the views of those in your country who are pushing environmental questions to the detriment – in your view- of financial priorities. You are determined to help to achieve your country's goal.

Individual brief Swaziland

2.5 Official Ministry of Environment

- *Main objective:* sustainable water use, without damaging the environment.
- You are immense pressure of conservationists and environmental groups to mitigate the effects of large water abstractions in the Komati river.
- *Personally:* You are torn between your country's need for economic development (i.e. further sugar cane development) and the needs of the environment. You think that tourism in Swaziland has potential, and will benefit from more sustainable and environmentally friendly production processes. Currently the sugarcane industry is not environmentally friendly (return flows from the sugar refineries damage the quality of the rivers; and over-utilisation of water for irrigation leaves rivers dry). You have sympathy for the ideas of "Water Demand Management" of your colleague in the Ministry of Agriculture; but you doubt whether that is then panacea of environmental problems in Swaziland.
- At the same time, you have some reservations about the new concepts of environmental flow requirements, which have been embraced by your South African and Mozambican colleagues (of the ministries of the environment in those countries). You are aware that Swaziland's water resources are limited; and that Swaziland may not be able to afford to institute environmental flow requirements.
- You are relatively young, and ambitious. You are new on the Swaziland delegation; and you want to establish your own niche in this delegation. You will try to establish coalitions with some of the other Swazi delegates.

Country brief Mozambique, 1990

Economically Mozambique is nearly bankrupt, but a peace deal with Renamo is within sight. So there is for the first time since c. 1982 a real possibility of peace in Mozambique. With the prospect of a settlement with Renamo, there is the perspective for economic reconstruction: this will, among others, imply: reviving the various irrigation schemes, and especially the sugar industry at Xinavane and Marracuene (Maragra), and rice cultivation near Macia. As well as the tourism industry at the mouth of the estuary of the Incomati. Furthermore, it will require rehabilitating the ailing water supply of the city of Maputo, whose water needs (which are met from Pequenos Libombos dam on the Umbeluzi river) are therefore expected to increase rapidly, and may, in some time in future, require additional water from the Incomati.

All these projects that may become possible once a peace settlement has been reached with Renamo, and once South Africa attains democratic rule, will require massive capital investments. A liberated South Africa may provide some of the capital required. So it is in the interest of Mozambique to keep friendly political relations with its neighbouring countries despite the recent history of destabilisation by South Africa.

The main stake of Mozambique in negotiating the Incomati river basin is as follows:

Ensure that more water from the Incomati flows undisturbed into Mozambique; especially at Ressano Garcia (Incomati), and from the Sabie (just upstream of Corumana). Protect your interests and projected future needs to the maximum.

Individual brief Mozambique

3.1 Official Ministry of Foreign Affairs

- *Main objective:* ensure that South Africa honours its obligations towards Mozambique (see earlier agreements)
- You want to build closer ties with Swaziland (who may become an ally against South Africa);
- Despite the above, you also try not to deteriorate the political relations with South Africa; keep an opening in case the country will attain majority rule with a new government which may be sympathetic to Mozambique.
- You are, just as your Swaziland colleague, a fervent supporter of SADC, and have attended several high level SADC meetings. You firmly believe that South Africa will shortly attain majority rule and will become a member of SADC.
- *Personally:* You are a realist and a regionalist; you know that Mozambique cannot achieve its ambitions of national reconstruction without strong political and economic ties with its neighbours.
- There is a dispute with the Ministry of Water on the leadership of the delegation. Traditionally the Water Ministry has been in charge of these negotiations, but your minister is taking the view that the broad scope of the agenda warrants a stronger role for Foreign Affairs. Many national interests are at stake. You are instructed to claim that position. You see as your personal strength that you have proven your effectiveness as a chairperson of a number of complex negotiations in the environmental field. You know how to promote decision making even under difficult circumstances. You know that your admirers sometime find you a bit manipulative.

Individual brief Mozambique

3.2 Official Ministry of Water

- *Main objective:* Get South Africa and Swaziland to agree to maintain a minimum flow at Ressano Garcia of 4 m³/s (i.e. the 2/3 of minimum flow during the 1960s); and South Africa to stop further new abstractions from the Sabie, which jeopardises inflows into Corumana
- You know that South Africa has various options to ensure a minimum flow at Ressano Garcia: decrease interbasin transfer out of Komati, decrease exotic tree plantations (said to be huge); the problem is that you do not have reliable information about all water uses in South Africa; and you distrust the few data given to you by the South Africans.
- Alternatively: you may consider South Africa to co-finance the proposed Moamba Mayor dam in the Incomati (this dam will be able to guarantee a minimum dry season flow by capturing wet season flows; with a capacity 700 Mm³ it has an estimated yield of 100 Mm³/a)
- You emphasise the importance of data sharing, especially about actual abstractions of irrigation, and of the extent of exotic tree plantations. You want to propose an integrated study of the Incomati basin, which would capture all available information, on the basis of which informed decisions can be taken about further developments (beyond the construction of Maguga and Driekoppies dams)
- *Personally:* You know your South African and Mozambican counterparts of water personally; whom you respect as professionals. However, you find it difficult to accept that South Africa did not honour certain earlier agreements, and you distrust some of the data that your South African counterpart have presented to the JPTC meetings. You are frustrated that you cannot check these figures and data, since your department of water currently lacks sufficient capacity in water resources modelling.
- You have heard via informal channels that the Ministry of Foreign Affairs is trying to hijack the function of delegation leader. Your Minister of Water is happy with the excellent support Foreign Affairs is rendering to international water negotiations, but you have convinced him that this type of negotiations should remain under the leadership of those who really understand what is going on in the sector: the engineers. You are worried that your minister is not inclined to make the issue an item for discussion in the council of ministers. On the other hand you are confident that you, with your impressive track record as a delegation leader and often as chair person in water negotiations, will not seriously be challenged by Foreign Affairs.

Individual brief Mozambique

3.3 Official Ministry of Environment

- *Main objective:* To use the argument of environmental flows to increase the dry season flows into Mozambique
- You are very concerned about the amounts of water that Swaziland and especially South Africa are pumping out of the Incomati basin. You know that South Africa uses that water of cooling thermal power plants, whereas other power plants in South Africa have been "mothballed" because it has surplus energy generating capacity (and gets electricity very cheap from Cabora Bassa, which is owned by Portugal, and located on the Mozambican part of the Zambezi river).\
- You are very concerned about the state of the Incomati estuary, and the increase of salt-intrusion in the mouth due to decreased fresh water inflows. As a result, shrimp fisheries have also been negatively affected. Small-scale *machongo* farmers in the bottom valleys of the Incomati river, who used to be highly productive, are affected too.
- You therefore see environmental flows as a new way through which to increase Mozambique's claim on the Incomati water resources.
- You don't believe in the new proposed Peace Park concept; you see it as an expansion of Kruger park encroaching on Mozambican territory. You do not like the idea of south African capital to invest in southern Mozambique; which you see as a form of re-colonisation.
- *Personally:* You have just followed a state-of-the-art training course on environmental flow requirements, and you are very well versed with the various methods to quantify those. Your private ambition is to obtain a PhD degree in this subject.
- During earlier informal discussions with members of your delegation you heard negative comments on your ideas about environmental flows. You feel that the professional level of some of them is below standard and you plan to explain your ideas in detail when preparing for the negotiations. You would be very surprised if it would not be a substantive part of the position paper.

Individual brief Mozambique

3.4 Official Ministry of Finance

- *Main objective:* to maximise the effect of economic reconstruction with the minimum amount of cash investments, since the treasury is nearly empty. You only have US\$ 50 Million at your disposal.
- You are representing the finance ministry of the poorest country in the world! But your minister have recently opened promising talks with the International Finance Corporation
- Your minister is preparing plans to re-privatise many of the industries that were nationalised during the 1970s and 1980s, including the sugar industry.
- There are also plans to construct a massive steel industry (Maputo Iron and Steel Project MISP) in the Incomati basin requiring much water (10 Mm³/a).
- You are aware that more water will be required: the Moamba Mayor dam in the Incomati has been proposed as a solution by your colleague from the Min. of Water, but will cost a massive US\$ 150 Million.
- *Personally:* You secretly admire the economic and technological might of South Africa. During earlier informal discussions with members of your delegation you heard negative comments on your ideas about regional integration and stimulating foreign (read: South African) investment. You feel that the professional level of some of them is below standard and you plan to explain your ideas in detail when preparing for the negotiations.

Individual brief Mozambique

3.5 Official Ministry of Commerce

- You support the proposed Maputo corridor (linking it to the Gauteng area in South Africa) which will help to revive the ailing Maputo harbour; and will attract new investments. But capital costs are very high: US\$ 100 million for works inside Mozambique.
- You take a special interest in these negotiations as you see them as a possibility to persuade South Africa to come in with financial support in compensation for whatever they may require from the Mozambican side.
- You have a special concern with safeguarding the interests of Maputo, and a regional commercial and industrial centre. You know that the envisaged developments in the near future will require much more water; and the most probable source of water will be the Incomati.
- You do not agree with your counterpart in the ministry of Finance, who wants to privatise the sugar industry in Mozambique; and sell it to South African companies. You would prefer that these companies would remain in the hands of Mozambicans. At the same time, you have an interest in boosting the sugar industry, so as to increase sugar exports to pre-war levels and increase hard currency income.
- *Personally:* Your boss, the Commerce Minister, has high expectations as you are seen as one of his most dynamic collaborators with the drive to realize even the most ambitious objectives. You do not shy away to bulldoze people if it is for the good cause. You are not entirely sure about the position of the representative of the Ministry of Finance.

Instruction from the President to the Mozambican delegation on instigation of the Mayor of Maputo

Background

- The current water source for Maputo (Pequenos Libombos, on the Umbeluzi river) will prove insufficient within 5-10 years, after the water supply system has been rehabilitated and extended to the many informal settlements around town (which sprung up during the 1980s when the countryside became unsafe). It is estimated that some 500,000 people have no access to sufficient safe water and sanitation (which gave rise to the recent cholera epidemic). The International Finance Corporation has already committed sufficient funds to rehabilitate the water supply; so you know need to ensure that by 2000 you will have access to an additional 20 Mm³/a (i.e. in addition to the 36 Mm³/a from Pequenos Libombos)
- The municipality of Maputo wishes the Mozambican government to ensure that Swaziland honours the old Umbeluzi agreement, in order to ensure sufficient inflows into Pequenos Libombos
- *Personally:* The Mayor has the personal vision that Maputo should be restored to its old glory, of a regional trade and commerce centre in south-east Africa, with its distinct Mediterranean atmosphere. The mayor has tried to become member of the negotiating team but that was successfully blocked by the Minister of Water. The mayor does not think so highly of the professionalism your Mozambican delegates.

***Objective:* you are instructed to ensure that there is sufficient water supply for Maputo.**

Brief SADC Facilitation Team, 1990

The facilitation team is a team sent out by SADC and with an official SADC mandate.

The main interest of the facilitation team is to show to the world that SADC can solve any potential tensions and conflicts that may exist within its membership; so as to enhance the credibility of SADC as an effective regional organisation.

The direct spinoff of such enhanced SADC profile is an increase in the willingness of the international community, and international financial institutions, to invest in the region.

The specific objective of the SADC Facilitation Team is:

To facilitate the process of the negotiations on the Incomati, so that the negotiations are finalized in the form of an agreement or minimally a joint statement acceptable to all parties.

Individual brief Facilitator

4.1 SADC Facilitator (Lawyer)

- *Main objective:* to facilitate the process of the negotiations on the Incomati; to ensure that the negotiations are finalized in the form of an agreement or minimally a joint statement acceptable to all parties.
- *Secondary objective:* to facilitate the formulation of a press statement.
- You are a Namibian national
- You are a senior diplomat called in to assist with the negotiations on the Incomati. You are an expert on international law, and international water law in particular. You are on the ILC committee of the United Nations, currently drafting the UN Convention. At the same time you are currently heavily involved in drafting the first ever SADC Protocol; i.e. the SADC Protocol on shared watercourse systems. You will use your vast expertise on international water law to facilitate the negotiations.
- Although you know that South Africa is formally not yet a member of SADC, you have a gut feeling that it will soon become one. So you are not bothered by that.
- *Personally:* There has been some unpleasant discussion involving the head of the organisation (SADC) as to the question who would lead the mediation team. The head of SADC, however, declined to resolve the issue, encouraging both team members to sort this out between themselves during the preparation meeting.
- You see yourself as the senior person on the facilitation team.
- You have an excellent reputation as mediator
- You need to work closely together with the other facilitator as a team; otherwise the tense and delicate negotiations may fail, and your reputation will be damaged.
- You are a seasoned diplomat; you do not let your personal feelings influence the course of events.

Individual brief Facilitators

4.2 SADC Facilitator (Hydrologist)

- *Main objective:* to facilitate the process of the negotiations on the Incomati; to ensure that the negotiations are finalized in the form of an agreement or minimally a joint statement acceptable to all parties.
- *Secondary objective:* to facilitate the formulation of a press statement.
- You are a Tanzanian national
- You are a senior hydrologist with extensive diplomatic experience both within SADC and beyond.
- You are currently heavily involved in drafting the first ever SADC Protocol; i.e. the SADC Protocol on shared watercourse systems. You will use your vast expertise on the hydrology of international waters, and water allocation and sharing arrangements to facilitate the negotiations.
- *Personally:* You are a senior diplomat seconded to the SADC water sector since its inception. You have earned a lot of respect in helping to build the SADC water sector. You have been able to achieve this by showing perseverance and to keep everybody on track. It was a great disappointment to you that you have not been approached for the position of leader of the facilitation team on the Incomati negotiations, and you will try to persuade your colleague to hand over that job to you. You have experienced resistance before and you are not the person to give up resign easily.
- You need to work closely together with the other facilitator as a team; otherwise the tense and delicate negotiations may fail, and your reputation will be damaged.

Individual brief Regional/Global Actors

5.1 Intervention by International observer (IFC- New York)

- *Main objective:* to invest in socially and environmentally sound projects with a nice rate of return, at concessionary terms.
- The International Finance Corporation is a United Nations Bank, with headquarters in New York, USA
- You have been invited by your SADC colleague, and you are eager to support him/her.
- In an earlier mission to Maputo you have already committed sufficient funds for the rehabilitation and expansion of Maputo water supply.
- You have a mandate to invest a maximum of US\$ 50 million for Swaziland (designated for Maguga dam)
- You also have a mandate to invest a further US\$ 100 million, *only for Mozambique*, in soft loans. This money is targeted for economic reconstruction of southern Mozambique; you may use it for various investment plans in your portfolio, including:
 - Moamba Mayor dam (total cost: US\$ 150 Million)
 - Support re-privatisation and rehabilitation of sugar industry at Xinavane (total cost: US\$ 20 Million)
 - Maputo corridor (total cost inside Mozambique: US\$ 100 million)

You also have some money delegated to you from the United Nation's GEF (Global Environmental Facility) to invest in cleaner production, in this case: conversion of irrigation technology for sugarcane in order to save water (as much as 30%). This money may be invested anywhere in the basin, to a maximum of US\$ 10 million.

Incomati Basin Negotiation Roleplay

The Incomati river basin; 2001

Background document II

Compiled by Pieter van der Zaag

5. Political and socio-economic developments since 1990

Nelson Mandela was released from prison in February 1990. In the same year the Mozambican government introduced a new constitution that provided for multi-party democracy, and started negotiations with Renamo. This resulted in the Peace Accord signed in October 1992. A UN peacekeeping force arrived in the country in 1993, and after some delays multi-party elections were held in November 1994. This development, together with the attainment of majority rule in South Africa after the elections in April 1994, put the lid on more than a decade of regional violence and heralded a new era of peace and regional cooperation.

Since 1995 new initiatives and developments in the Incomati basin indicate that political, commercial and cultural ties across national border are intensifying. The most obvious political development was that South Africa was accepted into the fold of the Southern African Development Community (SADC) in 1995. South Africa hosted the SADC summit in August that year, and three months later also the SADC conference of water ministers.

Because of the new peace, investment of private South African capital in Swaziland and Mozambique rose dramatically. An example is the so-called 'Maputo corridor', which involved the construction of a new highway (toll) between Maputo and the border at Ressano Garcia, improving communications between Gauteng and Maputo. Another massive multinational investment was the construction of an aluminium smelter in the estuary of Maputo Bay, which involved many players, including South African mining interests and cheap energy from Cahora Bassa, supplied through Eskom.

South African sugar business took advantage of the new liberal policies of Mozambique, Tongaat-Hulett and Illovo obtaining equity in the two Mozambican sugar estates in the Incomati, Xinavane and Maragra respectively. As a result, the three sugar companies that dominate the South African market now all have interests in the Incomati water resources, the two largest ones in the Mozambican part of the basin. In 1997 the smallest of these three companies, TSB, which operates in South Africa, commissioned a second mill at Komatipoort. Indicative of the new South African political dispensation, TSB boasts that a significant amount of sugar deliveries (40%) comes from small-scale producers.

The commitment to advance the plight of small-scale farmers runs through the recent policies of all three countries. Swaziland developed the Komati Downstream

WaterNet / CCR / ISRI / Catalic / UNESCO-IHE Delft / UZ for UNESCO

Development Project, which will irrigate 6,000 ha of sugarcane for smallholders from the new Maguga Nkomati Basin dam, a joint venture with South Africa (Mwendera et al., 2002). In the lower Komati and Lomati rivers in South Africa, the Nkomazi Irrigation Expansion Programme involves the development of 6,500 ha of irrigated sugarcane for emergent black farmers, drawing water from the Maguga dam in Swaziland and Driekoppies dam in South Africa (Waalewijn, 2002). In Mozambique the efforts are focused on rehabilitating existing irrigation infrastructure.

An icon of the new era of regional integration is the "peace park" concept, which involves the merging of three National Parks in three countries located in the Incomati and Limpopo river basins, namely Gaza (in Mozambique), Kruger (in South Africa) and Ghonarezhou (in Zimbabwe). The idea was mooted by Mr Anton Rupert, the founder and chairman of the South African chapter of the World Wildlife Fund for Nature, who presented his initiative to the Mozambican president Chissano as early as 1991, just after Nelson Mandela was released and Mozambique had adopted its new constitution. Mr Rupert was well acquainted with the area, as he owned a private park adjacent to Kruger, as well as the TSB sugar company. By 2002, the Great Limpopo Transfrontier Park is a fact, the first elephants having been moved across borders.

In sum, the contrast between the 1980s and the 1990s could hardly have been starker. Developments during the 1990s were characterised by cooperation and economic integration, and a new thrust of economic development. This rosy picture was temporarily disturbed by the floods of February 2000 that devastated southern Mozambique (Box 5.1). The floods triggered immediate assistance by South Africa and a watershed of relief support by the international community, and emphasised once more the need for further regional cooperation.

Box 5.1: The floods of February 2000 (Brito, 2002)

Heavy rains, which started in early February 2000, flooded parts of Mozambique's southern provinces. The Save, Limpopo, Incomati and Umbeluzi rivers, which have their head-waters in Zimbabwe, Botswana, South Africa and Swaziland, reached their highest-ever recorded levels in early March, and many riparian communities were submerged for weeks. 699 people died, 95 disappeared, and one million people required some form of emergency assistance.

Large sections of the major road connecting Maputo to the north were demolished. Bridges along the Limpopo flood plain and the railroad were damaged. About 20,000 cattle drowned and 140,000 hectares of crops were destroyed, with the largest irrigation scheme in the country (25,000 ha, along the Limpopo) seriously damaged. Health centres as well as water supply and sanitation infrastructure in many towns and villages suffered extensive damage, exposing one million people to water-borne diseases such as cholera, malaria and diarrhoea. The destruction caused by the floods is estimated at US\$ 600 million. Mozambique's economic growth went down from 10% in 1999 to 2% in 2000.

Dam development

During 1991-1997 no major new dam was commissioned on the Incomati basin. In the mean time, and with the emerging peace and stability in the region, water use increased sharply. As an example, in the lower Komati and Lomati rivers (in South Africa) alone, 5,300 ha of new irrigated sugarcane was established between 1993-2001 under the Nkomazi Irrigation Expansion Programme. A new sugar mill was constructed in Komatipoort in 1997 (Waalewijn, 2002).

In 1998 South Africa completed Driekoppies Dam (251 Mm³) on the Lomati river, which was one of the two dams being constructed under the bilateral agreement between Swaziland and South Africa. During 2001 and 2002, two other major dams were commissioned in the basin: Injaka (120 Mm³) on the Sabie river in South Africa, and Maguga (332 Mm³) on the Komati river in Swaziland. This brought the total storage capacity in the basin to 2,060 Mm³ (Table 5.1; Figure 5.1).

Table 5.1: Major dams (> 10 Mm³) in the Incomati; 2002

Tributary	Country	Major dam	Year commissioned	Storage capacity (Mm ³)
Komati	South Africa	Nooitgedacht dam	1962	81
Komati	South Africa	Vygeboom dam	1971	84
Komati	Swaziland	Maguga Nkomati Basin dam	2002	332
Komati	Swaziland	Sand River dam	1966	49
Lomati	South Africa	Driekoppies dam	1998	251
Crocodile	South Africa	Kwena	1984	155
Crocodile	South Africa	Witklip dam	1979	12
Crocodile	South Africa	Klipkopje dam	1979	12
Sabie	South Africa	Da Gama dam	1979	14
Sabie	South Africa	Injaka dam	2001	120
Sabie	Mozambique	Corumana dam	1988	879

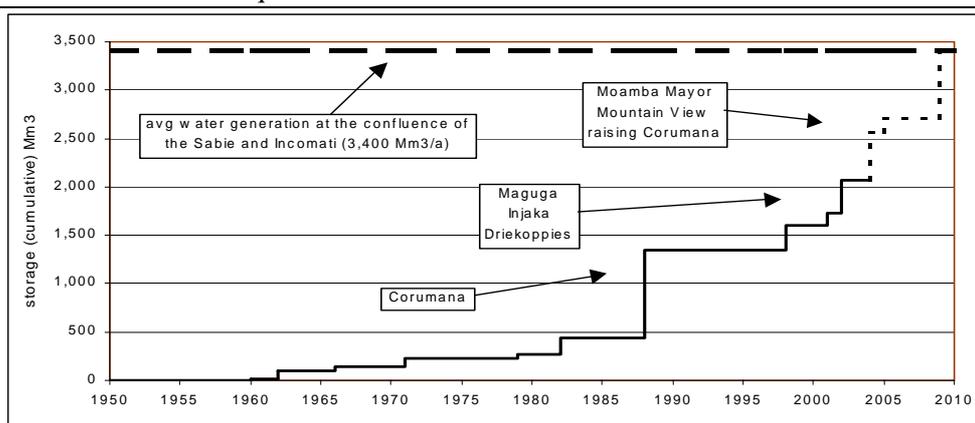


Figure 5.1: Development of storage capacity in the Incomati basin (1950-2010)

Consumptive water uses in the basin

By the year 2002, consumptive use of surface water amounted to 51% of the average amount of surface water generated in the basin, which is considered relatively high (Table 5.2).

Table 5.2: Estimated consumptive water use (Mm³/a) in 2002 in the Incomati basin, excluding evaporation losses from dams (source: estimated from JIBS (2001); table 2.19; TIA (2002), Annex I, and own estimates)

Country	Water generated	Domestic & municipal	Industry	Livestock & game	Exotic tree plantations	Irrigation	Inter-basin transfer	Total	% of water use generated	% of water generated
South Africa	2,937	90	35	8	473	670	132	1,408	78	48
Swaziland	479	6	1	2	46	48	135	238	13	50
Mozambique	171	3	11	1	2	150	0.0	167	9	97
Total	3,587	99	47	11	521	868	267	1,813	100	51
%		5	3	1	29	48	15	100		

Exotic tree plantations (afforestation)

The area under commercial forest plantations increased by 25% from to 340,000 to 405,000 ha (Table 5.3). JIBS II (2001) estimated that the total afforestation areas in South Africa and Swaziland (estimated to be nearly 400,000 ha by 2002) cause a flow reduction of about 518 Mm³/a, i.e. equivalent to 130 mm/a.

Table 5.3: Exotic tree plantations in the Incomati basin (ha) (source: JIBS II, 2001)

Country	Established in 1991	Estimated in 2002
Mozambique	2,400	5,000
South Africa	310,000	367,300
Swaziland	29,400	32,400
Total	341,800	404,700

Irrigation

Irrigated agriculture is the largest user of surface and groundwater in the Incomati. The area being irrigated in 2002 is estimated at 102,000 ha, consuming 870 Mm³/a of water (Table 5.4). In addition, all three countries are planning to further expand the irrigated area with another 74,800 ha, which would require an additional 780 Mm³/a of water. JIBS II (2001) has calculated that such amounts of water are simply not available.

Table 5.4: Irrigated area in the basin (ha)

Country	Irrigated area (2002)	New planned
Swaziland	4,700 *	7,400
Mozambique	14,300	52,300
South Africa	83,000	15,100
Total	102,000	74,800

* Excluding 10,800 ha outside the basin

Table 5.5: Irrigated crops in the Incomati basin (ha), 2002 estimate

	Mozambique	South Africa	Swaziland*	total
Perennial crops				
Orchards	500	19,700	1,200	21,400
Bananas	500	7,100	0	7,600
Sugar cane	10,000	30,100	2,900	43,000
Pasture	0	2,800	0	2,800
subtotal	11,000	59,700	4,100	74,800
Summer crops				
Summer grain	1,900	11,200	400	13,500
Summer vegetables	1,000	2,900	200	4,100
Tobacco	0	8,800	0	8,800
Rice	400	0	0	400
subtotal	3,300	22,900	600	26,800
Winter crops				
Winter grain	1,000	2,600	0	3,600
Winter vegetables	1,500	9,500	200	11,200
subtotal	2,500	12,100	200	14,800
Total annual irrigated	16,800	94,700	4,900	116,400
Irrigated area	14,300	83,000	4,700	102,000
Irrigation intensity	117 %	114 %	104 %	114 %

* The figures for Swaziland exclude 10,800 ha sugarcane in the neighbouring Umbeluzi basin that are irrigated with water from the Incomati.

The area planted with sugar cane increased over the period 1990-2000 by 37% from 31,400 to 43,000 ha (42% of the entire irrigated area in the basin; Table 5.5). TSB constructed a new sugar mill at Komatipoort in 1997, with a capacity to produce 240,000 tons of sugar per year. The two biggest sugar companies of South Africa took over the two sugar mills and estates in Mozambique. Both companies have large sugar estates in the Kwazulu Natal, which are rainfed. Tongaat-Hulett is ultimately owned by Anglo American, which, among others, also owns Hippo Valley and Triangle sugar estates in Zimbabwe. Illovo is the largest sugar company in South Africa (Table 5.6). Sugarcane production in the basin currently captures as much as 67% of all water used for irrigation, provides employment to a large labour force (some 30,000 directly employed), and generates between US\$ 70-100 million per year. Sugarcane processing in the Incomati basin is in the hands of few players.

Table 5.6: Sugar mills in the Incomati basin *

Mill	Country	Capacity (ton/a)	Company	Owner	Market share in RSA	Mills elsewhere
Komati	South Africa	240,000	TSB	Rembrandt	17%	
Malelane	South Africa	200,000	TSB			
Xinavane	Mozambique	50,000	Tonga-Hulett	Anglo American	34%	Zimbabwe
Maragra	Mozambique	100,000	Illovo	Illovo	49%	Swaziland

* Mhlume and Simunye mills in Swaziland, located in the Umbeluzi basin, have been omitted.

Water transfers

The two bulk water transfers remained unchanged. In the near future, another water transfer is expected to occur in the Incomati River, near the town of Moamba or at the confluence with the Sabie River, for the urban water supply of Maputo. Some 90 Mm³/a will be required for this purpose.

6. Water-related cooperation since 1990

6.1 The situation in the 1990s: Peace, protocols and bilateral projects

Swaziland and South Africa, wanting to establish the Komati Basin Water Authority and construct Driekoppies and Maguga dams, respected Mozambique's wish to come to a water sharing arrangement with Mozambique. This was agreed on 15 February 1991 by the three ministers of water, as follows:

- (a) to conduct a Joint Incomati Basin Study (JIBS);
- (b) to approve the first phase of the Komati Development plan (i.e. construct Driekoppies and Maguga dams);
- (c) pending the outcome of JIBS:
 - that the base flow at Ressano Garcia should be maintained at no less than 2 m³/s;
 - that concerning the Sabie, South Africa would consult the TPTC prior to construct any water work larger than 250,000 m³, or any water abstraction larger than 110 l/s.

During 1991-1997 no major new dam was commissioned on the Incomati basin, but water use continued to increase. This, combined with the great drought of 1992 resulted in the Incomati drying up again at the border, violating the agreed minimum flow at Ressano Garcia of 2 m³/s. Mozambique complained, but South Africa argued that it was caused by the extreme drought. In the mean time, South Africa did not prevent sugarcane farmers to build a weir immediately upstream of the border at Komatipoort, further affecting river flow.¹

Two major political developments with a positive impact on the Incomati basin were that South Africa attained majority rule in 1994, and that Mozambique for the first time held multi-party elections. Both developments consolidated the new era of peace and stability that emerged around 1991.

After the important Pigg's Peak meeting of February 1991, the TPTC met six more times during the period 1991-1997. The most important issue on the agenda during these meetings was progress on the Joint Incomati Basin Study (JIBS), which commenced in 1992. During these meetings, South Africa also regularly informed Mozambique about developments concerning the Injaka dam. The 14th TPTC meeting held in July 1995 also had the Umbeluzi basin on the agenda. The Maputo basin only started featuring during the 17th TPTC meeting held in May 1998. In 1995, the Joint Incomati Basin Study was completed in curtailed form, due to difficulties with gathering relevant data in Mozambique, and the apparent reluctance of Mozambique to actively cooperate.

¹ These same farmers would also fight a battle upstream. Eskom diverts large amounts of water out of the basin from Vygeboom dam (located in the Komati river upstream of Swaziland) to the Vaal river system. This water is used for cooling a thermal power plant (Waalewijn, 2002).

The Komati Basin Water Authority KOBWA (1992)

During 1992-1997 arguably the most important development on the Incomati basin was the establishment of KOBWA between Swaziland and South Africa. On 13 March 1992, South Africa and Swaziland signed the "Treaty on the Establishment and Functioning of the Joint Water Commission" as well as the "Treaty on the Development and Utilisation of the Water Resources of the Komati River Basin".

The first treaty established the JWC, replacing the JPTC, which would "act as technical adviser to the Parties on all matters relating to the development and utilisation of water resources of common interest to the Parties".

With the second treaty both countries committed themselves to building two new dams, the Maguga in the Swaziland part of the Komati river, and the Driekoppies in the South African part of the Lomati river; agreed about cost sharing (South Africa would fund Driekoppies dam, as well as 60% of the cost of Maguga); agreed about a water sharing arrangement in the Komati/Lomati (32.5% for Swaziland, 67.5% for South Africa); and agreed to establish the Komati Basin Water Authority (KOBWA), which would be the operational agency operating the dams on the Komati/Lomati.

The second treaty did also explicitly "recognise the right of the Republic of Mozambique to a reasonable and equitable share in the use of the waters of the Inkomati River Basin of which the Komati River Basin is an integral part. The Parties agree to enter into negotiations with each other when such share is claimed by the Government of the Republic of Mozambique" (Article 3, section 5).

Developments on the Incomati, 1996-1998

In July 1996, South Africa and Mozambique agreed to establish a Joint Water Commission on rivers of mutual interest, in due consideration of the interests of the other riparians of these rivers (i.e. Swaziland on the Maputo and Incomati, and Botswana and Zimbabwe on the Limpopo). In the same year, South Africa announced that it would start with the construction of Injaka dam (120 Mm³) on the Sabie river. While South Africa maintained that it tabled it at the TPTC and that it could not wait any longer for an agreement because of domestic and environmental needs, the Mozambican authorities considered it a surprise and a violation of the Pigg's Peak agreement of 1991.

Also in 1997, Mozambique and Swaziland started to hold meetings concerning the establishment of a Joint Water Commission, along similar lines as the JWC between Swaziland and South Africa, and that between Mozambique and South Africa. The most important topic discussed during the two meetings held in 1998 was the intention of Swaziland to increase its irrigated area on the Usutu river (part of the Maputo basin) with 11,500 ha under the Lower Usuthu Smallholder Irrigation Project (LUSIP). In April 1999 both countries reached an agreement at the technical level on LUSIP, and in July 1999 the JWC was formally established.

South Africa adopted in 1998 a new water act (the National Water Act), which explicitly stipulates that it will recognise regional and international agreements and obligations. As a result of the Act, a catchment management agency is currently being established in the Komati river, downstream of Swaziland. Similar agencies are likely to be established in other parts of the basin, such as in the Crocodile and Sabie rivers. Likewise, Mozambique had earlier established Regional Water Authorities (ARAs). ARA Sul is in charge of managing the water resources of, among others, the Incomati within Mozambican territory.

In 1998 South Africa completed Driekoppies Dam (251 Mm³) on the Lomati river, which was one of the two dams being constructed under the bilateral agreement between Swaziland and South Africa. The ceremony of the start of the construction of Maguga dam in Swaziland, the other KOBWA dam which would be completed in early 2002, was held around the same time.

In May 1997 the South African water minister committed his country to honour earlier agreements, to right wrongs of the past, and to do everything possible to ensure the agreed minimum flow in the Incomati at its border with Mozambique. This did not materialise in 1998. People in Mozambique have complained bitterly about the drying up of the Incomati, despite the 1991 agreement (see Box 6.1). In 1999 South Africa did manage to deliver the agreed flow at the border.

Box 6.1: News report No.147 by AIM, the Mozambique News Agency

Moamba, 16th November 1998

South Africa accused of keeping water

Residents of the district of Moamba, in the southern province of Maputo, are accusing the South African authorities of violating the agreement concerning the use of the water from the Incomati river, that flows through both countries, reports the daily paper "Noticias" on 3 November.

Moamba administrator Romao Mutisse stated that the South Africans take more than their share of Incomati water, which deprives the Mozambican side of water for irrigation and jeopardises the expected good harvest in the present agricultural season.

"If it rains, as the forecasts say it will, the 1999 harvest will be good", said Mutisse. "If it does not rain, but the South Africans release water as they should, we can still have a satisfactory harvest, mainly along the banks of the Incomati. But if it does not rain, and the South Africans continue violating their obligations concerning the use of international waters, then we will have serious problems in the Incomati valley".

Over the last few months farmers in Moamba have been complaining of shortages of water for irrigation, which they blame on the South African unilateral decision to retain the water on their side.

6.2 The situation since 1999: Towards a new agreement

The year 1999: a turning point?

Whereas by 1998 relations between Swaziland and South Africa were at their best, the relations between Mozambique and South Africa, as it concerned the Incomati, were not. Around 1999 a number of new initiatives were started, which would create the conditions for this relation to improve, and which would lead to the three riparian countries signing a new agreement on the Incomati and Maputo basins in 2002. These initiatives included the following:

- The TPTC established in 1998 the so-called Incomati System Operation Task Group (ISOTG), which would advise on how all major dams on the Incomati, including both KOBWA dams (Driekoppies and Maguga), should be operated in order to achieve equitable water distribution. The major development here was that the operation of both dams was made subservient to the interests of all three riparian countries (and not solely of Swaziland and South Africa).
- The commitment of Mozambique to proceed, in 1999, with the second phase of the Joint Incomati Basin Study (JIBS), with funding from Danida. The original study of 1995 would be complemented with data and information on the Mozambique part of the basin that were missing. Where necessary the earlier study would also be updated with new data.
- The initiative to conduct a Joint Maputo Basin Study. This effectively broadened the agenda of the TPTC, which had so far mainly focused on the Incomati. The study was aimed to provide information that would lead to a water sharing agreement between the three riparian countries on the Maputo. The importance to conduct this study increased when Swaziland indicated her intention to undertake a new smallholder irrigation project on the Usuthu river in Swaziland, known as LUSIP. The agencies willing to fund LUSIP demanded a water sharing agreement on the Maputo basin between the three countries. The Joint Maputo Basin Study started in 2000 and was completed in 2001.
- The TPTC subsequently decided that if a water sharing agreement on the Maputo basin was required, then it would be better to reach a similar agreement on the Incomati as well, and to incorporate both into one encompassing interim agreement for both river basins. The Inco-Maputo Task Group was established in May 1999 to prepare drafts for the TPTC, and met many times (20 meetings between May 1999 and February 2002).

The floods of February 2000

Nearly 800 people died, many more were dislocated and much infrastructure severely damaged during the floods of the Limpopo and Incomati in February 2000. South Africa assisted Mozambique with rescue operations. For many Mozambicans, this was probably the first time to view the South African military as "brothers", and created a tremendous measure of goodwill. Just as with previous floods, such as Demoina in 1984, this event once more emphasised the need for basin-wide coordination across

borders, and called for effective means of 'real-time' information exchange in order to mitigate as much as possible potential hazards of future floods.

The Joint Incomati Basin Study (JIBS), 2001

During 2001 and 2002, two major dams were commissioned in the basin: Injaka (120 Mm³) on the Sabie river in South Africa, and Maguga (332 Mm³) on the Komati river in Swaziland. This brought the total storage capacity in the basin to 2,060 Mm³. The official opening ceremony of Maguga dam on 5 April 2002 was conducted by His Majesty King Mswati III of Swaziland and South Africa's Deputy President Jacob Zuma. Significantly, Mozambique's Minister of Public Works and Housing, Hon. Roberto White, was present during the ceremony. The dam was renamed to Maguga Nkomati Basin Dam.

The second phase of the Joint Incomati Basin Study (JIBS) was finalised and submitted to the TPTC in April 2001. Although the study has not yet been formally approved by the TPTC, some conclusions of the study are worth mentioning:

- There is insufficient water in the Incomati to fulfil all the plans of the three riparian states. Mozambique's ambitious plans for irrigation development should be scaled down significantly and be limited to 36,000 ha over and above its current 22,000 ha.
- In order to cope with the high pressure on the water resources, Mozambique will have to increase storage capacity, first through raising the existing dam wall of Corumana (additional storage: 495 Mm³), and second by building the Moamba Major dam (700 Mm³). South Africa will have to construct Mountain View dam in the Sand river (245 Mm³). With these dams in place, storage capacity would be just above the average annual water generation in the basin at the confluence of the Sabie and the Incomati (see Figure 4.1); i.e. with an average residence time of 1 year.
- A sophisticated suite of computer models (Water Resources Yield Model and Water Resources Planning Model) was developed by consulting engineers BKS (Pty) Ltd (South Africa) and Acres International (Canada) for and in collaboration with the South African Department of Water Affairs and Forestry. The Water Resources Yield Model (WRYM) was used to analyse the water availability and water supply to the various water users in the basin. It allowed JIBS to measure the impact of various development scenarios. It appears that all three countries trust the model and the outcomes of the various development scenarios considered.
- JIBS emphasised the importance of experts from all three riparian countries having access to the WRYM computer model, as well as to new models that would assist with operational issues. For a considerable time, it remained unclear to Swaziland and Mozambique whether or not their experts would have access to the WRYM model. This was later clarified by South Africa. In the mean time, however, experts from Swaziland and Mozambique did not use the opportunity to

run development scenarios on their own. This might have assisted them in the trilateral negotiations.

Towards an interim-agreement, 2000-2001

The discussions initiated in 1999 on an interim agreement for the Incomati and Maputo basins were tedious. A major breakdown occurred in mid 2000 when the Inco-Maputo Task Group, charged with drafting the agreement, was finalising the 6th draft. The major issue was whether two annexes that were also being drafted, namely on the exchange of information and on transboundary impact, should be part of the current interim agreement or should become part of the final agreement, envisaged to be reached before the year 2010. The task group could not solve this stalemate. Given its limited mandate, the task group had to refer the matter back to the TPTC for resolution. The stalemate was finally resolved at that level, but significantly delaying the drafting process.

By the end of 2001 the negotiations had yielded little and some observers close to the negotiations were pessimistic whether an interim water sharing agreement was within reach.

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Incomati Basin Negotiation Roleplay

The Incomati river basin; 2002

Background document III

Compiled by Pieter van der Zaag

7. The Tripartite Interim Agreement of 2002

By the end of 2001 the negotiations had yielded little and some observers close to the negotiations were pessimistic whether an interim water sharing agreement was within reach. However, during the first months of 2002 substantial progress was made. The three water ministers, who met on 7 May 2002 in Ezulwini, Swaziland, declared in an official press release, that they:

1. had discussed the text of the draft "Tripartite Interim Agreement on the Protection and Sustainable Utilisation of the Water Resources of the Incomati and Maputo Watercourses" (TIA);
2. confirmed that the TPTC's "Resolution on the Exchange of Information and Water Quality Standards" would be passed prior to the formal signing of TIA; and
3. confirmed their commitment of signing the TIA during the World Summit on Sustainable Development in Johannesburg, South Africa, in August 2002.

As was indicated in chapter 5, the Tripartite Interim Agreement was indeed signed during the World Summit on Sustainable Development in Johannesburg, on 29 August 2002. Three weeks earlier, the TPTC had signed the resolution on the exchange of information and water quality.

A preliminary analysis of the interim agreement of 2002

The Tripartite Interim Agreement is a very comprehensive document, setting out the laudable objectives of protecting the water resources of the Incomati and Maputo basins and utilising these in a sustainable manner. Moreover, the agreement is bold in that it specifies, in an annex concerning "flow regimes", the water withdrawals in the three riparian countries that are allowed under this agreement (Table 7.1; compare with Tables 3.3 and 5.2). The quantitative data in this annex were derived from the JIBS study, although some have been modified (notably environmental water requirements).¹

¹ It is important to note that TIA does not explicitly consider evaporation losses from dams, as these have not been included in the allocations presented in the flow regime annex of the agreement.

Table 7.1: Consumptive water use (Mm³/a) in the Incomati basin, as allowed by TIA, excluding evaporation losses from dams (source: TIA (2002), Annex I; water generation taken from JIBS, 2001)

Country	Water generation	Priority uses *	Exotic tree plantations	Irrigation	Interbasin transfer	Total water use	% of total use	% of water generated
South Africa	2,937	205	475	786	131	1,598	68	54
Swaziland	479	22	46	126	136	329	14	69
Mozambique	171	19	25	280	88	412	18	241
Total	3,587	246	546	1,192	355	2,338	100	65
% of total use		11	23	51	15	100		

* *Priority uses include: Domestic & municipal; Industrial; and Livestock & game. Those priority water uses outside the Incomati basin are accounted for under interbasin transfer in the table.*

The most striking feature of the Agreement is that it allows a significant increase (nearly 30%) in the consumptive water uses of the water resources of the Incomati by all three countries, allowing the commitment level to increase from 51% in 2002 to 65% in the near future. This includes water reserved for the future needs of the city of Maputo (an interbasin transfer of 88 Mm³/a). The agreement is thus based on the premise that more (secure) water can be created by increasing the capacity of existing dams² and constructing new dams.³ This premise has been corroborated by the Inco-Maputo Task Group, which carefully analysed the proposed allocations, and conducted a systems analysis by feeding these allocations into the Water Resources Yield Model (WRYM) developed under JIBS. The outcomes were debated at length by this Task Group, and eventually all delegations were satisfied that the allocations can be provided at reasonable levels of assurance.⁴ However, it is clear that such levels of assurance can only be achieved at a high cost, not only in terms of finance but also in terms of increased evaporation losses from dams. Further additional allocations (as specified in a separate annex on "Reference projects" in the agreement) will therefore have to be considered very carefully.

Even with increased storage capacity, the significant increases in water withdrawals will most likely lead to more frequent shortages. These shortages will have to be resolved by relying on Article 1 and clauses 5 and 6 of Article 4 of the flow regime annex of TIA, which define procedures for managing water use during droughts. Article 1 assigns priority to water for domestic, livestock and industrial use, as well as to ecological water requirements. Implicitly, runoff reduction due to afforestation also takes priority since this type of water use cannot be altered overnight. This means that in case of water shortage, the irrigation sector (with 51% of withdrawals by far the largest water user in the basin) will have to decrease its abstractions. Consequently the irrigation sector will experience more frequent shortages in future. Enforcing this priority rule will be a challenge in terms of water management in all three countries, and more so if the political leverage of some large irrigators is considered (think, for example, of the sugarcane industry in all three countries).

² Corumana dam in Mozambique and Vygeboom dam in South Africa.

³ Moamba Major dam in Mozambique; Tonga, Mountain View, and New Forest dams in South Africa; Silingane and Ngonini dams in Swaziland.

⁴ Personal communication Mr Niel Van Wyk, 24 October 2002.

The premise of TIA that more secure water can be made available, resulted in the negotiating parties not having to critically evaluate current water uses. The large consumptive water use by exotic tree plantations as well as by some large interbasin transfers were not questioned. Afforested areas in all three countries are allowed to increase significantly, and existing interbasin transfers may continue.

The manner in which TIA defines first priority uses and other uses may not be entirely consistent with the national water laws of the three countries. An example is the National Water Act (1998) of South Africa, which, in Part 3, prioritises only the Reserve, which is water to satisfy basic human needs as well as to protect aquatic ecosystems. TIA, however, assigns the status of first priority use to the water transferred out of the Incomati basin from Nooitgedacht and Vygeboom dams for the use of cooling thermal power plants in the adjacent Olifants catchment, part of the Limpopo basin. The same priority is given to the water reserved for the future needs of the city of Maputo. This position may be questioned.⁵

Concerning water requirements of the ecosystems, the interim agreement defines target instream flows for the Sabie, Crocodile Komati and Incomati rivers. At Ressano Garcia, the minimum flow target is 2.6 m³/s, which is higher than agreed in 1991 at Piggs Peak (2 m³/s). At the estuary (Marracuene) the minimum flow target is set at 3 m³/s, which is less than recommended by JIBS (5 m³/s), but double the minimum flow recommended by Mozambique in 1984. Further detailed research on the water requirements of the Incomati estuary is clearly required, and the costs and benefits of various minimum flows estimated. This is not only relevant because many poor households derive important benefits from this estuary, but also because the integrity of the estuary and the whole of the Incomati river within Mozambique is important for the aquatic ecosystems in South Africa and Swaziland.⁶

Despite these critical observations, the Tripartite Interim Agreement is an important positive achievement, and a landmark in the sharing of international waters. The three countries have not only accepted the equity principle in utilising the Incomati and Maputo water resources, but have been able to translate this into concrete, measurable, and thus enforceable, commitments. They obviously take this agreement very seriously, as they invested three long years in negotiating it. However, negotiations on the mooted Comprehensive Agreement, to be concluded by 2006, will be tough and complex, as the Incomati basin is approaching 'closure'.

⁵ Compare this also with the consent by Mozambique to the interbasin transfer from the Pungwe river basin for the primary needs of the city of Mutare in Zimbabwe, and its refusal to allow Zimbabwe to transfer water from the same river out of the basin for irrigation purposes; a position which was accepted by Zimbabwe. Both countries reached this agreement on 27 September 1995, after 18 months of negotiations.

⁶ Personal communication Mr Niel Van Wyk, 31 October 2002.

Conflict Prevention and Cooperation in International Water Resources

Course Evaluation

Dear Participant,

In order to receive your feedback on the course “Conflict Prevention and Cooperation in International Water Resources”, we kindly invite you to complete the attached questionnaire. The results of the questionnaire will help us to ensure the quality of the course, and, if necessary, to make improvements.

Please note that the questionnaire is anonymous. Please share with us your comments freely and honestly.

Thank you!

Evaluation for Short Course on Conflict Prevention and Cooperation in International Water Resources

(Please tick appropriate boxes)

1) The course in general:					
	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
The course increased my understanding of conflict in an international water context.					
The course increased my understanding of the process of negotiation					
The course provided me with an appreciation of the water cycle					
The course increased my understanding of water issues in the context of regional SADC					
Comments:					

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
The multi disciplinary set up of the group added value to the course					
The course was challenging to me.					
The course is a useful contribution for my professional development.					
The course is a useful contribution to the specific requirements of my job.					
Comments:					

2) Content of the course

Would you like to provide feedback about any of the sessions and / or presenters.
This can be positive and / or negative.

Topic or presenter	Comments

Was there anything you would have liked more or less of in the course? What?

What has been most valuable to you? And why?

Did the course succeed to integrate water management and conflict resolution? Why or why not?

3) Methods of teaching

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
A wide variety of teaching methods has been used during this course.					
There was a fair balance between of theory and practical exercises in this course					
Comments:					

5) Working relations					
	Stimulating	Cooperative	Neutral	Distant	Difficult
The working relations with the facilitators has been:					
The working relations between participants has been:					
Comments:					

6) Logistics					
	Excellent	Good	Reasonable	Poor	Bad
The internal organisation and logistical support has been:					
The accommodation has been:					
Comments:					

7) Course duration					
	Far too long	Too long	Just Right	Too Short	Far too short
What do you think of the length of the course?					
Comments:					

Any other comments or suggestions:

Thank you!

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Constitution of UNESCO (excerpt)

London, 16 November 1945

The Governments of the States Parties to this Constitution on behalf of their peoples declare:

That since wars begin in the minds of men, it is in the minds of men that the defences of peace must be constructed;

That ignorance of each other's ways and lives has been a common cause, throughout the history of mankind, of that suspicion and mistrust between the peoples of the world through which their differences have all too often broken into war;

That the great and terrible war which has now ended was a war made possible by the denial of the democratic principles of the dignity, equality and mutual respect of men, and by the propagation, in their place, through ignorance and prejudice, of the doctrine of the inequality of men and races;

That the wide diffusion of culture, and the education of humanity for justice and liberty and peace are indispensable to the dignity of man and constitute a sacred duty which all the nations must fulfil in a spirit of mutual assistance and concern;

That a peace based exclusively upon the political and economic arrangements of governments would not be a peace which could secure the unanimous, lasting and sincere support of the peoples of the world, and that the peace must therefore be founded, if it is not to fail, upon the intellectual and moral solidarity of mankind...

