CRANFIELD UNIVERSITY

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INTEGRATED WATER RESOURCES MANAGEMENT AND ADAPTIVE MANAGEMENT: SHAPING SCIENCE AND PRACTICE

SCHOOL OF APPLIED SCIENCE

DOCTOR OF PHILOSOPHY (PHD) THESIS

CRANFIELD UNIVERSITY

SCHOOL OF APPLIED SCIENCE

Ph. D. THESIS

2008

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Integrated Water Resources Management and Adaptive Management: Shaping Science and Practice

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June 2008

This thesis is submitted in partial fulfillment of the requirements

for the degree of Doctor of Philosophy

Abstract

Complexity of challenges associated with water resources management is increasing due to factors such as climate variability and uncertainty, increased regulatory requirements, changes in planning horizons, and trans-boundary considerations. Integrated Water Resources Management (IWRM) and Adaptive Management (AM) are widely publicized approaches developed and proposed to deal with this complexity.

Both concepts have a history reaching back decades, but have been facing difficulties in their transfer from theory into practice. There is a clear need to look in more detail at the process of transforming IWRM and AM theory into practice and this research investigates this process and the factors that mediate it. A conceptual framework was developed - characterizing the process for transfer of theory into practice - that formed the basis for development of the research questions. The research approach focused on analyzing the implementation pathways of IWRM and AM in four case studies, whose selection was informed by the need to explore a context with extensive history of IWRM and AM practice. Data collection took place through semi-structured interviews aiming to uncover how those involved in planning and implementation of IWRM and AM experienced these processes. Besides aiming to understand the 'lived experiences', a more abstract framework of the process, factors and dynamics was derived, grounded in the views of the respondents.

The findings indicate different types of factors that influence the theory to practice process for IWRM and AM, relating to: (a) theory and its use in practice; (b) the environment that can complicate or facilitate the implementation process; (c) the way cooperation and decision-making processes are organized; and (d) individual attributes of those involved. Incorporating lessons from past into current initiatives are vital to more effective implementation of IWRM and AM. This research gives greater insight into the mediating factors and dynamics, providing this through empirical evidence into

design of IWRM and AM planning and implementation. It also provides a thorough discussion on what IWRM and AM exactly mean, proposing a new definition for both concepts.

Acknowledgement

The completion of this thesis has involved the support and help of a number of people, some of who may not have realized their contribution. For inspiring me to take this path in the first place, a warm recognition goes out to Ludo Prins, my former 'boss' at DHV Consultants, who gave me the opportunity to work in Sri Lanka in water projects through which I realized my passion for working in the water sector. This gave me the opportunity to interact with colleagues and academics, some of who became good friends and opened my eyes to the idea of further improving my understanding and knowledge of water management through PhD research.

During my time at Cranfield University, various people have played different roles during my research and I would also like to thank them very much for their support. The members of my review committee, Professor David Allan and Dr. Brian McIntosh, have both been a source of constructive feedback and encouragement. I would like to thank Dr. Undala Alam, Dr. Daniel Boye and Dr. Jen Smith for their great support and involvement during the analysis and coding process. There are also numerous others who have taken time to guide and assist me. There have been a number of fellow researchers at the School of Applied Science whose paths have crossed mine and who I would like to thank. Teresa Torregrosa who I met during the beginning of my stay at Cranfield and who has since become a good friend. Carol Webb, who was always there in my second year for coffees and good advice. Axelle Besancon, for being such a lovely person and always willing to take care of my cats while I was away (they thank you for that too). Diane Purcell, with whom I have shared many laughs and a few tears, thank you for your friendship. And of course all my fellow PhD students in PhD room 1 of Building 39, for the great atmosphere, stories and laughs that we have shared. I wish you all the very best during your research and your lives!

This research could not have been completed without the generosity of the many case study interview participants and individuals that shared their time and resources to give feedback on my findings. In particular, I would like to thank Steve Light and Kent Loftin – two great people who helped me get acquainted with the AM case studies and who reached out to help me to get in contact with a number of relevant case study participants. Also to Catherine Allan, Imogen Fullagar, and Andrew Ross for their support with the Murray Darling case study. To Pieter Huisman, who took plenty of time to help me get a better understanding of the Rhine and of course to all 48 interview respondents who have so kindly and openly shared their experiences.

During my research, I have been involved in the NeWater Project, where I had the pleasure and luck to work with a number of great people, too many to mention here individually by name. But I thank you all for this learning experience and your kindness and warmth. It has been a great experience! In particular I would like to thank Claudia Pahl-Wostl for her helpful suggestions and support during my research.

On a personal note, I would like to thank all my wonderful family members and great friends at home (especially Berbeli, Gertine, Reineke and Wietske who are the best friends anyone could wish!). My parents Cees and Marjan Medema, my parents-in-law Mary Rayond and John Kyser, my dear sissy Karin Medema and my sister-in-law Anne Raymond, for their unconditional love and support throughout. Most importantly: my partner, Patrick Raymond, for his patience, understanding and enormous support during the last three years. I love you guys all very very much!

And finally, an enormous heartfelt ‘thank you’ goes to my PhD supervisor, Dr Paul Jeffrey, for his respect and trust and for his tolerance, encouragement, care, attention, example, honesty and motivation. Thank you so very much for giving me this chance!

Thesis Publications

Medema, W., B.S. McIntosh, and P.J. Jeffrey (2008). From premise to practice: a critical assessment of integrated water resources management and adaptive management approaches in the water sector. Ecology and Society, 13(2):29. [online] URL: http://www.ecologyandsociety.org/vol13/iss2/art29

Medema, W. and Jeffrey, P. (2007). Factors which mediate implementation of Integrated Water Resources Management: Evidence from the Rhine Basin. Paper presented at the CAIWA International Conference on Adaptive & Integrated Water Management, 12 – 15 November 2007, Basel, Switzerland. Published in conference proceedings.

Medema, W. and Jeffrey, P. (2006). A review of the Adaptive Management Theory in the Context of Integrated Water Resources Management. Paper presented at the AWRA (American Water Resources Association) Conference on Adaptive Management of Water Resources, 26 – 28 June 2006, Missoula, Montana, USA. Published in conference proceedings.

Table of Contents

List of Figures 17

List of Tables 19

List of Equations 23

Abbreviations 25

1 Introduction 27

1.1 Research Background 27

1.2 Research Aim 30

1.3 Conceptual Framework and Research Questions 31

1.4 Research Objectives, Structure and Actions 33

1.6 Outline of Thesis 35

2 Literature Review 39

2.1 Introduction 39

2.2 IWRM and AM Concepts 40

2.2.1 The Promise of IWRM 40

2.2.2 How are ambitions of IWRM to be achieved? 44

2.2.3 Challenges and lessons learned - IWRM 47

2.2.4 The nature of the AM concept 51

2.2.5 How are ambitions of AM to be achieved? 53

2.2.6 Challenges and lessons learned - AM 56

2.2.7 Conclusions 58

2.3 Theory-Practice Process and Linking Dynamics 62

2.3.1 Introduction 62

2.3.2 Action Science 63

2.3.3 Theory and Practice 64

2.3.4 Models of Interaction between theory and practice 66

2.4 Change Management 70

2.4.1 Overview 70

2.4.2 Process of Change 72

2.4.3 Space and Time Aspects 73

2.4.4 Change Factors and Dynamics 75

2.4.5 Content Factors 76

2.4.6 Context Factors 79

2.4.7 Process Factors 81

2.4.8 Individual Attributes 82

2.5 Reflection on Conceptual Framework 83

2.6 Conclusions 86

3 The Research Process 89

3.1 Introduction 89

3.2 Describing Social Science Research 89

3.3 Research Paradigm 91

3.4 Research Intent and Strategy 95

3.5 Methodological Nature of the Research 98

3.5.1 Quantitative versus Qualitative Approach 98

3.5.2 Qualitative Research Strategies 102

3.5.3 Data Collection Methods 106

3.6 Interpretation of Qualitative Data 111

3.6.1 Data Analysis 111

3.6.2 Theory Building and Re-examining Literature 118

3.7 Validity and Reliability of Research 120

3.8 Strength and Weaknesses of Methodology 125

3.9 Summary 127

4 Fieldwork and Analysis Techniques 129

4.1 Introduction 129

4.2 Selection of Case Studies 129

4.3 Case Study Descriptions 131

4.3.1 Rhine 131

4.3.2 Murray Darling....137

4.3.3 Glen Canyon Dam Adaptive Management Program....140

4.3.4 Kissimmee River Restoration Project....144

4.4 Semi-Structured Interviews....147

4.4.1 Design and Testing....147

4.4.2 Selection of Respondents....149

4.4.3 Data Collection and Protocol....150

4.5 Data Analysis....153

4.5.1 Introduction....153

4.5.2 Similarity Analysis....154

4.5.3 Inter-coder Reliability Measures....157

4.5.4 Evaluation of Mediating Factors and Dynamics....159

4.5 Summary....164

5 Similarity Analysis....165

5.1 Introduction....165

5.2 Intercoder Reliability Analysis....165

5.3 Similarity Analysis – Findings for IWRM....175

5.3.1 Frequency of Ratings....176

5.3.2 Definitions of IWRM – Coherencies and Omissions....179

5.3.3 Objectives of IWRM – Differences and Similarities 182

5.3.4 Comparing the Consistency of Respondent Ability to Define and Describe IWRM 185

5.3.5 Understanding of IWRM Process and Education 188

5.3.6 Summary of IWRM case study findings 191

5.4 Similarity Analysis – Findings for AM 193

5.4.1 Frequency of Ratings 193

5.4.2 Definitions of AM– Coherencies and Omissions 195

5.4.3 Objectives of AM – Differences and Simmilarities 198

5.4.4 Comparing the Consistency of Respondent Ability to Define and Describe AM 201

5.4.5 Understanding of AM Process and Education 203

5.4.6 Summary of AM case study findings 207

5.5 Comparison of IWRM and AM Results 209

6 Mediating factors and dynamics 215

6.1 Introduction 215

6.2 Barriers and Enabling Factors for IWRM 215

6.3 IWRM – External Context 217

6.3.1 Government and policies 217

6.3.2 Political processes 219

6.3.3 Economic situation 220

6.3.4 Climate change and crisis events 221

6.4 IWRM - Internal Context 224

6.4.1 Existing structures 224

6.4.2 Legal framework 225

6.4.3 Roles, responsibilities and accountability 227

6.4.4 Power, control and representation 229

6.4.5 Resources and skills 230

6.3.6 Time Horizons 232

6.4 IWRM - Change Implementation Process 236

6.4.1 Competing Interests and Agendas 236

6.4.2 Stakeholder Involvement and Interaction 237

6.4.3 Communication and Collaboration 238

6.4.4 Leadership and Vision 240

6.4.5 Data and Information 242

6.5 IWRM – Individual Attributes 245

6.5.1 Attitude to Change 245

6.5.2 Level of Trust 246

6.5.3 Sense of Urgency and Awareness 248

6.6 Barriers and Enabling Factors for AM 251

6.7 AM - External Context 252

6.7.1 Political process 252

6.7.2 Economic situation 254

6.7.3 Climate change and uncertainties 255

6.8 AM - Internal Context 257

6.8.1 Existing Structures 257

6.8.2 Legal Framework 259

6.8.3 Roles, Responsibilities and Accountability 261

6.8.4 Power, control and representation 262

6.8.5 Resources and skills 263

6.8.6 Time Horizons 265

6.9 AM – Process Factors 269

6.9.1 Competing Interests and Agendas 269

6.9.2 Stakeholder Involvement and Interaction 270

6.9.3 Communication and Collaboration 272

6.9.4 Leadership and Vision 274

6.9.5 Data and Information 275

6.10 AM – Individual Attributes 279

6.10.21 Attitudes to Change....279

6.10.2 Level of Trust....281

6.10.3 Sense of Urgency and Awareness....282

6.11 Comparing of IWRM and AM Results....284

6.12 Conclusion....294

7 Discussion....295

7.1 Introduction....295

7.2 Key Empirical Findings....296

7.2.1 Similarity Analysis....297

7.2.2 Analysis of Mediating Factors....299

7.3 Discussing IWRM and AM....304

7.3.1 The Context of IWRM and AM….....304

7.3.2 … their Implementation… 308

7.3.3 … and proposed Definitions....310

7.4 Mediating Factors and Change Process....314

7.4.1 Content Factors – What is being changed? 315

7.4.2 Context Factors – Why is the change successful or not?....318

7.4.3 Process Factors – How is the change implemented? 320

7.4.4 Individual Attributes – Who is involved and affects the process?.321

7.5 Interactions and Dynamics 322

7.6 Proposed Conceptual Framework 328

7.7 Conclusions 331

8 Conclusions 333

8.1 Reflection on Research Findings 333

8.2 Implications of Research Findings 340

8.2.1 Contribution to Knowledge 340

8.2.2 Recommendations to Policy Makers and Practitioners 342

8.3 Limitations of Research 345

8.4 Recommendations for Further Research 346

References 349

Appendices 381

Appendix I: List of Mediating Factors from AWRA Discussion 383

Appendix II: Interview Script 385

Appendix III: Content of Email to Potential Respondents 391

Appendix IV: List of Respondents 393

List of Figures

Figure 1.1	Conceptual Model of Theory to Practice Process	32
Figure 1.2	The Overall Research Structure	35
Figure 2.1	Research Focus Areas, Research Gap and Supporting Research Domains	40
Figure 2.2	Deployment of IWRM policy and operations – a partial ideal or expedient?	46
Figure 2.3	The Adaptive Management Cycle	54
Figure 2.4	Knowledge Dissemination and Utilization	67
Figure 2.5	Mediating Action Model	68
Figure 2.6	Historical Perspectives on Change Management	71
Figure 2.7	Change is a Process	72
Figure 2.8	Phases and Attitudes for Change Process	73
Figure 2.9	Impact of Change Sources on the Individual, Organizational and Geopolitical Levels	74
Figure 2.10	Characterization of Proposed Change	79
Figure 2.11	Revised Conceptual Framework of Theory to Practice Process	86
Figure 3.1	Social Science Research Process	90
Figure 3.2	Template of Pathway Diagram	118
Figure 3.3	The Research Process	128
Figure 4.1	Rhine Basin and its Drainage Sub-basins in the Netherlands	133
Figure 4.2	Organization Structure of the ICPR	134
Figure 4.3	The Murray Darling River Basin in Australia	138
Figure 4.4	Governance Structure of the Murray Darling Basin Initiative	139
Figure 4.5	The Glen Canyon River Ecosystem and Colorado River	141
Figure 4.6	Organizations in the AM Program	142

Figure 4.7	Map of the Kissimmee River (Lake Kissimmee to Okeechobee)	145
Figure 4.8	Template for Similarity Ratings	157
Figure 5.1	Frequencies of Similarity Ratings for the Rhine	177
Figure 5.2	Frequencies of Similarity Ratings for the Murray Darling	178
Figure 5.3	Comparing IWRM Definition and Objective for the Rhine	185
Figure 5.4	Comparing IWRM Definition and Objective for the Murray	187
Figure 5.5	Frequencies of Similarity Ratings for the GCDAMP	193
Figure 5.6	Frequencies of Similarity Ratings for the KRRP	194
Figure 5.7	Comparing AM Definition and Objective for the GCDAMP	201
Figure 5.8	Comparing AM Definition and Objective for the KRRP	203
Figure 5.9	Comparing Similarity Ratings for Definition of IWRM and AM	208
Figure 5.10	Comparing Similarity Ratings for Objective of IWRM and AM	210
Figure 6.1	Multi-Levels of Integration Process	221
Figure 6.2	Structures, Legal Framework, Roles and Responsibilities	234
Figure 6.3	Comparing barriers Rhine and Murray Darling	288
Figure 6.4	Comparing enabling factors Rhine and Murray Darling	289
Figure 6.5	Comparing barriers GCDAMP and KRRP	291
Figure 6.6	Comparing enabling factors GCDAMP and KRRP	292
Figure 7.1	Oversight of Discussion Elements	296
Figure 7.2	Binoculars as a Metaphore for Theory-Practice Interaction	324
Figure 7.3	Cycle of Knowledge Creation and Conversion	325
Figure 7.4	Spiral of Knowledge Conversion	326
Figure 7.5	Conceptual Framework for Theory-Practice	328
Figure 7.6	Interaction between context, process and individual attributes factors	329
Figure 7.7	Theory-Practice Process and Mediating Factors	331

List of Tables

Table 1.1	Explanations of the Steps in the Conceptual Model	33
Table 2.1	Comparison of IWRM and AM Approaches	59
Table 2.2	Major Barriers to the Implementation of IWRM and AM Concepts	61
Table 3.1	Descriptions for Paradigm, Ontological & Epistemological Premise	91
Table 3.2	Silverman's Two Schools of Social Science	92
Table 3.3	Basic Beliefs of Alternative Inquiry Paradigms	93
Table 3.4	A Summary of Research Objectives	96
Table 3.5	Quantitative Style versus Qualitative Style	99
Table 3.6	Internal and External Critiques of Quantitative Methods in Social Science and the Qualitative Redress	100
Table 3.7	Summary of Differences Between Quantitative and Qualitative Research	101
Table 3.8	Different Types of Case Studies	105
Table 3.9	Qualitative Data Collection Types, Options, Advantages and Limitations	108
Table 3.10	Predominant Criteria for Sound Interpretative Research	122
Table 4.1	Potential Case Studies and Selection Criteria	131
Table 4.2	Levels of Water Management in The Netherlands	135
Table 4.3	Agencies and Other Stakeholder Groups of GCDAMP	143
Table 4.4	Research Questions, Interview Sections and Analysis Steps	153
Table 4.5	Formal Statements for Definition and Objective of IWRM	154
Table 4.6	Formal statements for definition and objective of AM	155
Table 4.7	Key Features of Categories or Themes	161
Table 4.8	The Coding Process in Inductive Analysis	161

Table 5.1	Similarity Ratings of Respondents' Statements for IWRM Definition & Objective	166
Table 5.2	Similarity Ratings of Respondents' Statements for AM Definition & Objective	167
Table 5.3a	Contingency Table IWRM Definition - Coder 1 & 2	168
Table 5.3b	Contingency Table IWRM Definition - Coder 2 & 3	168
Table 5.3c	Contingency Table IWRM Definition - Coder 1 & 3	168
Table 5.4a	Contingency Table IWRM Objective – Coder 1 & 2	169
Table 5.4b	Contingency Table IWRM Objective – Coder 2 & 3	169
Table 5.4c	Contingency Table IWRM Objective – Coder 1 & 3	169
Table 5.5a	Contingency Table AM Definition – Coder 1 & 2	170
Table 5.5b	Contingency Table AM Definition – Coder 2 & 3	170
Table 5.5c	Contingency Table AM Definition – Coder 1 & 3	170
Table 5.6a	Contingency Table AM Objective – Coder 1 & 2	171
Table 5.6b	Contingency Table AM Objective – Coder 2 & 3	171
Table 5.6c	Contingency Table AM Objective – Coder 1 & 3	171
Table 5.7	The % of Observed Agreement Between Coder Pairs on IWRM	172
Table 5.8	The % of Observed Agreement Between Coder Pairs on AM	172
Table 5.9	The % of Expected Agreement Between Coder Pairs on IWRM	173
Table 5.10	The % of Expected Agreement Between Coder Pairs on AM	173
Table 5.11	Scott's pi Calculations for All Coder Pairs on IWRM	174
Table 5.12	Scott's pi Calculations for All Coder Pairs on AM	174
Table 5.13	Composite Reliability Calculations	174
Table 5.14a-b	Matrix With Ratings Frequencies for Experience Groups - IWRM	212
Table 5.15a-b	Matrix With Ratings Frequencies for Experience Groups	213

	– AM	
Table 6.1	Barriers and Enabling Factors for IWRM Planning & Implementation	216
Table 6.2	Barriers and Enabling Factors for AM Planning & Implementation	252
Table 6.3	Comparing of IWRM and AM Results	285
Table 7.1	Modes of Knowledge Conversion	317

List of Equations

Equation 5.1 Percentage of Observed Agreement……172

Equation 5.2 Expected Frequency……173

Equation 5.3 Percentage of Expected Agreement for Coder Pairs……173

Equation 5.4 Scott's Pi……174

Equation 5.5 Composite Reliability……174

Abbreviations

AM	Adaptive Management
AMWG	Adaptive Management Working Group
AOP	Annual Operating Plan
AWRA	American Water Resources Association
C&SF	Central & Southern Florida
EIS	Environmental Impact Statement
EU	European Union
GCDAMP	Glen Canyon Dam Adaptive Management Program
GCMRC	Grand Canyon Monitoring and Research Center
GWP	Global Water Partnership
GWP-TAC	Global Water Partnership – Technical Advisory Committee
ICPR	International Commission for the Protection of the Rhine
IIASA	International Institute for Applied Systems Analysis
IRBM	Integrated River Basin Management
IWRM	Integrated Water Resource Management
KRRP	Kissimmee River Restoration Project
MDBC	Murray-Darling Basin Commission
NHV	Netherlands Hydrological Society

RAP	Rhine Action Plan
ROD	Record of Decision
RIZA	Institute for Inland Water Management & Waste Water Treatment
SFWMD	South Florida Water Management District
SoI	Secretary of Interior
SOR	Save Our Rivers
TWG	Technical Working Group
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WFD	Water Framework Directive
WWF	World Wildlife Foundation
WWPC	Western Water Policy Commission

1 Introduction

1.1 Research Background

The sustainable management of water resources is one of the major challenges for environmental policy in the 21st century. The world's freshwater resources are unequally distributed and even in countries, which do not have problems of scarcity, a major cause of water shortage and sanitation problems is poor water governance (Pahl-Wost *et al.*, 2008). Water is a particularly complex natural resource to manage because of scalar dynamics; for example, depletion or pollution of water in one part of a river basin affects users a great distance away. As scale increases, so do the number of interactions, divisions and drivers; e.g. land use, markets, urban growth and political and transboundary borders (Lankford, 2008: 45).

It has been recognised by various scholars (e.g., Wurbs, 1998; Simonovic, 2000; Matondo, 2002) that the complexity of water resources management challenges can be expected to increase due to factors such as population growth, climate variability and uncertainty, increased regulatory requirements, changes in planning horizons, the interplay of phenomena at different temporal and spatial scales, as well as socio, environmental and trans-boundary considerations (Matondo, 2002). Different approaches have been developed and proposed to deal with the complexity and uncertainties in water resources management aiming at a sustainable use of these resources. Two examples of such approaches are IWRM and AM. As these approaches provide prescriptions regarding how knowledge should be produced and used in order to achieve specified desirable (natural resources management) outcomes, they might be referred to as management frameworks.

Since the early 1990s, the concept of IWRM has been known and recognized (Mitchell, 1990, Dublin Statement, 1992, Global Water Partnership, 2000, 2005). The UNDP (2006) and Global Water Partnership (2005) state that the IWRM concept is currently the most popular concept for water management. A

WEB issue analysis of the IWRM concept conducted by Thelwall *et al.* (2006) indicates a considerable representation of IWRM literature on the web, but such prominence is also revealed in a number of reports of high-profile organizations and initiatives launched to support IWRM planning and implementation (Mukhtarov, 2008). The IWRM concept has been embraced by organizations such as: the United Nations Development Programme (UNDP, 2006); the United Nations Environmental Programme (UCC-IWRM); the World Bank (WB); the Asian Development Bank (ADB, 2006); the World Water Council (WWC); the European Union Water Framework Directive (EU WFD); and the Global Water Partnership (GWP, 2006).

AM is the operative management strategy in a range of resource management settings, including fisheries, forestry, wetlands, agriculture, watershed management, and species conservation (Levine, 2004). Well-known North American examples of AM include: e.g., the Florida Everglades (Gunderson, 1999); the Columbia River basin (Lee, 1993); the Colorado River (Collier *et al*., 1996), the Kissimmee River in Florida (Light and Blann, 2000). AM is also being used, for example, to manage water quality in Australia (Gilmour et al., 1999) and marine areas in Southeast Asia and the Pacific. In Australia, two major natural resource management initiatives – the Natural Heritage Trust (NHT), and the National Action Plan for Salinity and Water Quality (NAP) – are underpinned by bilateral agreements between the State and Federal Gorvenments which place AM as a founding tenet (Allan, 2008: 65).

Both IWRM and AM have multi-decade histories of development and application – IWRM from the first UNESCO International Conference on Water in 1977 and AM from the early work of Carl Walters (Walters and Hilborn, 1978). IWRM is particularly concerned with pursuing what might be termed an integrationist agenda; the integrated and co-ordinated management of water and land as a means of balancing resource protection whilst meeting social and ecological needs and promoting economic development (Odendaal, 2002). AM stems from the recognition that even though interactions between people and ecosystems are inherently unpredictable (Gunderson *et al.*, 1995) there is a need to take

management action (Johnson, 1999). AM is a process to cope with uncertainty in understanding centred on a learning model where 'natural resource management actions are taken not only to manage, but also explicitly to learn about the processes governing the system' (Shea *et al.*, 1998). In other words, AM acknowledges the deep uncertainties of water resource management and attempts to reduce those uncertainties over time by a process of using management actions as experiments to test policy (Walters, 1986).

Both IWRM and AM make claims about how best to organize knowledge production for sustainability in natural resource use under conditions of complexity – IWRM focusing on integration and co-ordination, AM focusing on handling uncertainty. In addition, both frameworks have been criticized for not living up to their ambitions, in suffering from problems in translation from research to practice. For example, Biswas (2004) has argued that the kind of institutional and organizational integration demanded by IWRM may not be possible, whilst Walters (1997) noted that many AM initiatives have either 'vanished with no visible product' or become 'trapped in an apparently endless process of model development and refinement'. However, as interest continues unabated within the research literature in developing and applying both IWRM and AM to water management, there is a need to stand back and critically reflect on the success of these frameworks. The aim in doing so is to contribute to improving the way in which water resources and water use are managed by identifying the source of, and solutions to problems encountered in implementing management frameworks developed on the back of scientific theory within research literature.

In other words, incorporating lessons from past into current initiatives is vital to more effective implementation of IWRM and AM. There is a clear need to look in more detail at the process of transforming theory into practice for both IWRM and AM and investigate the different factors (and their dynamics) that mediate this process.

While using the term 'theory', it should be noted that management frameworks are not normally explicitly articulated as theories, but they do, at root, provide guidance for interventions, which generate benefit or utility and therefore embody testable statements about the relative effectiveness of different ways of producing and using knowledge to manage natural resources. These management frameworks are 'testable' in that it should be possible to empirically test the posited relationships between modes of knowledge production and natural resource domain outcomes for any framework. And they form 'theory' in the sense that each framework will provide a conceptual system for understanding how to generate knowledge to effectively manage a particular natural resource, and for explaining the impact of different modes of knowledge production on natural resource outcomes.

1.2 Research Aim

In the first phase of this research (see Chapter 2), IWRM and AM are reviewed as theories, conceptual devices or abstract models, focusing in particular on: their nature and (historical) development; their anticipated benefits; and the challenges and lessons learned through their application. [1] This review clearly reveals that both IWRM and AM concepts face common challenges to their transfer from theory into practice and that it is crucial to look in more detail at the process of transforming these concepts into practice.

Rynes *et al.* (2001) describe the divide between theory and practice as an issue that is common and characteristic to most of the history of academic knowledge

[1] The following definitions for IWRM and AM are developed by the author in Chapter 7 - Section 7.3.3:

- *IWRM is a democratic process for developing and managing water and related resources in a coordinated and sustainable manner*
- *AM is a process of inquiry that incorporates new knowledge with the aim to continually improve management policies and practices*

production. On a more philosophical level there have been debates about this divide between theory and practice for centuries. However, in order to understand the process and the dynamics between theory and practice, it is necessary to investigate the nature of the linkages between them. Tensaki and Hay (2004) state that this investigation has not been undertaken systematically and has also not provided much reference to the processes and the sequence of activities entailed in these linking dynamics. According to Burgess (2005) it is crucial to become aware of the reasons for the fundamental incoherency between theory and practice and to understand what constitutes their linking dynamics. These contributions frame the research challenge undertaken and reported in this thesis.

The main aim of this research is to make a contribution to increased understanding of the process of implementing water management theory and concepts; IWRM and AM. More specifically, the overall research aim is to:

> *'Investigate the implementation pathways of IWRM and AM in order to identify the mediating factors and dynamics that emerge as IWRM and AM theories are put into practice*'

The research approach (reported in detail in Chapter 3) is to analyse the (historic) implementation processes of IWRM and AM through four case studies.

1.3 Conceptual Framework and Research Questions

In line with the research aim, a conceptual framework (see Figure 1.1) is developed to illustrate the process of which IWRM and AM are translated from theory into practice. In order to develop an appropriate conceptual framework, additional literature was investigated with regard to existing (generic) models of theory-to-practice processes and the mediating factors that influence this process. However, this literature review did not reveal much earlier research done in this area, but did provide relevant insight to develop a conceptual framework that forms the basis for development of the research questions for this study.

While complexity is moving into every corner of science, the researcher has been inspired by the *Law of Parsimony*, developed by William van Occam, an influential philosopher of the fourteenth century. This law states that '*what can be done with fewer is done in vain with more'.* In the light of this statement, the conceptual framework visualises a minimum representation of how theory and practice are linked.

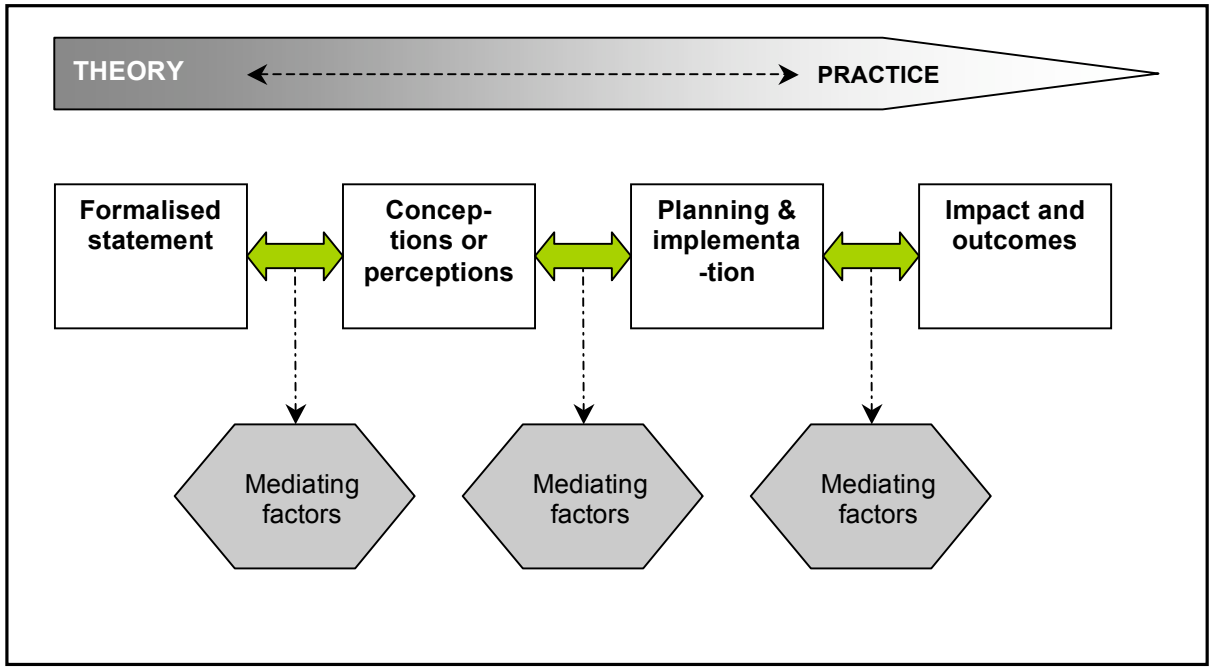

Figure 1.1 Initial conceptual framework of theory to practice process

The large arrows - that visualize the bridging dynamics between theory and practice - link the steps in the conceptual framework. These steps and the nature of the bridging dynamics are influenced and determined by different mediating factors, as shown in the three hexagons at the bottom of the framework. For this research mediating factors are defined as those factors that either hinder or facilitate the planning and implementation of IWRM and AM. To summarize, the proposed abstract representation of theory to practice depicts a process in which theory and practice are interconnected. Although Figure 1.1 appears to show a linear model of theory to practice process, the researcher proposes that this process and the four steps are continuously repeated. In other words, it is an iterative process whereby theory informs practice and practice informs theory. Review and revision of theory can be informed by any

stage in the process. Testing of theory can only take place when practice is evaluated.

The four steps of the conceptual framework are described in more detail in Table 1.1 below:

Steps	Description
Formalised statement	Formal or official statement of theory or concept as described in academic and public literature
Conceptions or perceptions	The way theory or concept is perceived and interpreted by users of a theory
Planning and implementation	How the theory (through perceptions) is translated into objectives, plans, actions and interventions
Impact and outcomes	The realised impact and outcomes of the actions and interventions that are anchored in and based on the theory

Table 1.1 Explanations of the Steps in the Conceptual Framework

The research questions for this study are developed on the basis of the conceptual framework as discussed above:

1. Are perceptions of IWRM and AM across policy makers and practitioners congruent with the formalized concepts of IWRM and AM?
2. What is the nature and role of mediating factors that influence the planning and implementation of IWRM and AM interventions, and the realization of their desired goals?
3. What are dynamics between the factors that influence the planning and implementation of IWRM and AM interventions and the realization of their desired goals?

1.4 Research Objectives, Structure and Actions

To answer the research questions, four research objectives have been identified that guide the research structure and actions developed:

A) Analyze the similarity between formal definitions of IWRM and AM and definitions articulated by practitioners;

B) Identify the types of mediating factors that influence the planning and implementation process of IWRM and AM in four case studies;

C) Investigate the dynamics between the different types of factors as identified in the former objectives;

D) Further develop and refine the conceptual framework of the theory to practice process for the implementation of IWRM and AM based on the findings of the case studies.

Figure 1.2 illustrates the research structure that is followed to meet the research objectives, respond to the research questions, and to subsequently revise the conceptual framework in the context of this new knowledge. As indicated in Figure 1.2, there are two reflection phases (I and II). The first reflection phase on the initial design of the conceptual framework for this research was undertaken in the beginning of this research (during research design and planning) though a pre-fieldwork robustness check. This check took place in the form of discussions with a number of experts during a conference in Montana, USA, organized by the American Water Resources Association (AWRA). The insights from these discussions were then coupled back to existing and relevant literature with the aim of improving the initial conceptual framework (Reflection I). The outcomes of Reflection I are discussed in Chapter 2 (Section 2.5). After complete collection and analysis of the case study interview data, a final review phase (Reflection II) is carried out during which additional existing literature is investigated to reflect on the overall findings and the conceptual framework. This second reflection phase is discussed in the beginning of Chapter 7 (Discussion).

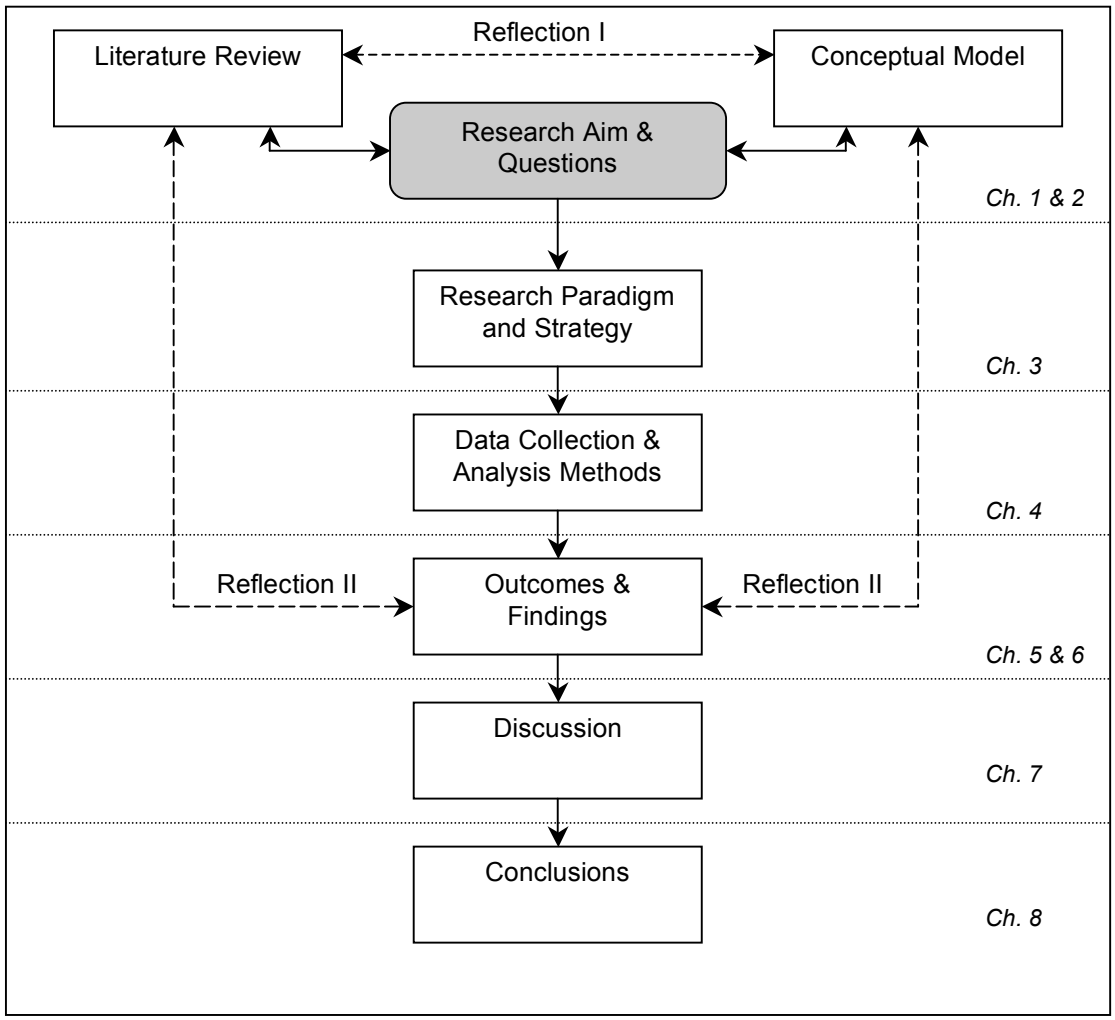

Figure 1.2 The Overall Research Structure

The next and final section of this chapter discusses the outline of the thesis, which is in line with the research structure provided in Figure 1.2.

1.6 Outline of Thesis

This thesis is structured into eight chapters - in line with the research structure – as follows:

Chapter 2 – Research Background

This chapter provides a synopsis of the literature relevant to the study. Its aim is to convey an understanding of the current and main issues in relevant areas,

such as water management concepts, IWRM, AM, theory-to-practice processes, literature on change processes, etc. The material positions the research in the context of existing knowledge. From this, the novelty which this research offers as a contribution to the domains considered is established. First, a brief overview of the pertinent domains is presented. Second, these are returned to in more depth in order to communicate a landscape of the subject areas, and to tease out significant issues and to present the locus of their correspondence to this research.

Chapter 3 – Research Process

Chapter 3 provides an overview of the research methodology and reviews the decisions made about method and technique selection. The topics discussed in this chapter include: research paradigm - epistemology & ontology; exploratory, qualitative research; case study approach; data collection and analysis methods. The aim of Chapter 3 is to demonstrate the solid foundation upon which relevant research decisions were made, and to highlight influencing issues. The actual development of research methods for data collection and analysis are described in more detail in Chapter 4.

Chapter 4 – Fieldwork and Analysis Methods

This chapter presents the criteria for the selection of case studies and provides relevant background information on selected case studies with the support of documentation and reports. It also introduces the criteria for the selection of research respondents in each of the four selected case studies as well as a thorough explanation of how these participants were identified, approached and selected. Finally, the data analysis techniques used in this study are described, which then leads into the presentation of the data from the similarity analysis between formalized statements of IWRM and AM and the definitions provided by the case study respondents in the chapter following.

Chapter 5 – Similarity Analysis

In this chapter, methods for measuring intercoder reliability are discussed and applied to the findings from the similarity analysis conducted by three different coders. The results of the intercoder reliability tests are summarized and presented. This chapter further continues to provide a discussion of the results from the similarity analysis conducted on the data from all four case studies and compares the outcomes of this analysis.

Chapter 6 – Evaluating Mediating Factors

The aim of this chapter is to evaluate the mediating factors (in the form of barriers and enabling factors) as they have been described and highlighted by the respondents from the different case studies. These mediating factors have been winnowed from the interview transcripts and classified according to the four key categories described in Chapters 1 and 2. The analysis indicated that these four key categories were appropriate to encompass all highlighted factors.

Chapter 7 – Discussion

Due to the depth of data presented in this thesis, this chapter aims to first provide a summary of the principle insights derived as findings from the semi-structured interviews presented in the previous two chapters. Data and findings from the semi-structured interviews are summarized first and these findings are carried forward throughout the discussion chapter. The aim of this chapter is to revisit relevant literature to discuss the overall findings and updated conceptual framework within a contemporary context. Also presented here are the implications of the findings and limitations of the study. By means of this approach clear contributions to knowledge and paths of potential further research are derived, which are presented and elaborated on in the concluding chapter.

Chapter 8 – Conclusions

This chapter summarises the main points derived from the discussion chapter by carrying forward the 'key contributions' established. It then considers how the research aim and objectives were met and how the research question was answered by means of this study. The contributions to knowledge this study has provided are further outlined and described and suggestions for further research are made.

2 Literature Review

2.1 Introduction

This chapter provides an assessment of the literature relevant to this study. Its aim is to convey an understanding of the current main issues in relevant research areas discussed, and to position the research covered in this thesis in the context of the literature. From this, the novelty which this research offers as a contribution to the domains considered is clearly established.

The subject matters of this research are the water management concepts, IWRM and AM, and the primary academic field that informs the work presented in this thesis lies in the management research area of the social sciences. This chapter starts with a thorough review of literature with regard to IWRM and AM in order to create a deeper understanding of these water management concepts and present the research gap that forms the main focus of this study: their transfer from theory into practice and the linking dynamics and mediating factors that influence this process. In order to develop the conceptual framework that supports this research in developing research questions and visualizing the theory-practice process, action science literature helps to develop a greater understanding of the links between theory and practice that need to be understood in order to generate knowledge that is useful, valid, descriptive of the world, and informative of how things might be changed (Argyris *et al.*, 1985).

This also points to another domain of research that might contribute to this study, that of change management. The focus here will be on contributing evidence and models from change management literature that will help to explain and identify mediating factors and dynamics that influence the process of planning and implementation of IWRM and AM. In other words, Action Science and Change Management are two research domains that support this research in investigating and understanding the theory-practice process for

IWRM and AM. These domains are brought together to provide a consideration of issues that have arisen during recent developments in the implementation of IWRM and AM concepts.

Figure 2.1 depicts the above-described domains for this research and visualizes the point of novelty brought forward and addressed through this research.

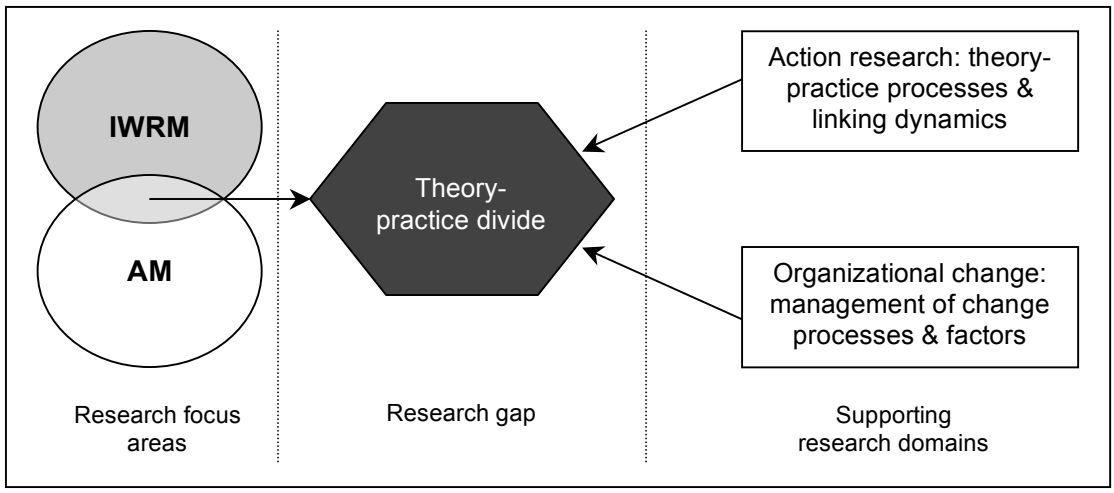

Figure 2.1 Research Focus, Research Gap and Supporting Research Domains

As elaborated in Chapter 1, the overall research aim of this study is: *to investigate the implementation pathways of IWRM & AM in order to identify the mediating factors and dynamics that emerge as IWRM & AM concepts are put into practice*. The literature review on IWRM and AM has shaped this research aim, whereas literature on Action Research and Organizational Change has supported the development of the conceptual framework that has informed the fieldwork.

2.2 IWRM and AM Concepts

2.2.1 The Promise of IWRM

IWRM as a water management paradigm evolved from the realization that those sectors involved cannot continue to manage water independently of each other and of the environment (Stikker, 1998; Dziegielewaki and Baumann, 1992;

Gleick, 2000; Duda and El-Ashry, 2000; White, 1998). IWRM seeks to consider economic, environmental, technical, social as well as cultural benefits and issues, while ensuring the sustainability of water resources for future generations (Braga, 2001). According to Lankford *et al*. (2007) the concept of IWRM has entered the vocabulary of water managers and stakeholders as the mainstream approach to water management.

The definition of IWRM as provided by the Global Water Partnership (GWP) is regarded as the most authoritative definition (e.g. Snellen and Schrevel, 2004; Jonker, 2007; Lankford *et al.,* 2007). The GWP defines IWRM as 'a process that promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems' (GWP-TAC, 2000). The World Bank (1993: 10) developed a similar definition: 'IWRM is the adoption of a comprehensive policy framework and the treatment of water as an economic good, combined with decentralized management and delivery structures, greater reliance on pricing, and fuller participation by stakeholders'. Hooper (2005) quotes other definitions of IWRM and 'integrated river basin management', IRBM, all quite similar.

These definitions capture the essence of IWRM – a broadening of the bounds of the management 'system' (with regards to water) to include multiple sectors, stakeholders, disciplines and scales. It is this balancing of goals and views of interdependent players which separates 'integrated management' from other forms of management practice (Grigg, 1999).

One of the central aims of IWRM is to promote co-ordination and integration as a means of achieving more holistic cross-sectoral water management (Jønch-Clausen and Fugl, 2001). The approach is proposed to create a clearer link between, and better understanding of, human and ecosystem requirements and the interactions between them (Wallace *et al*., 2003), and to manage 'people's activities in a manner that promotes sustainable development (improving livelihoods without disrupting the water cycle) (Jonker, 2002). Much like the

concept of sustainability, IWRM is not an end state to be achieved; it is a continuous process of balancing and making trade-offs between different goals and views in an informed way. One might then ask, what is the difference between sustainable and integrated water resources management? We shall return to this question below in our review of the challenges faced and lessons learned by IWRM theorists and practitioners.

IWRM has been advocated by many as the best means of incorporating the multiple competing and conflicting uses of water resources since the first UNESCO International Conference on Water, in 1977. Various international organisations have been trying to promote IWRM all over the world and during the last decades a number of conferences have been held with a focus on IWRM, for example, the Dublin Conference (1992) and the World Summit on Sustainable Development in Johannesburg (2002). Indeed, the IWRM approach is often referred to as the Dublin-Rio principle because it highlights an important principle developed during the Dublin Conference: that freshwater is finite, vulnerable and that it is essential to sustain life, economic development and the environment.

Despite this conceptualization, implementation of IWRM has remained elusive. A number of authors (e.g., Allan, 2003; Jonker, 2004; Biswas, 2004; Jeffrey and Geary, 2004) state that a reason is that the GWP definition does not provide the theoretical clarity required to practitioners for successful implementation. Jonker (2007) addresses four contemporary papers (by Allan, 2003; Rahaman and Varis, 2005; and Merrey et al., 2005, Van der Zaag, 2005) that argue the GWP definition for different reasons. According to Jonker (2007), these authors propose four possible directions in which the current IWRM concept could be developed in order for IWRM to become a concept that would assist with and guide implementation:

1 Adding new terms in the concept as Allan (2003) proposes;
2 Addressing the issues that arise during implementation efforts as proposed by Rahaman and Varis (2005);

3 Extending the definition as done by Merrey et al. (2005);
4 Viewing it as a framework and not a process as proposed by Van der Zaag (2005).

Jonker (2007) agree with Van der Zaag (2005) that the problem with the conceptualization of IWRM as a process is the issue that makes it difficult to guide implementation. A number of authors (White, 1998; Savenije and Van der Zaag, 2000; Thomas and Durham, 2003; Van der Zaag, 2005) are of the view that differences in practices of water management across sectors point towards the usefulness to think of IWRM as a framework rather than a process. This would allow these different sectors to manage water in a way that would best suit their particular needs (Jonker, 2007). By locating these practices within a common framework, shared with other water users, integration can be achieved (Durham et al., 2002; Savenije and Van der Zaag, 2000; Koudstaal et al., 1992). In other words, integration then takes place on the level of outcomes and achievements instead of on the level of practice (process). The implication with this perspective, however, is that the integration of outcomes does not address or deal with how the interaction and balancing of viewpoints of different stakeholders takes place nor does it address the process of trade-offs between different sectors.

In contradiction with his suggestion to integrate the outcomes and not pay too much attention to the process, Jonker (2007) then states that 'IWRM is not primarily about water, but essentially about people' (2007: 1262) and proposes the following definition of IWRM: 'IWRM is a framework within which to manage peoples' activities in such a manner that it improves their livelihoods without disrupting the water cycle'. This definition is certainly less complicated and extensive or 'wordy' than the GWP definition of IWRM, which will likely help practitioners to create a clearer vision of what it is IWRM is pointing towards, thus making it easier to guide and measure implementation.

2.2.2 How are ambitions of IWRM to be achieved?

IWRM in effect calls for a broader systemic approach to water management. Within the IWRM model there is recognition of the wide range of interacting environmental and human processes spread across a range of scales and institutions of relevance to water management. There is also a recognition that sustainable use of water resources will require more than the individual and separate management of these processes. IWRM therefore recognises that water resources will only effectively be managed if done so systemically and in a manner which acknowledges the holistic, interconnected nature of the various processes involved (Everard and Powell, 2002). How is such an approach to be implemented in practical terms?

Recent information about the current state of the IWRM concept and its implementation as understood by the GWP can be found in the Technical Advisory Committee (TAC) Background Paper No 10 (GWP-TAC, 2004). This document describes the 'Why, What and How' of the IWRM planning processes to provides guidance on implementation of IWRM. Successful implementation is seen to rely on three components or pillars (GWP-TAC, 2004):

- An *enabling legislative and policy environment* which sets up and empowers;
- An appropriate *institutional framework* composed of a mixture of central – local, river basin specific and public – private organisations, which provides the governance arrangements for administering;
- A set of *management instruments* for gathering data and information, assessing resource levels and needs and allocating resources for use.

These three pillars constitute a statement of the necessary governance conditions for the successful implementation of IWRM but in themselves are not sufficiently detailed or prescriptive to map out the road to realising the various ambitions of the approach. It could even be argued that the three pillars constitute a generic statement of the necessary governance conditions for implementing any natural resource management approach. In addition to this,

however, the GWP provides more detail on implementation in the form of a toolbox of good practices.

IWRM implementation is viewed as a cyclical process often referred to as the 'IWRM Cycle' (GWP-TAC, 2004). This cycle has been described in great detail elsewhere but in summary follows these steps:

1. Recognising the need to change through *establishing the status* of water resources and *building commitment to reform* current management practices, then;
2. *Assessing the gaps* between current management practices and those needed to resolve water resource issues, then;
3. *Preparing a management strategy and action plan* which completes the three pillars for successful IWRM implementation, and *building commitment to actions*, then;
4. *Implementing the plan* and *monitoring and evaluating progress* towards achieving goals.

The cycle is a modified version of the standard decision-making process model of problem formulation – option generation and selection – implementation – monitoring and evaluation, tailored to suit the IWRM context. As such it is a closed loop process although stakeholder involvement (a key aspect of IWRM for bringing together different perspectives on water resource issues and management - Radif, 1999) may result in certain phases and steps in the process having to be repeated. The cycle represents an ongoing learning and development process in which different countries can find themselves at different stages (GWP-TAC, 2000).

When it comes to implementation of IWRM, Lankford *et al.* (2007) identify two in their view contrasting systems of designing and incorporating IWRM (see Figure 2.2). In the left of their framework, they outline the manner in which governments and donor projects have in the recent past attempted to implement normative comprehensive IWRM programs (Van Koppen *et al*., 2004; World Bank, 1996) that incorporate the Dublin principles (ICWE, 1992)

calling it 'the IWRM continuum'. Lankford *et al.* (2007: 2) highlight that the 'operational programs differ from the comprehensive strategy because they cannot capture the whole picture without adequate funding' as constraints associated with scale, data availability, policing, knowledge, logistics, variability and systemic interfaces invalidates the pursuit of a complete IWRM as defined by the GWP. They, however, propose that the comprehensive framework of IWRM should not be the starting point for drawing up water operations, but instead to focus on 'problems' on the ground and the ongoing iterative relationships with stakeholders in a basin or catchment: this approach clearly has links to the AM concept.

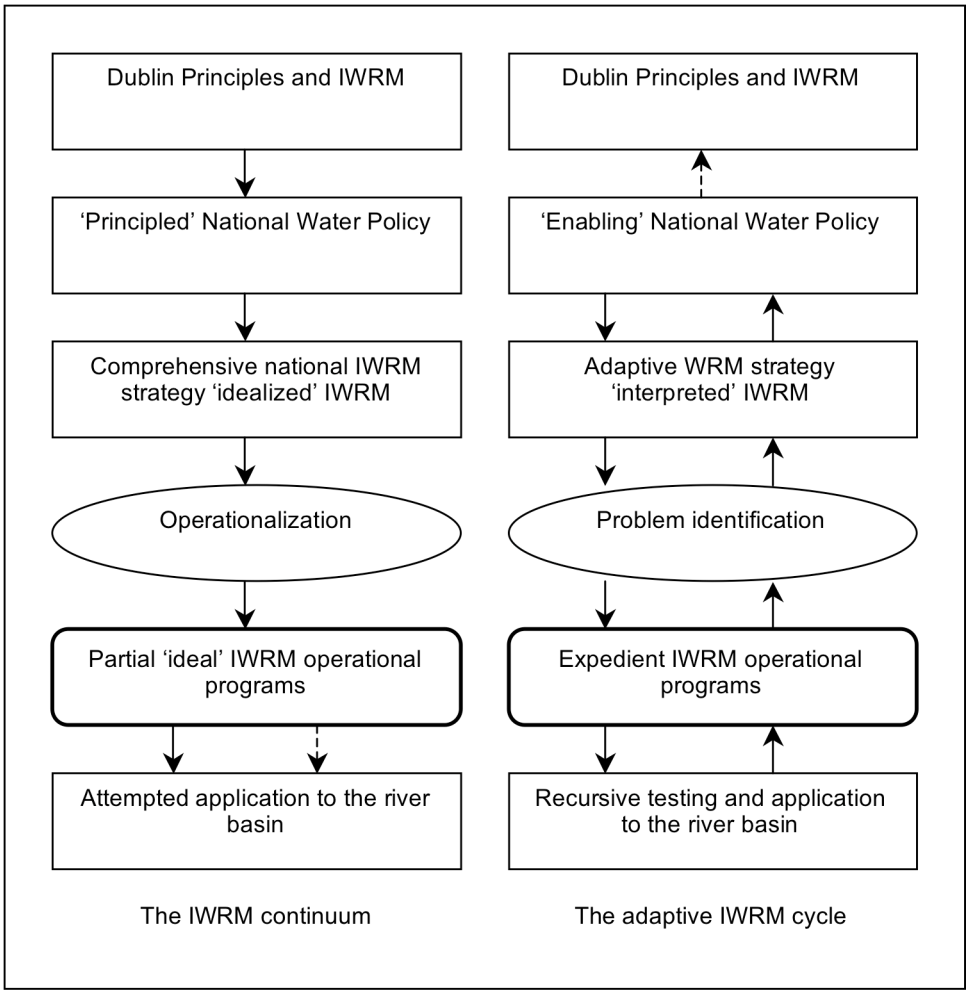

Figure 2.2 Deployment of IWRM policy and operations – a partial ideal or expedient? (Source: Lankford et al., 2007)

Implementation of IWRM is a balancing act (Lankford *et al.*, 2007): on the one hand reflecting on 'ideal IWRM' (that comes from the theory of IWRM and its principles - Van Hofwegen, 2001), and on the other hand reflecting the problems found. For example, Mitchell (1990: 4) writes that 'at the strategic level, a comprehensive approach should be used to ensure that the widest possible perspective is maintained, but in contrast, a more focused approach is needed at the operational level where attention should be directed to a smaller number of issues that account for most of the problems'.

2.2.3 Challenges and lessons learned - IWRM

Despite IWRM being promoted as an attractive approach by many supra-national as well as national organisations, case evidence from implementation experiences does not clearly demonstrate its ability to enhance water resource sustainability (as recently noted by Rahaman and Varis, 2005). As noted above, the ambitions of IWRM are expansive. Such broad aims are a significant hindrance to the ability of practitioners to demonstrate utility as the yawning gap between theory and practice is both difficult to bridge and offers an uncertain reward for those who try. The challenges facing the practical implementation of IWRM are numerous and this section provides a review of key critiques in this field in three key areas – definition, evidence and capacity.

IWRM has never attracted an agreed definition, and neither has the question of how it can be implemented been fully addressed (Odendaal, 2002). Indeed, although the GWP recently called for clarification of the essential elements of IWRM to help policy makers have a clear understanding of the issues that need to be focused on (GWP-TAC, 2000), the concept remains elusive and fuzzy (van der Zaag, 2005). Going further, Jønch-Clausen and Fugl (2001) suggest that IWRM has degenerated into a *buzz-word* that is used by many different people who, however, have a different understanding and give a different meaning to it. The fact that there is such ambiguity about the IWRM concept may itself be a barrier to implementation – why should there be an institutional change in water resource management if the meaning and benefits of

integration cannot be unambiguously articulated? It will be crucial to come to a more specific, evidence based understanding of the challenges and empirical evidence of IWRM in order to reach an effective translation of IWRM into operational reality.

Although the GWP definition of IWRM is broad and therefore impressive, in practical terms, it gives very limited practical guidance to present and future water managers and has been criticised as being difficult to implement for this reason (Biswas, 2004). Indeed it remains to be seen whether it is possible for a single paradigm to encompass all countries and regions, each with very different physical, economic, social, cultural, and legal conditions (Biswas, 2004). The necessity to adapt the IWRM concept to suit different local contexts makes it very difficult to develop a generic and overall description of strategies and techniques (Jeffrey and Geary, 2004).

Furthermore, the cross-sector, multi-stakeholder approach advocated by IWRM creates significant challenges which need to be met (Ohlson, 1999) including among other things: ambiguous boundaries and complex linkages; difficulties with objectives, alternatives and consequences; pervasive uncertainty, and multiple stakeholder conflict. Geldof (1997) categorises these challenges into three types:

1) *Complexity*: the more component parts we take into consideration and the more interactions we want to describe, the more information we need;
2) *Subjectivity*: the information we get is not always free of values, it can be biased, linked to interests, which makes it necessary to weigh things up against each other;
3) *Uncertainties:* the differences between the amount of information we need to perform our tasks and the information we actually have.

If IWRM is to be successfully implemented, and its promises to be realised, these three obstacles must be overcome. The question is why should IWRM be any more successful in this regard than other approaches including, notably,

sustainable development or as we shall discuss in the next section, Adaptive Management?

On *evidence*, Jeffrey and Gearey (2004) argue that empirical evidence of unambiguously demonstrated challenges and benefits of IWRM implementation is either missing or very poorly reported. It is clear that the role and benefits of IWRM will vary depending on the context of the implementing country: different countries will have different ways of implementing the IWRM process, be at different development stages and will therefore derive different benefits (GWP-TAC, 2000). Despite the difficulties of untangling the relative impact of IWRM over other aspects of implementation context, Walther (1987) analysed three Canadian case studies to assess the success of IWRM. He concluded that the success and performance of IWRM, measured in terms of output such as formal decisions or plans, is primarily a function of the historical situation into which a project is placed, and only secondarily of its professional design.

One of the main supposed benefits of using IWRM as a paradigm is its focus on the blending of viewpoints (Grigg, 1999). In other words, IWRM provides a holistic approach that considers the contributions of all users, planners, sciences and policy makers (Jeffrey and Geary, 2004). In a sense, however, IWRM is not holistic since it considers water to be very important, if not the most important resource. Integrated management of only one resource is not possible because of interconnections with other resources and aspects of human activity from land-use planning through transport to regional economics. However, if all resources and activities were to be managed in an integrated and holistic manner, most countries would end up with large, unmanageable, undesirable and counter-productive institutions. To avoid this, Biswas (2004) suggests that the aim should not be to integrate the management of these resources, but to create close collaboration, cooperation, and coordination between the existing institutions that are associated with the management of these resources. Again, whether or not such ambitions result in benefits remains largely to be seen but problems which can occur through a lack of

integration between water and other policy sectors are well recognised (see Samuels *et al.,* 2006).

On *capacity*, Keen (2003) has acknowledged that the current 'water crisis' could also be termed a 'crisis of Governance' as it is mainly related to problems in management and governance and goes beyond mere technical challenges. This view is supported by the GWP who note, that 'IWRM is a political process and involves conflicts of interest that must be mediated' (GWP-TAC, 2003). Effective water governance is necessary for the successful implementation of IWRM plans (Koudstaal *et al.*, 1992). Thus, many of the key implementation challenges involve the establishment of suitable policies and laws, viable political institutions, workable financing arrangements, self-governing and self-supporting local systems, and a variety of other institutional arrangements that will help to mitigate this impending crisis (Grigg, 1999, Wallace *et al.*, 2003).

In many countries, the principles that underlie the IWRM concept have not been internalized into socio-economic development policies and systems of governance. There is a lack of planning tools, management strategies, and human, institutional and systematic capacities to meet local demand for sustainable water services under climate variability and climate change regimes. Trans-boundary and regional water issues bring about additional complexity in developing appropriate national responses to water resources management (Kashyap, 2004).

These implementation capacity issues are attracting increasing attention from authors, many of whom echo Gilbert White's (1998) observation that 'the problems of accurate analysis of inter-sectoral linkages and of achieving institutional reforms in the planning process are formidable. It would be optimistic to expect early or easy solutions. Therefore, they deserve prompt, concerted attention' (White, 1998).

Analysis of actual IWRM operations manifest itself usually as critiques of IWRM or of specific and generic concerns regarding the appropriateness of river basin institutions to developing countries (Lankford *et al.*, 2007). Moench et al. (2003)

conclude that attempts to implement IWRM are not likely to be successful as people focus on constraints and immediate tasks, and not on understanding and integration of numerous factors that may have an influence.

Some of the above described practical concerns are also being addressed in a growing body of research and theory around AM (National Research Council, 2004; Swanson *et al.*, 2004) that in turn mirrors developments in adaptive natural resources management (Hagmann and Chuma, 2002; Stankey *et al.*, 2005; Tompkins and Adger, 2004). Even though AM implies practical action, it also remains 'primarily an ideal rather than a demonstrated reality' (Stankey *et al.*, 2005: 56). This next section will elaborate further on the concept and practice of AM as described in contemporary literature.

2.2.4 The nature of the AM concept

AM is a resource management approach that is claimed to solve a number of problems that have plagued traditional natural resources management (Levine, 2004). The AM approach stems from the recognition, that natural systems and the interactions between people and ecosystems are unpredictable (Gunderson *et al.* 1995) and recognizes the need for management actions to proceed even if our understanding of a system and the effects of management on a system are incomplete (Johnson 1999). Therefore, adaptive policies are designed to test hypotheses about system response to human interventions (Lee 1993). In other words, management actions are taken not only to manage, but also explicitly to learn about the processes governing the system (Shea *et al.* 1998).

Although the origin of the AM concept lies in many different intellectual and practitioner fields, its initial presentation as a natural resources management paradigm was in the 1970s (NRC, 2004). It was developed at the International Institute for Applied Systems Analysis in Vienna to support the management of natural resources under uncertainty (Holling, 1978; Walters, 1986; Walters and Holling, 1990; Irwin and Wigley, 1993; Parma *et al.,* 1998; Prato, 2003; Ohlson, 1999). Uncertainty refers to the situation in which the information that describes a problem under study is deficient (Klir and Wierman, 1999).

AM has been described by Holling (1978) as an 'integrated, multidisciplinary and systematic approach to improving management and accommodating change by learning from the outcomes of management policies and practices'. In other words, AM involves the design and implementation of management programs that offer the possibility to experiment with and compare selected policies and practices. This comparison takes place through evaluation of alternative hypotheses about the system (Holling, 1978; Walters, 1986; Lee, 1999). Lee (1993) emphasises the usefulness of this approach by stating: if human understanding of nature is imperfect, then human interactions with nature should be experimental. Although Holling (1978) is of the opinion that the AM concept will support management to proceed even if there is a lack of sound scientific foundation for action, other authors contradict this by suggesting that AM requires major investment in research, monitoring, and modelling to test alternative hypotheses about sustainable use and management of the natural resources (Smith and Walters, 1981; Hilborn *et al.,* 1995; Walters and Green, 1997; Prato, 2003).

AM can be seen as a management process that is both anticipatory as well as adaptive (Kay, 1997). Hypotheses and assumptions are developed based on a thorough understanding of the system as a way to anticipate possibilities and uncertainties that could have an impact on the system. These hypotheses and assumptions are translated into plans and actions, which are evaluated and monitored in order to test their affect on the system. Based on these results, the hypothesis and assumptions will be adapted with the objective to improve the overall management framework. The idea is that this process is repeated to guarantee continuous improvement. Advantages that are claimed for AM (McLain and Lee, 1996; Wondolleck and Yaffee, 2000; McDaniels and Gregory, 2004) include: (a) increasing the pace and frequency at which policy makers and resource managers acquire knowledge about ecological relationships; (b) aiding management decisions through the use of iterative hypothesis testing; (c) enhancing information flows among policy makers; (d) creating shared understanding among scientist, policy makers, and managers.

AM has multiple meanings and descriptions. Listed below are some examples of definitions given to the concept of AM by some the key authors, which illustrate this variability:

- An integrated, multidisciplinary process which integrates environmental with economic and social understanding at the very beginning of the design process, in a sequence of steps during the design phase and after implementation (Holling, 1978)
- A concerted effort to integrate existing interdisciplinary experience and scientific information into dynamic models that attempt to make predictions about the impacts of alternative policies (Walters, 1997)
- An approach to natural resource policy that embodies a simple imperative: policies are experiments; learn from them (Lee, 1993)
- AM is learning to manage by managing to learn (Bormann et al., 1999)
- A systematic process for continually improving management policies and practices by learning from the outcomes of operational programs (Nyberg and Taylor, 1995)
- A process combining democratic principles, scientific analysis, education, and institutional learning to increase our understanding of ecosystem processes and the consequences of management interventions, and to improve the quality of data upon which decisions must be made (Ecological Society of America, 1996)

The fact that AM has multiple meanings is not really surprising. Like IWRM, AM has been around for several decades, and like IWRM, AM has not stopped evolving as a concept. Consequently many people and disciplines tend to have a differing description for and understanding of the AM concept (Goodin, 1996; Pahl-Wostl, 2002). As is the case with IWRM, this ambiguity can be a source of confusion and result in a lack of clarity about purpose and process.

2.2.5 How are ambitions of AM to be achieved?

Often people think of AM as ‘learning by doing’, but this misses the essential goal of needing to experiment with complex systems to learn from them. In the

process of AM, management actions are taken not only to manage, but also explicitly to learn about the processes governing the system (Shea *et al.* 1998). Various models of the AM process have been proposed, ranging from simple to fairly elaborate (for example, Figure 2.3).

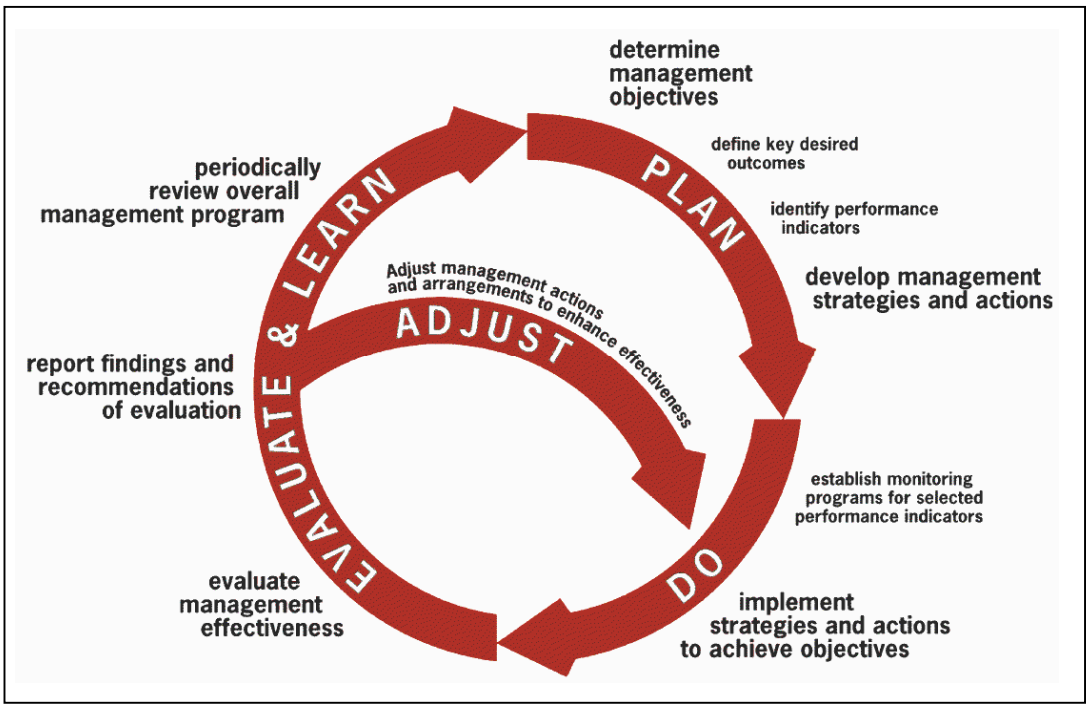

Figure 2.3 The Adaptive Management Cycle (Source: www.cmar.csiro.au)

Bormann *et. al.* (1999) describe AM as a process that involves 'learning to manage by managing to learn' including the following steps: development of management experiments; gathering information for and increase understanding of uncertainties; and, development of continuous monitoring procedures and space for adjustments.

Many researchers have emphasized the importance of stakeholder involvement throughout the process for improving the quality and perception of decisions made at each step (Dovers and Mobbs, 1997; Shindler and Cheek, 1999). An idealized cycle of AM includes the following sequence of steps, which are continually repeated (adapted from Johnson, 1999; Parma et al., 1998; Walters, 1997; and Healey et al., 2004): (1) establish a stakeholder adaptive management team; (2) define the problem(s) to be addressed; (3) establish goals and objectives; (4) specify a conceptual framework that expresses the

collective understanding of how the system in question functions, highlighting key uncertainties and acknowledging factors that are outside of the system; (5) develop hypotheses about the effects of different management actions that address the uncertainties; (6) design management experiments/ interventions to test hypotheses while meeting management goals; (7) design a monitoring plan to measure the impact(s) of management interventions; (8) implement management interventions; (9) monitor; (10) evaluate the impacts I terms of management goals and hypotheses; (11) reassess and adjust the problem statement, goals, conceptual framework, interventions, and monitoring plane.

AM theory can be split up in two streams, that of passive AM and of active AM. Passive AM formulates predictive models of ecosystem responses to management actions, bases management decisions on model predictions, and uses monitoring data to revise model parameters (Walters and Hilborn, 1978). This form of AM is non-experimental which makes it rather simple and inexpensive to implement. However, Hurlbert (1984) and Wilhere (2002) are of the opinion that this form of AM lacks statistical validity and does not provide reliable information for decision-making. Through time, the AM concept has slowly evolved from this passive form into an active form of AM, whereby experimentation is a key element for the development and evaluation of management decisions and actions (Halbert, 1993). These experiments and the outcome of their implementation form a basis for determining whether a particular intervention has achieved a desired outcome. In comparison to passive AM, the active form of AM claims to provide reliable information for decision making, since experiments include replication and randomization of management actions (Lee, 1993).

The active AM process is supposed to offer a framework to integrate research, policy and local practice to increase the adaptive capacity of river basins through a cyclic learning process that encompasses policy formulation, implementation and evaluation as well as the modification of conceptualisations based on the outcome of the policy evaluation (Holling 1978, Walters 1986, Gunderson et al 1995, Gunderson and Holling 2001). From both institutional

and ecosystem management perspective, continuous and deliberate learning emerges as a result of this experience-knowledge-action cycle. This learning cycle suggests that purposeful action derived from experience-based knowledge will itself result in new knowledge (Checkland and Scholes, 1990).

2.2.6 Challenges and lessons learned - AM

Despite the logic and appeal of the AM approach as a tool to aid decision making in complex, regional or large-scale ecosystem contexts, there is significant disquiet amongst researchers about the obstacles that have prevented its successful implementation and limited its effectiveness as a management approach (e.g. McLain and Lee, 1996; Walters, 1997; Levine, 2004). This section provides a summary of these key challenges as identified in the literature.

A major barrier is the fundamental tension between the strategies of science and management (Lee, 1993). Walters (1997) has made an assessment of the AM concept, in which he describes several limiting factors that have affected successful implementation of AM, such as: the focus on perfecting models rather than field testing them, expenses and risks involved in undertaking large scale experiments, fear among research and management organizations that AM may undermine their credibility, and fundamental conflicts among diverse stakeholders about ecological values. Although it is important for the implementation of AM to have a clear vision or model of the system (Walters 1986), the objective for AM should be the learning itself and not so much the development of tools that can help to support this learning process (Lee, 1999). However, it has been noted that the transition from theory and model development to actual implemetaton of experiments can be difficult (Walters and Green, 1997).

A number of barriers and challenges have been described in the literature, that are limiting the long-term effectiveness of the AM approach, most of which can be classified as social and institutional rather than technical issues (e.g. McLain and Lee 1996). The failure to strive for and implement actively adaptive

experiments is due to several reasons: (a) no flexibility in the institutional system, (b) little or no resilience in key components of the ecological system, and (c) technical challenges with designing experiments (Gunderson 1999). Other obstacles that have been described (Lee 1993) include: (i) high costs of information gathering and monitoring; (ii) resistance from managers who fear increased transparency; (iii) political risk due to the uncertainty of future benefits; (iv) difficulties in acquiring stable funding; and (v) fear of failure.

Lee (1993) writes that institutional challenges may be a key barrier to implementation of AM, but he states at the same time that the AM approach may be a tool for enhancing institutional effectiveness. Learning is information intensive and requires the active participation of many stakeholders that need to maintain a commitment to the learning process throughout (Margoluis and Salafsky 1998; Lee 1999). Sound adaptive water management relies on functioning institutions that are designed to accommodate change and new information. The institutional base is crucial for sustainable water resources management and development. Also long term sources of funding are crucial for the AM approach. Stakeholders may view AM and its experiments as too time consuming, complex, costly and ecologically and economically risky, and they may be unwilling to accept experiments without knowing the consequences.

In addition to the institutional and social barriers, another major reason for failure to achieve widespread adaptation and a rather modest success when adopted is the failure to define what is meant exactly by AM and how it should be implemented. The AM concept has many different meanings and definitions and it could simply be that resource managers do not understand exactly what AM is, how to apply it usefully in practice (Pahl-Wostl 2002) and difficulties in translating results from site-level projects to whole river system (Levine, 2004). However, one of the major challenges posed by AM is that it requires learning to occur at spatial and temporal scales relevant to the defined management task (Lee, 1993; Gunderson et al., 1995).

There are a number of reasons why the AM concept has not been successfully translated from theory into practice. Based on evidence from three case studies of AM, McLain and Lee conclude that the proposed advantages have not always been achieved. Walters (1997) goes further noting that out of the 25 major planning exercises for AM that he has participated in, only 2 could be considered well-planned. Other initiatives have either 'vanished with no visible product' or become 'trapped in an apparently endless process of model development and refinement'. This section has highlighted the muddled reality of AM, its range of meanings, applications, scales, and uses. Most of the benefits, such as ecological and social improvements, and learning, have yet to be realized.

It becomes clear from these reviews that AM is struggling with similar difficulties and challenges to its implementation as IWRM and the question rises whether there is something in common to explain these difficulties?

2.2.7 Conclusions

It would seem that despite both IWRM and AM offering attractive ambitions for improving water resource management, these have yet to be adequately realised. In Table 2.1 the two approaches are briefly compared and described in terms of the types of the problem they address, the nature of their approach, who is primarily involved in each, how their ambitions are to be realised, what they generate and what characterises good practice for each.

	IWRM	AM
Addresses problems that …	… are seen to be the fault of fractured planning and a lack of appreciation of the connectivity of processes	… 'Big Science' and 'Command & Control' approaches have failed to effectively solve, and that determinism does not adequately describe.
Is a …	…. call for joined up governance	.. theory about effective management of natural resources and a process for organizational learning
Involves ...	... multiple organizations and stakeholders operating across sectors and scales	... responsible authorities with support from different stakeholders
Is achieved by …	… reform of the existing governance system (planning, management and communication processes)	… engaging in a program of active learning about natural resource dynamics and use
Generates ...	… coordinated and integrated sets of resource management plans and actions	… a style of management which emphasizes exploration and learning.
Good examples are characterised by …	… strong political commitment to reform and to inter-organisational, cross-sectoral management	… a combination of hypothesis formulation, action and analytical reflection on the outcomes of management with the emphasis on learning

Table 2.1 Comparison of IWRM and AM Approaches

IWRM is primarily concerned with reform of water governance arrangements whereas AM is primarily concerned with the reform of responsible authorities, although this may involve stakeholder participation or co-ordination with other agencies. IWRM is concerned with changing the way in which water is managed by, in one sense, reformulating the problem or re-bounding the 'system' of concern. AM is concerned with changing the way in which responsible authorities view and undertake management action to focus on learning as a key way of combating uncertainty and promoting adaptivity. In this regard IWRM and AM are both focussed on and require some degree of institutional reform – from changing some management processes to potentially establishing entirely new organisations.

Each approach could inform change agendas at different scales but there is also a difference with regards to their degree of prescription. As a call for reform of governance, IWRM is less detailed in its prescription than AM, which is a call for reform of organisational process. Variations in the institutional structure and processes of water governance in different countries are substantial and there

is little to be gained from claiming that a single form of governance system would be better in some sense. On the other hand the scope of AM is tighter and so the prescriptive content correspondingly stronger. Reforming organisational processes is also a significant and costly task to the organisation(s) concerned but on a lesser scale compared to the reforms called for by IWRM. It can be concluded that both IWRM and AM face many barriers to their successful transfer from theory into practice. Table 2.2 identifies four common types of barrier for both approaches.

The fact that both approaches share a common set of barriers perhaps points to a wider, underlying problem – that of translating generic, science-based management concepts and theories developed by academics into practice. The gap between concept and reality may be too wide for implementation to bridge at least with regards the way in which such concepts are currently formulated and pushed out towards practice.

	IWRM	AM
Institutional	Effective water governance is crucial for the implementation of IWRM plans. Problems in management and governance go beyond mere technical challenges, in the case of IWRM, institutional reform is needed: correct policies, viable political institutions, workable financing arrangements, self-governing and self-supporting local systems, etc. Institutions are rooted in a centralised structure with fragmented sub-sectoral approaches to water management and often local institutions lack the capacity. Awareness and priority at political level of water issues is in many cases limited. Also information and data to support sound management of water is generally lacking.	It is said that institutional challenges may be the key barriers to implementation of AM, and/ or that AM may be a tool for enhancing institutional effectiveness. Social dynamics and institutional rigidities may complicate the implementation of the AM approach. Learning is information intensive and requires active participation of many stakeholders that need to maintain a commitment to the learning process throughout. Sound adaptive water management relies on functioning institutions that are designed to accommodate changes and new information. This institutional base is crucial for sustainable water resources management and development. Also long-term source of funding is crucial for the AM approach, which should include all steps of the process.
Evidence of success	The necessity to adapt the IWRM concept to suit different local contexts which doesn't allow for a generic, complete description of strategies and techniques. In practical reality, the IWRM concept has not structurally demonstrated its benefits to increase the sustainability of water resources management. Empirical evidence is either missing or poorly reported. It will be important to identify the essential elements for IWRM, while avoiding rigid prescriptions and allowing for vast differences among countries.	AM is a form of systems analysis which includes and performs many feedbacks between sectors, instead of narrow technical analysis, while using conceptual qualitative modelling instead of formal quantitative modelling. The drawback of this soft approach is that it is not easily reportable or demonstrable because it does not provide quantitative results. Also the AM approach has emerged into a more generic process, which could jeopardise the intended flexibility of the approach. It is important here to identify short-term strategies in the face of long-term uncertainty.
Ambiguity of definition	The most used definition of IWRM by the GWP gives very limited practical guidance to present and future water management practices. Besides the GWP definition there are several other definitions that all differ from each other in one or more facets or dimensions. Ambiguity of definition further compounds difficulties in demonstrating success.	A reason for failure to achieve widespread adoption and a rather modest success when adopted is the failure to define what is meant exactly by AM and how it should be implemented. The AM concept has multiple and often ambiguous definitions. Resource managers may not understand what AM is and how they can apply it in practical reality.
Complexity, cost and risk	IWRM takes into account relationships and dynamic interactions between human and natural systems, land and water systems, and key stakeholder agencies and groups. This interconnectedness on different scales and levels makes it very complex to translate the IWRM concept into practice. Management problems end up with ambiguous boundaries and complex linkages with other problems; goals, alternatives and consequences that are not well defined or understood; pervasive uncertainty which may not be quantifiable; and iterative management which involves conflict and negotiation among multiple stakeholders.	Stakeholders may view experimental management as too time consuming, complex, costly and more ecologically and economically risky. They may be unwilling to accept experiments without knowing the consequences. AM is considered difficult to initiate and sustain and unlikely to be affordable in many instances. AM is likely to be costly and slow in many situations, so those involved in stewardship should consider thoroughly whether this approach is worthwhile in all cases. New information must be collected and processed by management actors to draw meaningful conclusions and implement appropriate action. Providing such information is a difficult, costly task.

Table 2.2 Major Barriers to the Implementation of IWRM and AM Concepts

2.3 Theory-Practice Process and Linking Dynamics

2.3.1 Introduction

In a general research context, there have been (philosophical) debates about the linkages and dynamics between theory and practice for centuries, but in the context of management practice, it is only since recently that the academic literature has started to investigate this. Tensaki and Hay (2004) state that such investigations have not been undertaken systematically and have not provided much reference to the processes and the sequence of activities entailed in creating such linkages. According to Burgess (2003) it is crucial to become aware of the reasons for the fundamental incoherency between theory and practice.

From a scientific perspective, to develop and improve theory, it is crucial to understand how things work in practice (Argyris and Schon, 1978; Tardino *et al*., 2002). Bingman and Smith (2001) observe that much traditional research does little to stimulate thinking and facilitate action, and instead ends with a written product when the felt or expressed need is for strategy, technique, and actionable ideas. Driver (1985) refers to this as the 'user gap'. Observations from Driver's own experiences imply that when many practices that are grounded in theory are applied to organizational realities, they tend to be divorced in part or whole from the thinking that predicted their worth in the first place (Friedman, 2001).

The great divide between theory and practice characterizes most of the history of academic knowledge production (Rynes et al., 2001). A sign of successful linking and bridging of theory and practice is the production of *actionable scientific knowledge* through *action research* (Tenkasi and Hay, 2004). Actionable scientific knowledge can be referred to as 'the knowledge-creation processes that meet the criteria of the scientific/ research community and the requirements of practitioners' (Adler *et al*., 2003: 84). The following section provides an explanation of what action research involves, and how this

approach helps in linking theory and practice. In order to understand the process and the links between theory and practice, it is necessary to understand what constitutes theory and what constitutes practice as well as investigate the nature of the linkages between them (Tensaki and Hay, 2004). Subsequently, the meaning of theory and practice are discussed as well as their linkages and two existing models of interaction between theory and practice.

2.3.2 Action Science

An increasingly volatile global environmental context appears to be causing a widening of the divide between theory and practice in management and organization studies (Van de Ven & Johnson, 2006). Argyris *et al.* (1985) also addressed this divide between theory and practice, when they describe, for example, how 'programs fro transforming organizations succeed each other with the seasons, leaving in their wake the weary wisdom that nothing really changes'. Lindbloom and Cohen (1979) have written about producing knowledge (or theory) that can be used to produce action (practice). A small but increasing number of studies has begun to investigate the links and dynamics between theory and practice – specifically concerning knowledge production and consumption (e.g. Aram & Salipante, 2003; Shrivastara and Mitroff, 1984; Gibbons et al, 1994; Thomas and Tymon, 1982).

Traditional concepts of theory define it as an abstract body of knowledge that informs practice (McNiff *et al.,* 2002). This perspective emphasizes that the purpose of research is to (accurately) represent an objective reality or truth by building scientific theories (Crotty, 1998). From this point of view, knowledge is seen as separate from the people who create it. However, action science aims for a new concept and notion of theory and knowledge and what these constitute (McNiff *et al*., 2002) and involves a way of 'exploring previous claims to certainty in the way the world is and a means of pursuing better practices' (Walker, 2004: 3). Within this context, knowledge and theories are generated out of practice and are fed back into that practice (McNiff *et al*. 2002).

In other words, knowledge or truth does not exist independently but is instead

created by individual perceptions (mind) and through their everyday experiences (Crotty, 1998) and the construction of theories (and knowledge) then becomes a dynamic process (Whitehead, 1988; McNiff *et al*., 2002). According to this view, knowledge is never static or complete but is constantly changing as new understanding emerges. As McNiff *et al*. (2002) state, in other words, that an answer will always generate new questions, which in turn will generate new answers. According to this view, a critical process informs knowledge and 'modes of understanding' (Winter, 2002: 27), practice-based knowledge and tacit or personal knowledge (McNiff *et al*. 2002) are considered qualitatively valid knowledge and theory (Walker, 2004).

Action science is said to adopt a perspective that is both dialectical and 'critically' subjective (Reason & Rowan, 1981: 13; Reason, 1988a: 11-12). It recognises that a 'situation comes to be understood through the attempt to change it, and changes through the attempt to understand it' (Schön, 1983: 132). Action science does not suppress the individuality of experience, nor does it ignore or overlook it: moreover, individual experience is the starting point of the hermeneutic spiral, which is then subject to reflection that focuses on 'the outcomes of action, the action itself and the intuitive knowing implicit in the action' (Schön, 1983: 56).

2.3.3 Theory and Practice

While in general the need for bridging theory and practice has been emphasized, there has also been very little clarity about the nature of theory and practice (Oliver, 2001). In line of the principles concerning theory and practice in action science, Bateson (1973) states that theory and practice are considered as integrated parts of a whole: neither can be understood in isolation from the other and it is necessary to focus on the interaction between theory (form or content) and practice (process). This concludes that practice is in relationship to theory and that they cannot be viewed as two independent activities (Reay, 1986).

Many practitioners and scholars, however, experience these two as separate entities (Mullen et al., 2005). Consider, for example, that Schwab (1969; 2004: 109) identifies theory as a 'structure of knowledge' that 'abstracts a general or ideal case': it is associated with 'models, meta-theory, as well as organizing principles, including conceptual schemes and methods' (2004: 107), which some see as fixed and limiting. On the other hand, practice is often viewed as action 'that treats real things: real acts, real people (managers and practitioners), things richer, and different from their theoretical representations (2004: 110). Mullen *et al*. (2004) emphasize that with this kind of categorization of theory and practice in mind, it becomes clear that theory and practice, when viewed as separate forms of understanding, have become different lenses for viewing issues.

A number of authors (e.g. Reay, 1986; Kaptelinin and Nardi, 1997; Sless, 1997; Tensaki and Hay, 2004) claim that theory and practice are linked and should be integrated. Reay (1986), for example, describes how theory is often used to understand, evaluate and change a situation, which may then lead to a change in perception. This same author also explains that without action (practice) this is an incomplete process that then loses creative aspects of testing and evaluating theory (in action) and promoting change.

In order to develop more understanding about what constitutes theory and what constitutes practice, some authors (e.g., Tsoukas, 1996; Nonaka and Takeuchi, 1995; Van de Ven and Johnson, 2006) discuss different typologies of knowledge. Nonaka and Takeuchi (1995; as described by Rynes *et al*., 2001), for example, make a distinction between two types of knowledge, tacit and explicit knowledge:

- *Tacit knowledge* (also practical knowledge or know-how) is personal, subjective and context-specific generally held in cognitive frames;
- *Explicit knowledge* (also know-what or know-why in the form of theories) is codified and transmittable in formal, systematic language.

This distinction between tacit and explicit knowledge is very similar to another distinction made between context-specific knowledge (largely attributable to practitioners) and general knowledge produced by management scientists (e.g. Shrivastara and Mitroff, 1984; Aram and Salipante, 2003). Theories in use can be made explicit by collective reflection on action, whereas tacit knowledge can become explicit through 'reflective inquiry' (Schön, 1983; Lallé, 2003). New knowledge is seen as being created most rapidly when there is continual and iterative cycling from one form of knowledge conversion to another (Rynes *et al.*, 2001).

To conclude this section, it should be emphasized that conceptions of theory can vary between different (scientific) disciplines. Becher (1989) argues that divisions in research approaches point to disciplinary differences over issues such as the status of theories and paradigms. This illustrates that the purpose of theory may not be fixed and depends upon the individuals who adopt theory. The links between theory and practice are then 'owned' and given shape to by these individuals (Oliver, 2001; Williams et al., 2000).

2.3.4 Models of Interaction between theory and practice

The purpose of this sub section is to investigate existing conceptual models of theory-practice interaction in order to identify how different authors propose that theory and practice are linked. It is important to note, however, that after a thorough investigation of both published and electronic sources, it appears that a very limited number of interaction models for theory and practice have been developed. This section discusses two existing models for theory-practice interaction that have been found relevant and insightful for this study and the development of its conceptual framework.

As an introduction to these models of interaction between theory and practice, a metaphor is provided that has been developed by Mullen *et al*. (2004: 10) which compares the interaction between theory and practice as that of binoculars:

> 'With one lens representing theory and the other practice, but framed in one instrument, the use of binoculars allows to gain perspective on how theory and practice work together but independently. The focal point and the distance between the two lenses are an important thing to consider. It is only when you step back from the theories we believe to be true that we can really see how they are being played out in practice. It is also true that when we reflect our practices we are then in a better position to see how theory has played a part'.

Huberman (1993) proposes a process through which research knowledge becomes practical knowledge (see Figure 2.4). He states that research is generated in a 'scientific' universe with the aim of contributing to a specific body of knowledge, after which it is transferred to practitioners (Stream I). The bulk of research in knowledge dissemination and utilization is focused on this transfer process and the conditions under which this can be accelerated (Huberman, 1993).

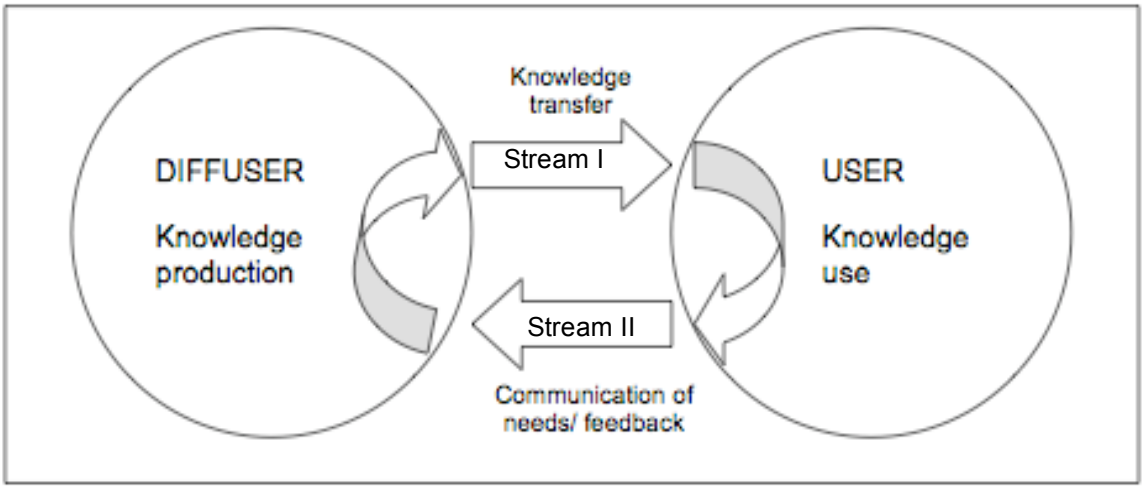

Figure 2.4 Knowledge Dissemination and Utilization (Source: Huberman, 1993: 13)

However, the bottom part of Figure 2.4 appears to be more in line with the action research tradition, whereby practitioners define the type of knowledge they require and the research community then frames its subsequent studies based on this feedback and the identified needs (Stream II). This figure clearly

proposes that the scientific/ research community and practitioners interact with each other through this process of transferring theory and knowledge and communication of feedback or needs.

Tensaki and Hay (2004) propose a model of 'mediated action' that is based on action research as the guiding framework to interpret the theory-practice linkages (see Figure 2.5). This model appears to elaborate in more detail on the above-described process by Huberman (1993). In the 'mediated action' model (which is based on a project cycle), the top process is in line with 'Stream II' in the first model and the bottom process with 'Stream I'.

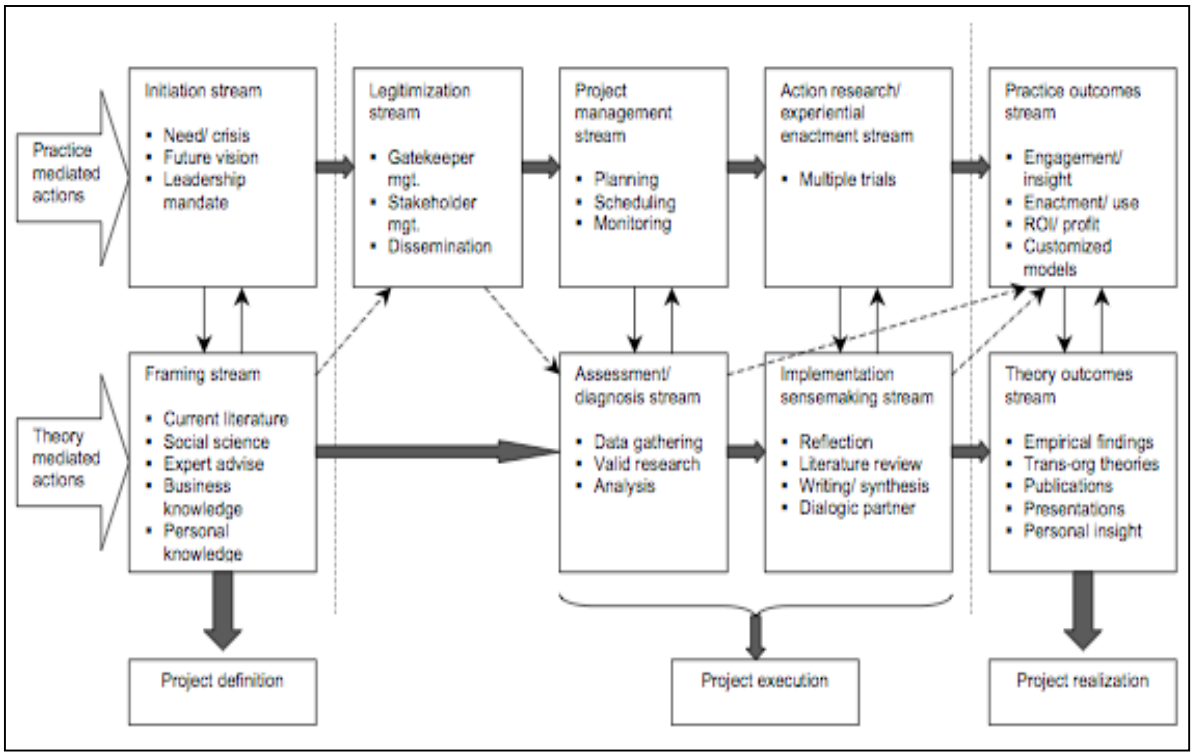

Figure 2.5 Mediating Action Model (Source: Tensaki and Hay, 2004)

The goal of the study by Tensaki and Hay (2004) was to 'develop a process model of theory-practice linkages that describes the elements of theory and practice, the nature of the linkages between them, the forms and functions of these linkages as well as the strategies that are used in constructing these linkages' (2004: 179). The underlying principle of this study is that 'action is the

common uniting theme for theory and practice' (2004: 180). Reference is made to definitions for theory and practice developed by Kaptelinin and Nardi (1997)

- Theory: Actions that are mediated by 'theoretical precepts' (formal domains of knowledge as represented and available in the forms of books, articles, expert opinion, and principles of research);
- Practice: Actions that are mediated by 'contextual contingencies and conventions' (non-theoretical tools that may include norms, routines, rules, and established procedures).

Tensaki and Hay (2004) propose that theory and practice are linked when a theoretically mediated action (theory) influences a practically mediated action (practice) or the other way around. These authors indicate that the sequence of projects can best be described as containing three major stages: project definition, execution, and realization. The results and outcome have been achieved through a stream of practice-mediated actions and a stream of theory-mediated actions. Furthermore, the data indicated that there are linking points between these two streams of action both within a stage and between stages. The nature of these links can be explained according to three analytical categories: (1) the forms of the linkages or their structure; (2) the functions of these linkages or the role they perform by linking theory and practice; (3) the strategies or manoeuvres through which the linkages were constructed.

The paper by Tensaki and Hay (2004) discusses these linking dynamics between the different stages of theory and practice quite extensively. This interaction model between theory and practice is useful as it provides and reveals a number of distinct elements of a practice and a theory nature that mediate and inform the respective streams of action. Together these elements and streams enable and define the outcomes for each stage in the project cycle; thus creating a very clear picture of the different dimensions of the theory-practice process as well as of the linking dynamics.

2.4 Change Management

Numerous arguments have been put forward regarding the need for a major change in water resources management (see Section 2.2). For example, increasing awareness of the impacts of climate change has lead to the insight that water management must become more flexible in order to deal with uncertainties and surprise. Pahl-Wostl (2008) states that the development and implementation of integrated and adaptive water management approaches require a structural change in water management regimes. Contributing evidence and models from change management literature are summarized in this section.

2.4.1 Overview

Change has always been a big part of everyday life. However, contemporary change seems to reflect more turmoil than ever before: with fast changes and dramatic implications for the entire world. Our way of life is transforming as we live it. Besides changes at the individual and organizational levels, there are profound national and global transitions that are not only altering our lives, but also shaping those of future generations. Connor (1993: 37) describes change as it is today as follows:

> 'Nearly twenty-five hundred years ago, the Greek philosopher Heraclites wrote that you cannot dip your toes into the same river twice. In other words, the ancients faced the challenge of transition just as people do today. In one form or another, people have always had to confront the repercussions of change. So what is different? The change encountered in previous eras was different. What has changed about change is its magnitude, the approach it requires, the increasing seriousness of its implications, and the diminishing shelf life of the effectiveness of our responses to it.'

He further describes several fundamental issues that contribute to the dramatic increase in the magnitude of change: faster communication and knowledge

acquisition; growing worldwide population; increasing interdependence and competition; limited resources; diversifying political and religious ideologies; constant transitions of power; and, ecological distress (Connor, 1993: 39). The interaction between these factors has a large impact on the volume, momentum and complexity of change and demand a radical shift in what people think, how they feel, what they believe and how they behave (Clarke, 1994).

The last few decades have seen a number of key theories that have influenced Change Management thinking over the past century (summarized in Figure 2.6). Which model or framework best suits is depending in part on (organizational or institutional) culture and personal preferences. Any of the models contain similar elements of change, presented in a slightly different way (Poole and Van de Ven, 2004)

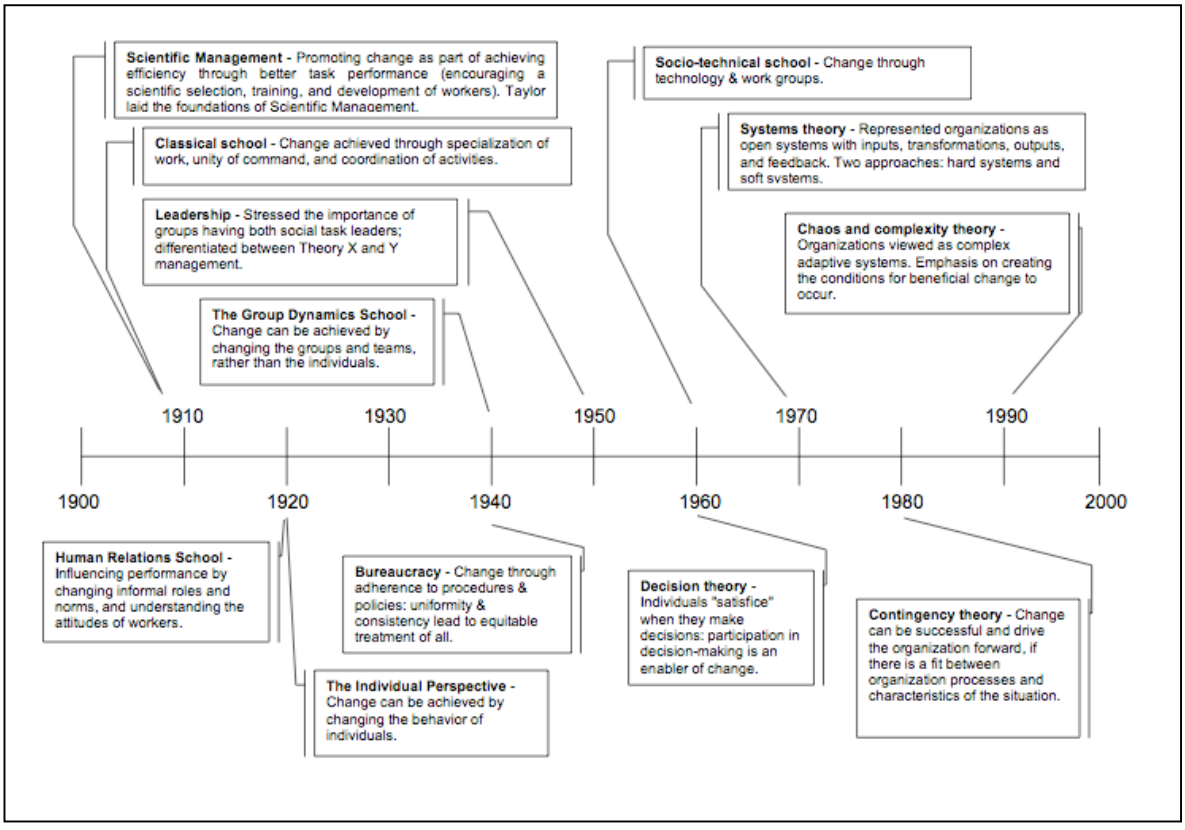

Figure 2.6 Historical Perspectives on Change Management (Summarized from www.jiscinfonet.ac.uk)

2.4.2 Process of Change

Change is a process, generally implemented in the form of policies, programs or projects. For over half a century, researchers have attempted to provide insight into the change process and its dynamics in order to help organizations successfully implement change. This has resulted in a variety of theories that have been developed to understand and predict processes that organizations go through to implement organizational change (Lewin, 1947; Isabella, 1990; Galpin, 1996; Armenakis & Bedian, 1999a).

One of the first models was developed by Lewin (1958) and classifies the change process into three phases: the present state, the transition state, and the desired state (Figure 2.7).

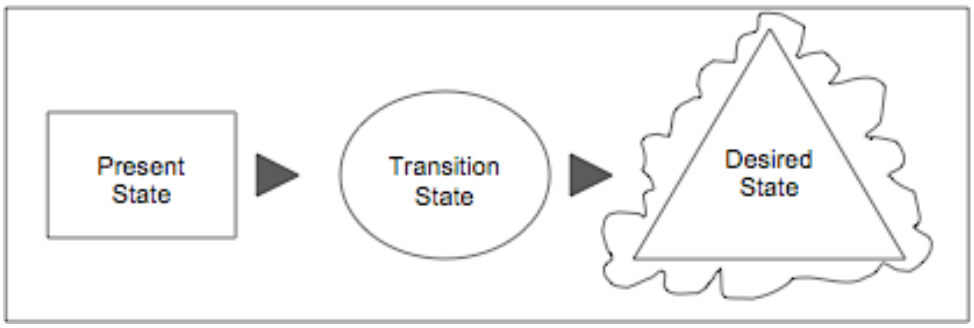

Figure 2.7 Change is a Process (Source: Connor, 1993: 88)

Lewin (1947) argues that change must move from *unfreezing* (of the present state), to *moving* (through the transition state), and *freezing* (when the desired state is reached). In order to go through these stages of unfreezing, moving and freezing successfully, the attitudes and behaviors of individuals towards the the intended change should go from initial *readiness*, to *adoption*, and finally *institutionalization* (Lewin, 1947; Armenakis *et al*., 1999):

- *Readiness* occurs when the environment, structure, and organizational members' attitudes are such that employees are receptive to a forthcoming change;
- *Adoption* occurs when the organizational members temporarily alter their

attitudes and behaviors to conform to the expectations of the change;

- *Institutionalization* occurs when the change becomes a stable part of employees' behavior.

These different phases, stages and required attitudes and their links are visualized in Figure 2.8.

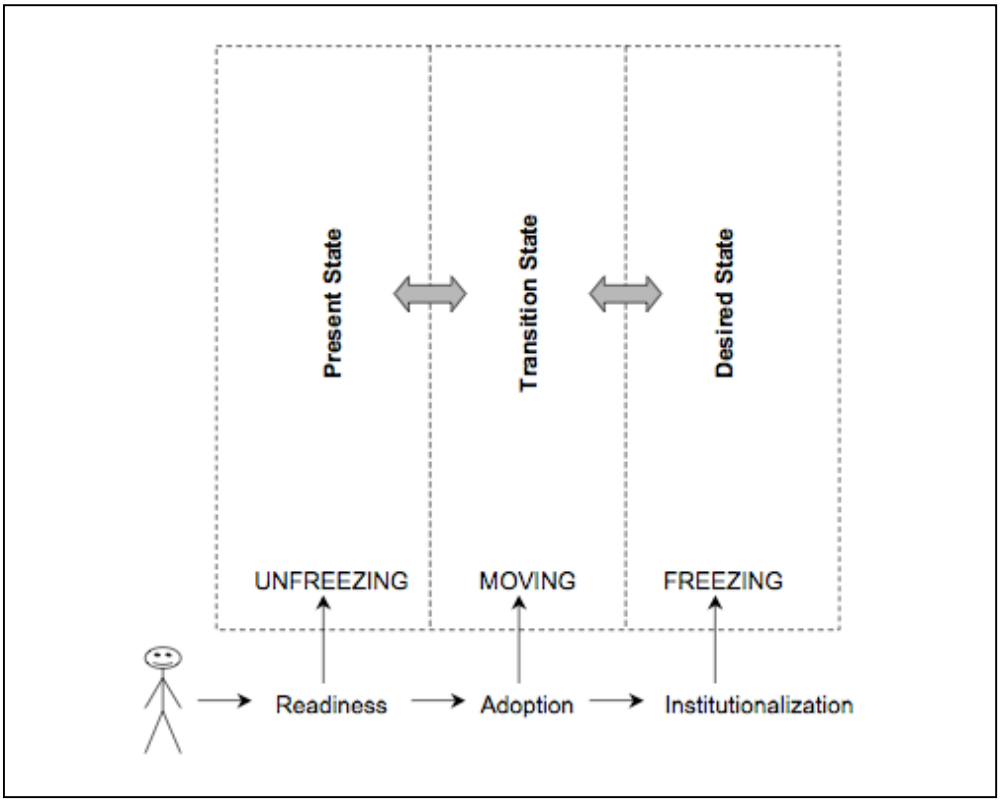

Figure 2.8 *Phases and Attitudes for Change Process* (Adapted from Lewin, 1947, 1958)

Building on this so-called 'Lewinian phase model', several change researchers have described steps practitioners can employ in implementing organizational changes (Armenakis *et al.*, 1999; Galpin, 1996; Judson, 1991; Kotter, 1995).

2.4.3 Space and Time Aspects

Every facet of life – from behavioral ethics to organizational, national and global levels – is undergoing change as forces external to each facet change (Walkers *et al.*, 2007). There is general consensus that change consists of 'multilevel

phenomena' (Poole, 2004: 20). Basil and Cook (1974) identify three origins of change: (a) institutional- structural; (b) technological; and (c) social-behavioral, and state that each origin of change impacts on the other origins. In addition, they also impact three different levels: geopolitical, organizational and individual levels (Figure 2.9).

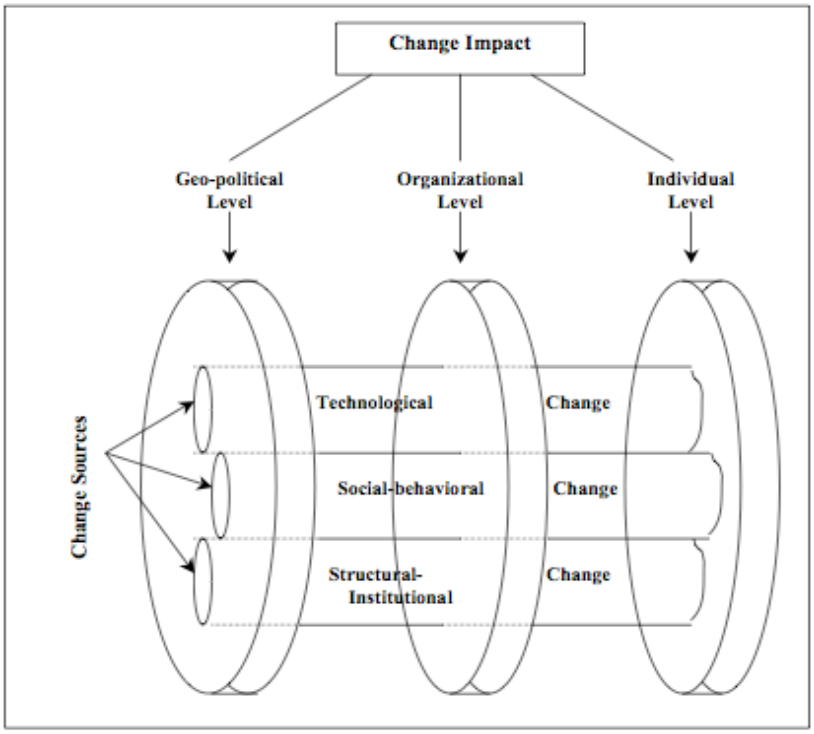

Figure 2.9 *Impact of Change Sources on the Individual, Organizational and Geopolitical Levels (Source: Basil and Cook, 1974: 4)*

Poole and Van de Ven (2004: 25) highlight, however, that these levels of analysis are 'not just dimensions of space, but social constructions with unique and sometimes complex structures of their own'. For example, rather than just having one group-level in an organization or system, there may be various types of groups (e.g., work units, informal cliques, cross-functional teams) that are related in complex ways.

Just as with levels of analysis, multiple temporal elements are also involved in most change processes (Basil and Cooks, 1974). 'This is true not just because of the substantive role that time plays in theories of change, but also because of

the complex way in which time enters into human activities' (Poole and Van de Ven, 2004: 23). While the full import of time in research on change is far from comprehensive, several frameworks and studies of time and its role in change processes have been advanced (McGrath and Rotchford, 1983; McGrath and Kelly, 1986; Zaheer *et al.,* 1999; Ancona *et al*. 2001; Goodman *et al*., 2001; Barkema *et al*., 2002). All these studies highlight several key issues, such as the nature of time, its role in theories of change, and how to best capture time as a metric and construct in change theories.

For example, McGrath and Kelly (1986) provide an analysis of the nature of time and provide a detailed explanation of several perspectives of time. On the other hand, Zaheer *et al*. (1999) develop an analysis of the significance of five different types of time scales in organizational theory and research. As the studies describe, each of these perspectives and time scales might have implications for theories of organizational change. Implicit with each perspective of time are notions on how time can be incorporated into theories of change (Poole and Van de Ven, 2004).

2.4.4 Change Factors and Dynamics

It is assumed that most managers and academics accept that change is unavoidable. However, research has indicated that only one third of all change initiatives achieve any success (DeVos and Buelens, 2003). Moreover, many failed change attempts result in a sharp loss of motivation, satisfaction and commitment, as well as a rise in the level of cynicism (Applebaum and Batt, 1993). This clearly implies the importance of a thorough understanding of the change process and its inherent consequences.

In a meta-analysis, Damanpour (1991) suggest that many organizational change researchers have searched for factors that contribute to the speed and effectiveness with which organizations move through different stages. In a review of organizational change research conducted during the 1990s, Armenakis and Bedeian (1999) indicate that three factors are common to all change efforts shaping reactions to these efforts: *content issues*, *contextual*

issues, and *process issues*. Studies have focused on these factors individually and examined the extent to which each of these facets influences the change process (e.g., Devos *et al.*, 2002; Eby *et al.*, 2000; Pettigrew *et al*., 2001). Studies, however, that address these factors simultaneously in an integrated way are still very rare (Self *et al*., 2001). In fact, Damonpour (1991) suggested that change success might ultimately be determined by a fit between these content, contextual, and process factors.

Another factor that should not be ignored in change research *are individual differences or attributes* among the change agents and the change targets (Bray, 1994). For example, Judge *et al.* (1999: 107) suggest that change success can depend in part on the 'psychological predispositions of individuals experiencing the change'. Although change is often aimed for structures, hierarchy, systems and technology, Schein (1980) states that it is mediated through individual change. He emphasizes that many change efforts fail because the importance of the individual, cognitive-affective nature of organizational change is underestimated.

The following sections will elaborate in more detail on the meaning of content, context, process and individual factors.

2.4.5 Content Factors

Content factors refer to *what* is being changed or the type of changes being implemented. Sometimes change is deliberate, a product of conscious reasoning and actions (planned change). In contrast, however, change sometimes unfolds in an apparently spontaneous and unplanned way (emergent change), for example, when external factors (such as economy and political climate) influence the change. Even the most carefully planned and executed change programs will have some emergent impacts. Walker *et al.* (2007) highlight that there are a number of ways in which change can be categorized, mostly related to the extent of the change and whether it is organic (bottom-up) or driven (top-down).

It should also be noted that different researchers have adopted similar dichotomous distinctions about organization change content, such as: first-order and second-order change (Watzlawick, 1978); continuous and discontinuous change (Hinings and Greenwood, 1988); and piecemeal and quantum change (Miller and Friesen, 1984). However, all these descriptions of different types of change imply that change differs in scope and focus, as well as to the degree with which they impact a system or organization. Four types of changes have been described in more detail below (Source: Walker et al., 2007: 762):

- *Fundamental change* often occurs in an attempt to meet demands coming from the external environmental. For example, demands such as new government regulations, a crisis situation, etc. Fundamental changes involve 'actions or events that alter the very character of the organization or system' (Reger *et al*., 1994: 32);
- *Incremental change*, on the other hand, is often a step-by-step movement toward an organizational or system ideal. For example, in order to meet future desired goals, the management of the system may attempt to fine-tune or adjust current operations to meet these future goals.
- *Episodic change* is infrequent and intentional. Typically, management introduces change in an attempt to correct the misalignment between the current state of operations and the environmental demands. Weick and Quinn (1999) describe how these changes may be spurred by external factors (such as changes in technological demands) or internal factors (such as a change in key personnel). Episodic changes may include changes in structure or ownership;
- *Continuous changes* are perceived to be ongoing and constantly evolving. Management may implement continuous change in an attempt to upgrade work practices (Brown and Duguid, 1991) or social practices (Tsoukas, 1996).

On the basis of the above-described categories, Ackerman (1997) distinguished

three additional types of change:

- *Developmental* is either planned or emergent; it is first order, or incremental. It is change that enhances or corrects existing aspects of an organization, often focusing on the improvement of a skill or process;
- *Transitional* seeks to achieve a known desired state that is different from the existing one. It is episodic, planned and second order, or radical. Much of the organizational change literature is based on this type;
- *Transformational* is radical or second order in nature. It requires a shift in assumptions made by the organization and its members. Transformation can result in an organization that differs significantly in terms of structure, processes, culture and strategy.

Orlikowski (1996) highlights that the distinction between episodic and continuous change helps clarify thinking about an organization's future development and evolution in relation to its long-term goals. Using these characteristics, Pennington (2003) states that proposed changes could be placed along two scales: radical-incremental and core-peripheral (see Figure 2.10). To identify the character of a proposed change along these scales can provide a sense of how difficult the introduction of any particular initiative might be and how much disturbance to the status quo it might generate.

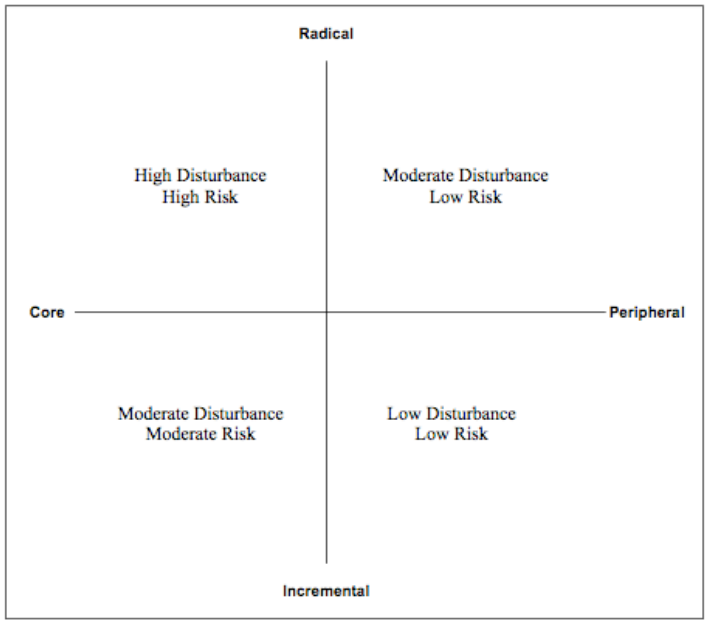

Figure 2.10 Characterization of Proposed Change (Source: Pennington, 2003)

A number of authors (e.g. Beer and Nohria, 2000; Self *et al.*, 2001) distinguish changes from those having a severe impact on the lives of people involved, to changes where the impact is much less serious and threatening. DeVos and Buelens (2003) emphasize that different types of changes have differing impact on attitudes of those involved towards the change content. In other words, they indicate that the content of intended change processes are directly related to attitudes and reactions to this change. As an example, Applebaum and Batt (1993) describe how changes that threaten job security of employees can have a destructive effect on morale and attitudes, even when it is not their own job that is threatened by the change.

2.4.6 Context Factors

Change context factors, are described by Mowday and Sutton (1993), as 'organizational conditions external to individuals that influence affective reactions, such as, interpersonal relationships, organizational norms and values, rules and regulations'. Context factors refer to the pre-existing forces in the external and internal environment of a system or organization (Walker *et al.*,

2007). These context factors characterize the circumstances or existing external and internal conditions that have been shown to influence the effectiveness of the system or organization.

External contextual are defined as those factors and forces over which organizations have little control. Instead they must make changes in response to such demands (Walker *et al*., 2007). Examples of such external contextual forces are: competitive pressure (Meyer *et al*., 1990); governmental deregulation (Kelly and Amburgey, 1991); or legislative and technological changes (Haveman, 1993).

Internal contextual factors may include levels of professionalism, managerial attitudes toward change, managerial tension, technical knowledge resources, and slack resources (Damonpour, 1991). Eby *et al.* (2000) found that the conditions of the internal context can explain the general attitude or readiness towards change. Moreover, Armenakis and Bedeian (1999) state that an organization or system's prior change history has impact on internal contextual issues. For example, cynical feelings or resistance to change may result from a loss of faith in the change agents or a history of unsuccessful change attempts (Reichers *et al*., 1997) and the presence of these feelings has the potential to negatively affect the success of a change process.

In other words, independent of what is being changed: external and internal contextual factors can explain why a change initiative is or is not successful (Johns, 2001). People in organizations driven by politics, territoriality, or inconsistent leadership, will have a different attitude towards change than workers who can rely on an open and strong leadership that clarifies goals related to change (DeVos and Buelens, 2003). Other variables that affect the level of openness to change are: e.g., the culture and climate of organizations in directing and motivating people (Schneider *et al.,* 1996); trust and confidence in the goodwill of sincerity of management and leadership on two levels: executive and supervisory levels (Folger and Konovsky, 1988; DeVos and Buelens,

2003). Trust of team members in their leader is a critical antecedent of people's cooperation in implementing strategic decisions (Korsgaard *et al*., 1995).

2.4.7 Process Factors

The change process encompasses *how* change is implemented and process factors refer to the actions taken by change agents during the planning and implementation of the proposed change (Walker *et al*., 2007). Apart from the above-mentioned context conditions and the specifics of change (content), the way in which change is planned and implemented also affects the attitudes of people involved to the intended change. The underlying assumption is, that the way leaders and change agents introduce change and prepare people for change must be through open and honest communication (Armenakis *et al*., 1993).

The planning and implementation of change goes through different phases. Several models have described these different phases (e.g. Isabella, 1990; Judson, 1991; Galpin, 1996; Armenakis *et al*., 1999). These phases are referred to as the change process. Research has indicated that participation is a central variable to increasing acceptance of change (Kotter and Schlesinger, 1979; Kotter, 1995; Wanberg an Banas, 2000) and that a lack of participation is a major cause of disappointing results. Walker *et al*. (2007) emphasize that people involved must believe that their opinions have been heard and given respect and careful consideration.

Armenakis *et al*. (1999) suggested a successful change message must address five different key areas:

1. *Discrepancy component* that involves an explanation of the gap between the current state and the desired state;
2. *Appropriateness component* that is more specific and conveys the idea that the proposed change (i.e. content) is appropriate in bridging the gap between the current state and the desired state;
3. *Efficacy* where the change target expresses confidence in the ability to

successfully implement the change;

4. *Principal support component*, which ensures readiness by addressing that both internal and external leaders are supporting the change;
5. *Personal valence* helps clarify the personal benefits of successfully implementing the change.

These components need to be addressed and in addition, active or passive participation and timely communication are important change process variables that play key roles in leading successful change (Armenakis *et al*., 1999). Other researchers adopt a similar approach, placing emphasis on honest and open communication by change agents (Galpin, 1996; Judson, 1991; Kotter, 1995).

2.4.8 Individual Attributes

In addition to the macro-level factors described above, each change process also involves a variety of individuals that possess various attributes (dispositional and personality characteristics) that determine attitudes and behaviours towards change (Staw and Ross, 1985; Schneider, 1987). In other words, individual attributes refer to *who* is involved as change is planned and implemented. During these change efforts, these individual attributes can influence reactions and commitment to change (Walkers *et al.*, 2007).

Substantial empirical work examined the influence of personality characteristics in coping with change (Judge *et al*., 1999; Wanberg and Banas, 2000). For example, individuals highly tolerant of ambiguity (Budner, 1962) should be better equipped to handle the uncertainty associated with organizational change (Judge *et al*., 1999). Similarly, individuals high in openness to experience (McCrae and Costa, 1986) and high self-monitors (Snyder, 1974) should react more positively to organizational change efforts (Wanberg and Banas, 2000). Another important individual characteristic is locus of control: the individual perception of his or her ability to exercise control over the environment (Rotter, 1966).

Thus, a complete model of change should not only address macro-level forces such as content, process, and contextual factors, but also micro-level factors such as individual differences and attributes. There is also strong evidence to believe that individuals might react differently to the same change because of characteristics of change agents as well as those of their own (Armenakis *et al.*, 1993). Armenakis *et al.* (1993) emphasize the importance of internal change agents (i.e. leaders and managers) as individuals might react differently regarding the same situation within a change setting due to the managers and leaders' attributes.

2.5 Reflection on Conceptual Framework

As indicated in Figure 1.2 in Chapter 1, there are two reflection phases (I and II). The first reflection phase was undertaken during and after the initial research design and planning, whereas the second reflection phase occured during and after data collection and analysis of the selected case studies. Reflection I provides a sort of pre-fieldwork robustness check of the initial conceptual framework (Figure 1.1) and this section elaborates on the insights and revisions made to this initial framework after the first reflection phase. Literature relevant to this discussion has been provided in this chapter.

The initial design of the conceptual framework was discussed with a number of experts during a session at a conference in Montana, USA, organized by the American Water Resources Association (AWRA). The aim of this luncheon session was to integrate and exchange ideas on different topics with other researchers and experts. One of the topic discussions was themed: *challenges facing AM & IWRM and overcoming them*, and questions that were proposed for this particular discussion were:

- What are the toughest challenges you encountered while developing, implementing & operating an AM or IWRM program?
- Are the challenges different between the development, implementation & operation stages?

- How can these challenges be overcome?

During this discussion, the initial conceptual framework was introduced and proposed as a framework for finding answers to the questions posed. The experts involved in the discussion (seven in total) all agreed that the conceptual framework would be a useful guide to the discussion as it clearly identifies the different stages of IWRM and AM programs. Many barriers and challenges were discussed (an oversight of these mediating factors is provided in Appendix I) and when it came to discussing how they individually affected the different steps, all participants agreed that the identified factors are not linked specifically to certain steps only. Rather, these factors were characterized as inter-connected, influencing the overall process of developing, planning and implementing IWRM and AM in different ways.

When highlighting barriers and enabling factors to the implementation of IWRM and AM concepts, participants were also aked to indicate where in the overall process of developing, planning and implementing those factors have most impact and influence. In a majority of cases, respondents indicated that the factors would influence more than one step of the overall process. As described in Section 2.4, academic literature on strategic and change management describe four types of factors that influence implementation of a strategy or change process: content, context, process and individual attributes (Pettigrew and Whipp, 1991; Devos and Buelens, 2003). Some of these key factor categories are also mentioned briefly in papers focusing on water management practices in the Netherlands (Kuijpers and Glasbergen, 1990; Rooy, 1995; Mostert, 2006). The conference discussion (and mediating factors identified) clearly indicate that the four key categories of change processes are applicable and useful for this research and further revision of the conceptual framework:

(1) *Content factors (meso)*: factors relating directly to theory and its use in practice. Conceptions of a particular theory may vary between different scientific, professional disciplines, etc. It can therefore be argued that the purpose and shape of theory may not be fixed and depends upon how the

users of this theory conceptualise and perceive it (Becher, 1989; Williams et al., 2000; Oliver, 2001);

(2) *Contextual factors (macro/ meso)*: factors refering to the internal and external environment that can complicate or facilitate the implementation process of strategies or concepts and include issues such as the formal institutional structure, the political and scientific culture and environmental awareness;

(3) *Process factors (meso)*: apart from the overall context, the way and manner in which a specific theory is implemented can affect the implementation process. The process factors refer to how cooperation and decision-making is organised; referring to issues such as the type of organizations, facilitation of the process and in- or exclusion of stakeholders;

(4) *Individual attributes (micro)*: in addition to the above-mentioned more macro-level factors, individual attributes refer to micro-level factors relating to the reactions to change efforts by stakeholders and individuals involved.

The links and connections between the three key macro-meso level categories of mediating factor influencing the translation from IWRM and AM theory into practice have been visualised within a revised conceptual framework below (Figure 2.11). The micro-level factors (individual attributes) are at the core of the framework.

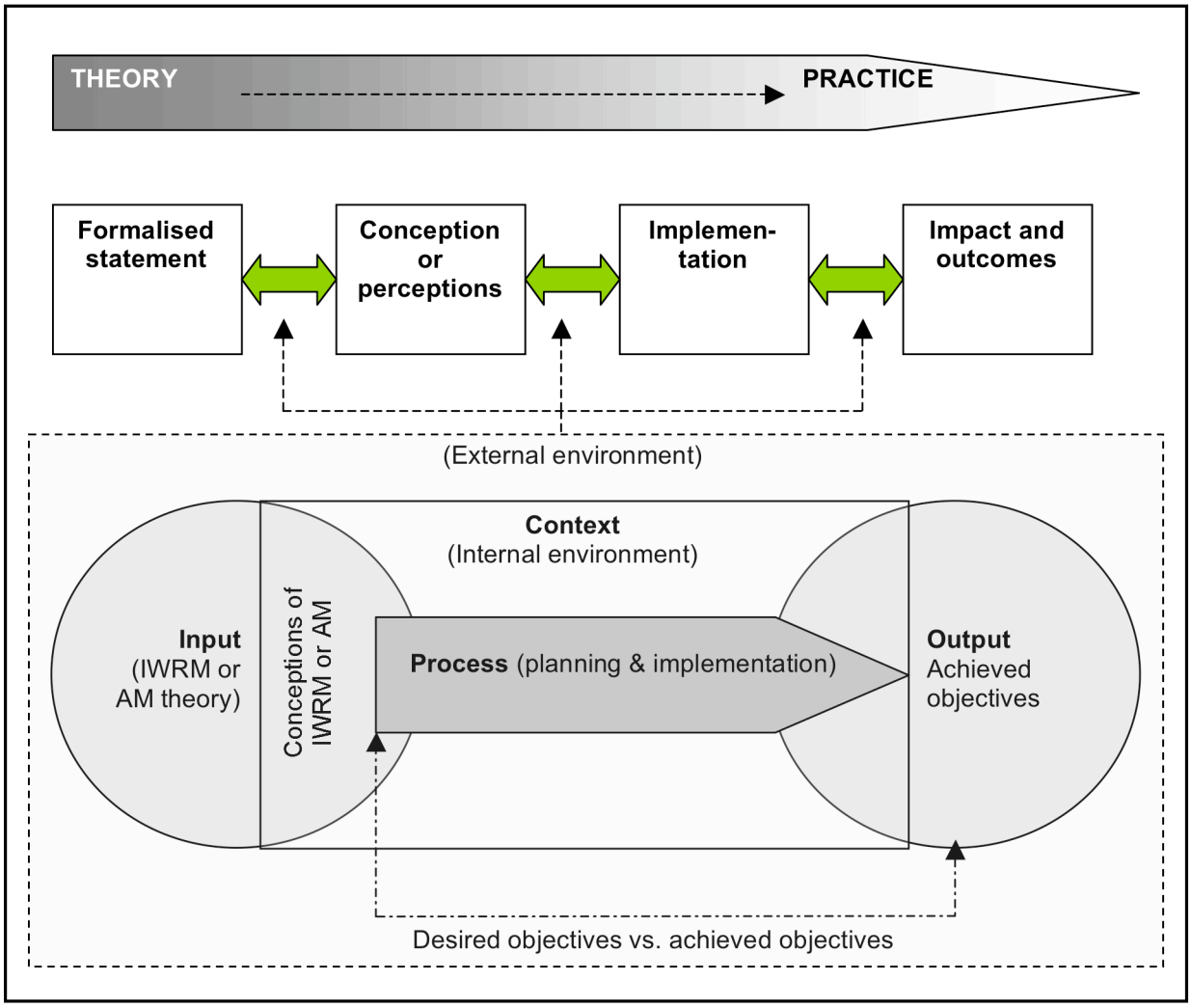

Figure 2.11 Revised Conceptual Framework of Theory to Practice Process

The upper part of the framework shows the initial conceptual framework with steps for translation of theory into practice. Within the dotted box, the links and dynamics of the three key macro-level categories are visualised (content, context and process).

2.6 Conclusions

This chapter is a synopsis of the literature relevant to this study. Its aim is to convey an understanding of the current and main issues in relevant areas, such as water management concepts, IWRM, AM, theory-to-practice process, literature on change processes, etc. The aim of this chapter is to position the research covered in this thesis in the context of relevant existing academic

literature. From this, the novelty this research offers as a contribution to the domains considered is established. First, a brief overview of the pertinent domains is presented. Second, these are returned to in more depth in order to communicate a landscape of the subject areas, and to tease out significant issues and to present the locus of their correspondence to this research.

3 The Research Process

3.1 Introduction

This chapter provides a discussion and elaboration on the design of the adopted research process. The background context of this research has been provided in Chapter 1, as well as the initial conceptual framework and research questions that form the basis of this research design. This chapter describes the development of the social science research process executed. It provides an overview of the broad scope of research methodology considered in order to make decisions concerning the actual research undertaken.

There is a burgeoning literature, which describes and categorizes social science research and its conduct. The aim of this chapter is to demonstrate the foundation upon which relevant research decisions were made and to highlight influencing issues. The actual research methods used and implemented are referred to along the way. Methods for data collection and analysis are described in more detail in Chapter 4. The following sections identify the concepts that are central to describing and situating the research process within the accepted categories of social science research and how these concepts are applied to this research.

3.2 Describing Social Science Research

This section elaborates the fundamental epistemological character of the research undertaken: paradigmatic underpinnings of the research; intent of the research; and methodological nature of the research. There are many ways to describe and categorize the social science research process including the choice of research paradigm, research strategy and methods. However, there seems to be general agreement that the development of a social science research topic involves the following stages (see Figure 3.1):

1. Identifying where the research fits within the spectrum of the major social science *research paradigms*, in particular where the research fits along the positivist- interpretivist spectrum;
2. Determining the *research strategy* that suits the research questions to be answered and the circumstances of the research;
3. Detailing the *research methodology*, e.g. methods for data collection and analysis (including views on utility of qualitative vs. quantitative methods);
4. *Interpreting the data* including the 'art, politics and practice' of interpretation;
5. Acknowledging the *limitations of the research*;
6. *Conclusions* are the result of interpreting the data while acknowledging the limitations of the overall research design, data and process.

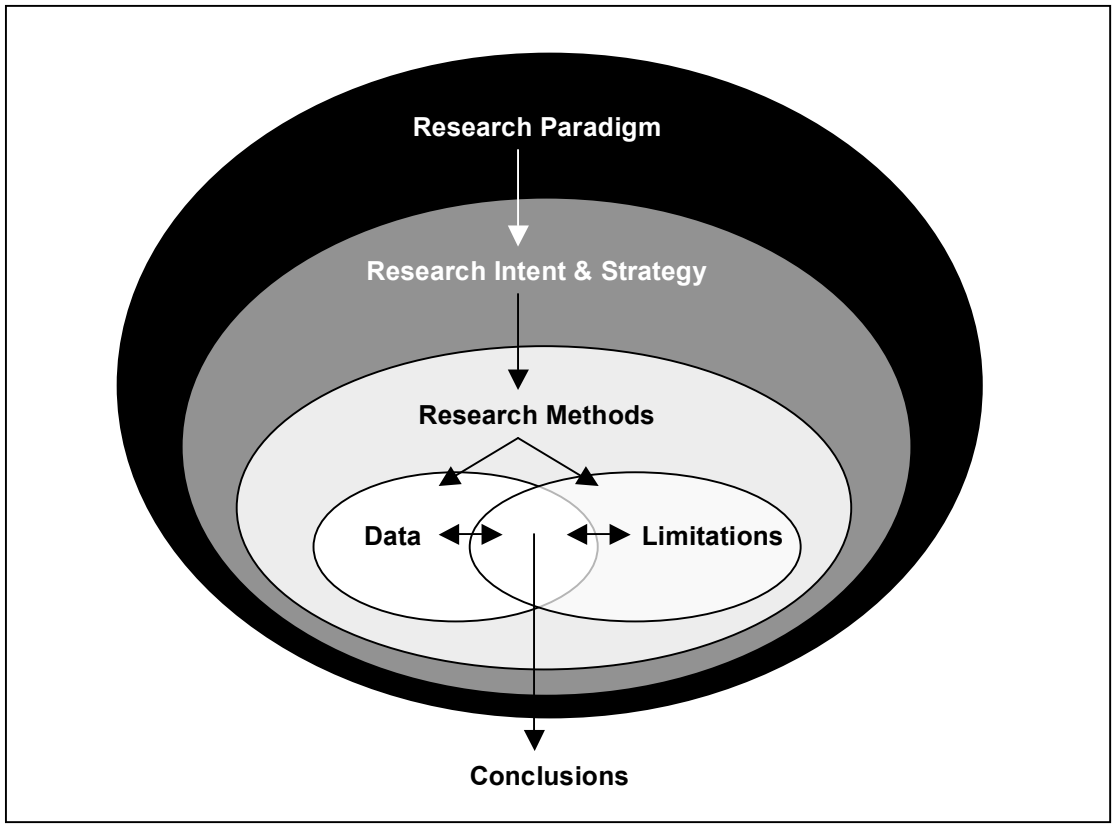

Figure 3.1 Social Science Research Process

These steps are interdependent and nested in nature, which suggests that a choice at an outer stage of the research process affects the subsequent inner stages. The remainder of this chapter will focus on the above steps in the

context of this research, providing a 'roadmap' for the conduct of the research and for the thesis itself.

3.3 Research Paradigm

Denzin and Lincoln (1994: 105) state that '*questions of method are secondary to questions of paradigm, which we define as the basic belief system or worldview that guides the investigator, not only in choices of method but in ontologically and epistemologically fundamental ways'.* Before discussing the different research paradigms, Table 3.1 provides a description of the terms 'research paradigm', 'ontological premise' and 'epistemological premise'.

Terms	Descriptions
Research Paradigm	Encompassing both epistemological and ontological positions as well as methodological premises
Ontological Premise	Relating to the nature of social reality and how researchers understand their perceptions of the world at large and the people in it
Epistemological Premise	Referring to the theory of knowledge that is held by which researchers understand their relationships with the known

Table 3.1 Descriptions for Paradigm, Ontological & Epistemological Premise (Source: Denzin and Lincoln, 2000)

Silverman (1993: 21) states that research paradigms are associated with two broad and very different versions of research, broadly called 'positivism' and 'interpretivism'. Silverman explains how a positivist approach seeks to test correlations between variables, whereas an interpretivist approach is more concerned with observation and description (for an oversight of these two 'schools' see Table 3.2).

Approach	Concepts	Methods
Positivism	Social structure, social facts	Quantitative hypothesis-testing
Interpretivism	Social construction, meanings	Qualitative hypothesis-generation

Table 3.2 Silverman's Two Schools of Social Science (Silverman, 1993: 21)

Guba and Lincoln (1994) have expanded and organized these two broad categories – positivism and interpretivism – into a spectrum of five paradigms that share some traits between them. Table 3.3 provides an overview of the relationships between these two approaches as the two broad categories of 'positivist' and 'interpretivist' (after Silverman) have been linked to the more detailed continuum of social science research paradigms (as described by Guba and Lincoln). These five research paradigms (see Table 3.3) are described in more detail below:

(1) Positivism science traditions hold to naïve and critical realist positions concerning reality and its perception. In the positivist version it is asserted that there is a reality out there to be studied, captured and understood, whereas the postpositivist argue that reality can never by fully apprehended, only estimated (Guba, 1990).

	Issue	Ontology	Epistemology	Methodology
Positivist	Positivism	Naïve realism – 'real' reality but apprehendable	Dualist/ objective: findings true	Experimental/ manipulative; verification of hypotheses; chiefly quantitative methods
	Post-positivism	Critical realism – 'real' reality but only imperfectly and probabilistically	Modified dualist/ objectivist/ critical tradition/ community: findings probably true	Modified experimental/ manipulative; critical multiplism; falsification of hypotheses; may include qualitative methods
Interpretivist	Critical Theory	Historical realism – virtual reality shaped by social, political, cultural, economic, ethnic, and gender values crystallized over time	Transactional/ subjectivist; value-mediated findings	Dialogic/ dialectic
	Constructivism	Relativism – local and specifc constructed realities	Transactional/ subjectivist; created findings	Hermeneutic/ dialectic
	Participatory	Participative reality – subjective-objective reality, co-created by mind and given cosmos	Critical subjectivity in participatory transaction with cosmos; extended epistemology of experiential, prepositional and practical knowing co-created findings	Political participation in collaborative action inquiry; primacy of the practical; use of language grounded in shared experiential context

Table 3.3 Basic Beliefs of Alternative Inquiry Paradigms (Adapted from Densin and Lincoln, 2000: 168)

(2) Postpositivism relies on using a combination of different methods as a way of capturing as much of reality as possible. Although many qualitative researchers in the postpositivist tradition will use statistical measures, methods

and documents as a way of locating groups of subjects within a larger population, they will seldom report their findings in terms of the complex statistical measures or methods to which quantitative researchers are drawn (Denzin & Lincoln, 2000).

(3) Critical Theory is based on a dialectical concern with the social construction of experience. Critical theory analyses competing power interests between groups and individuals within a society, in particular identifying who gains and who loses in specific situations. The interpretive framework of critical theory research is historically situated, ever changing, ever evolving in relation to the cultural and ideological climate. Qualitative methods such as historical narratives and first-person accounts and oral histories are example of valid forms of data within critical theory (Denzin and Lincoln, 2000).

(4) Constructivism assumes that there are 'multiple realities' and that researcher and researched co-create understandings of the world in a naturalistic setting. Findings are usually presented in terms of credibility, transferability, dependability and conformability, replacing the usual postivist criteria of internal and external validity, reliability and objectivity (Denzin and Lincoln, 2000).

(5) Participatory inquiry gives primacy to practical outcomes and emphasizes working with groups as 'co-researchers'. Knowledge arises in and for action. This type of research is concerned with the development of effective action that may contribute to the transformation of organizations towards greater effectiveness and greater justice. It differs from orthodox science in that it is concerned with 'primary' data encountered 'on-line' and 'in the midst of perception and action' and only secondarily with recorded data (Denzin and Lincoln 1994: 330).

The choice of paradigm involves explicit consideration of the ontological question, 'what is the nature of reality?' (Denzin and Lincoln, 2000: 19) According to Guba and Lincoln (1994: 107) a paradigm may be viewed as 'a set of basic beliefs that deal with ultimates or first principles and which guide action'. It represents a worldview that defines (for its holder) the nature of the

world, the individual's place in it, and the range of possible relationships to that world and its parts. The beliefs are basic in the sense that they must be accepted simply on faith (however well argued); there is no way to establish their ultimate truthfulness (Guba and Lincoln, 1994).

Within the spectrum of paradigms outlined in Table 3.3, the research reported in this thesis fits within the interpretivist paradigm, and more specifically between the constructivism inquiry paradigms. The case study participants' views are critical to creating the findings of this research and provide a specific and locally constructed reality. The active participation of the stakeholder representatives during the interviews was crucial to testing the validity of the 'set of ideas' or 'theory' that the researcher brought to the research. Also the conference discussions held with experts to check the robustness of the initial conceptual framework.

Within specific contexts, institutions and organizations, there is a cultural and social reality that can only be partially understood by the researcher. This reality is subject to the changing views and opinions of the actors that shape that reality. The initial research questions and conceptual framework for this research function as a starting point for exploration and inquiry with the aim of developing greater understanding. Along the way, the conceptual framework has changed somewhat, based on the findings and insights from the discussions.

3.4 Research Intent and Strategy

Another method used in the literature to characterize social science research is to define it in terms of its proposed research objectives. These objectives provide insight into the underlying intention of the research and they also form the basis of the research strategy. This section will elaborate on the research intent and strategy adopted for this research.

In general, it is considered that there are several possible research objectives: exploration, description and explanation (Babbie, 1989; Neuman, 2000). Table

3.4 provides a summary of these research objectives and they are also described in more detail below.

Goals of Research		
EXPLORATORY	DESCRIPTIVE	EXPLANATORY
▪ Become familiar with the basic facts, setting, and concerns ▪ Create a general mental picture of conditions ▪ Formulate and focus questions for future research ▪ Generate new ideas, conjectures, or hypotheses ▪ Determine the feasibility of conducting research ▪ Develop techniques for measuring and locating future data	▪ Provide a detailed, highly accurate picture ▪ Locate new data that contradict past data ▪ Create a set of categories or classify types ▪ Clarify a sequence of steps or stages ▪ Document a causal process or mechanism ▪ Report on the background or context of a situation	▪ Test a theory's predictions or principle ▪ Elaborate and enrich a theory's explanation ▪ Extend a theory to new issues or topics ▪ Support or refute an explanation or prediction ▪ Link issues or topics with a general principle ▪ Determine which of several explanations is best

Table 3.4 A Summary of Research Objectives (Source: Neuman, 2000: 22)

- *Exploratory* studies typically focus on 'what' questions, and traditionally seek to either satisfy the researcher's desire for better understanding, and/or to provide hypotheses and a springboard for further study (Neuman, 2000).
- *Descriptive* investigations present, as the name suggests, a description of a phenomenon within its context (Yin, 1989), where the researcher observes and then describes his or her observations.
- *Explanatory research* attempts to ask 'why' questions. Its purpose is to go beyond exploration and description to examine cause-effect relationship (Annandale and Hunt, 2000).

In addition to the above described research objectives, Morgan and Smiricich (1980) described a fourth possible objective, taken from the participative paradigm: *participative inquiry*. This type of research objective starts with the idea that knowledge should be judged with reference to criteria based on action and usefulness. The aim is to link knowledge, action, and its practical consequences in a way that allows generalization beyond the immediate situations in which such action occurs (Morgan, 1983).

There is a link between the different research paradigms of social science and the intent of research as just introduced. For example, those who ascribe to the positivist/ interpretivist dichotomy would probably agree that positivist research has more of a descriptive and explanatory tendency than does interpretivist research, which tends to focus more on exploration, collaboration and application.

The research intent and strategy address the epistemological question, 'What is the relationship between the inquirer and what can be known?' (Denzin and Lincoln, 2000: 19) The intent of this research is three-fold: exploration and description with a hint of participatory change. Neuman (2000: 21) describes that studies may have multiple purposes (e.g. both to explore and to describe), but one purpose is usually more dominant. In the case of this research, the dominant epistemology is that of description with exploration closely following. Mainly because this research aims to create a better understanding of the mediating factors and dynamics between those factors that influence the implementation of water management concepts and theory (exploratory). However, in order to create this understanding the researcher has focused on different contexts and investigated the experiences shared by different actors in those specific contexts (descriptive). The learning throughout the research process has most likely not been unidirectional: the researcher has learned about the contexts and experiences from actors, but those actors were at the same time learning (or becoming more aware) about their own level of understanding and ability to describe (their experiences with) the IWRM or AM concepts. They were also triggered during the interviews to go through a short

process of reflection through the request to 'go back in time' and recall mediating factors and events that influenced the implementation of specific water management concepts (participatory change).

The strategy that has been followed for this research can be described as follows:

- Starting with a *research problem* (i.e., the need to understand the mediating factors that influence the translation of IWRM and AM theory into practice);
- An *action plan* was developed as well as a set of *questions* to be answered (i.e., the overall research process and interview design);
- From there the *field research* started (i.e., semi-structured interviews);
- Data was *analyzed* and reflected upon (i.e., writing thesis), and a set of *conclusions* were developed (i.e., in the form of discussions of findings and the framework);
- The proposed framework would certainly benefit from testing via implementation and evaluation. However, this is beyond the scope of this project and is therefore considered under *recommendations for further action*.

As stated, a descriptive and exploratory intent characterizes this research and points to an open-ended, inductive approach whereby the researcher also consciously adopts the role of the 'learner' and recognises outsider/ insider distinctions. The research participants are the 'experts' and the researcher was there to listen, record and synthesize their views into a framework for informing better application of water management concepts.

3.5 Methodological Nature of the Research

3.5.1 Quantitative versus Qualitative Approach

Just as worldview, paradigm, research intent and strategy influence each other, so they, in turn, influence the choice of methods used. When comparing qualitative and quantitative research, Hutton (1990) states that qualitative and

quantitative research use different ranges of techniques and have different roles. Neuman (2000) expands in more detail on quantitative as well as qualitative research approaches and states that both styles of research share basic principles of science but differ also in significant ways (see Table 3.5 below).

QUANTITATIVE STYLE	QUALITATIVE STYLE
Measure objective facts	Construct social reality, cultural meaning
Focus on variables	Focus on interactive processes, events
Reliability is key	Authenticity is key
Value free	Values are present and explicit
Independent of context	Situational constrained
Many cases, subjects	Few cases, subjects
Statistical analysis	Thematic analysis
Researcher is detached	Researcher is involved

Sources: Creswell (1994), Denzin and Lincoln (1994), Guba and Lincoln (1994), and Tashakkori and Teddlie (1998)

Table 3.5 Quantitative Style versus Qualitative Style (Neuman, 2000: 16)

Ragin (1994: 92) explains that the styles can also complement each other: 'key features common to all qualitative methods can be seen when they are contrasted with quantitative methods'. This author further describes that quantitative data techniques are data condensers with the aim to be able to see the big picture. Qualitative methods, on the other hand, are best understood as data enhancers. When data are enhanced, it is possible to see key aspects of cases more clearly'. In contrast to the structured nature of quantitative studies, respondents in qualitative research, such as interviews, are encouraged to

qualify or elaborate on points made in order, for example, to clarify their point of view (Hutton, 1990). Another author, Partington (2002: 109), describes a qualitative research design simply as 'one where the data are collected in the form of words and observations, as opposed to numbers. Analysis is based on the interpretation of these data as opposed to statistical manipulation'. Guba and Lincoln (1994) present two main critiques, one internal to the quantitative approach and one external to it, that can be re-dressed by the application of a qualitative approach (these critiques are summarized in Table 3.6).

Criticism	Quantitative Methods	Qualitative Redress
INTERNAL		
Context stripping	Focus on selected subsets of variables, ignoring contextual variables. This detracts from the data's usefulness, relevance and ability to generalize to other situations	Qualitative data can redress this by providing contextual information
Exclusion of meaning and purpose	Unlike objects, people attach meaning to their actions. Quantitative data does not provide insight in this regard	Qualittative data can provide rich insight into why humans do what they do
Disjunction of grand theories with local contexts: The 'etic' / 'emic' dilemma	The theories of the researcher [the outsider 'etic' perspective] may have no bearing on the reality of the researched [the insider 'emic' perspective]	Qualitative research helps 'ground' theory in the reality of the individuals/ culture being studied
Inapplicability of general data to individual cases	Easily quantified, statistically meaningful generalizations have limited relevance to individual cases	Qualitative data can help avoid inappropriate generalization
Exclusion of the 'discovery dimension' in inquiry	Gloss over the creative, divergent thinking of the researcher that generated the hypotheses being empirically tested	Qualitative research acknowledges the discovery process and input of the researcher
EXTERNAL		
The theory-ladenness of facts	Assumes total objectivity in the formulation of theories, e.g., that theory, observation, data collection and interpretation of data are independent, a position that has been largely refuted	Accepts that theories are value statements and facts are only facts within some theoretical framework
The underdetermination of theory	Proceeds on the principle of theory verification; e.g. every swan I have seen is white; therefore black swans do not exist	Favours theory falsification; e.g., one black swan completely falsifies the argument that black swans do not exist
The value-ladeness of facts	Assumes that researcher's values do not have a bearing on how data is interpreted	Accepts that researcher's values influence interpretation of data and 'facts'
The interactive nature of the 'inquirer-inquired into' dyad	Assumes that the inquirer does not influence the phenomena observed, a position that has been well refuted in the hard sciences, e.g. Bohr complementarily principle and Heisenberg uncertainty principle	Accepts that findings are created through the interaction of the inquirer and the phenomena [e.g., people, in the social sciences]

Table 3.6 Internal and External Critiques of Quantitative Methods in Social Science and the Qualitative Redress (Summarized from Guba and Lincoln, 1994: 106-107)

Miles and Huberman (1994) provide a loose framework of characteristics of what determines qualitative research: (1) intense and prolonged contact in the field; (2) research designed to achieve holistic or systemic picture; (3) gaining of perception from the subjective point of view of the understanding of the research participant(s); (4) research that revolves mostly around the analysis of words; (5) data that provides multiple interpretations; and (6) lack of standardized research instrumentation.

Based on what has been described above in this section, the following summary is provided (Table 3.7), indicating how qualitative research differs from quantitative research in five significant ways:

Differences in Research Style	Quantitative	Qualitative
Use of positivism and interpretivism	Reality can be fully apprehended; reality is most reliably represented by positivist/ statistical methods	Reality can only be partially apprehended; reality is best represented using multiple methods of data capture
Acceptance of postmodern sensibilities	Rejects postmodern view; positivist methods are the only way to report about the society and the social world	Accepts postmodern view; positivist methods are one way of 'telling stories' about society and the social world
Capturing the individual's point of view	Interviewing and observation considered unreliable, impressionistic and not objective	Can get closer to the individual's viewpoint through detailed interviewing and observation
Examining the constraints of everyday life Securing rich descriptions	Etic view of the world; attempts to stand outside the constraints of everyday life Unconcerned with securing rich descriptions as this interferes with statistical generalization	Emic view of the world; immerse themselves and confront the constraints of everyday life Focus on securing rich descriptions such as historial narratives and oral history

Table 3.7 Summary of Differences: Quantitative and Qualitative Research

The nature of the research questions being asked (see Chapter 1) and the aim of developing a greater understanding about the process of implementing water management theories clearly suggest the use of qualitative methods to ensure

'rich' data collection. Partington (2002) suggests that qualitative research lends itself to an inductive approach, where less structure in the research design permits the exploration of questions. However, challenges to qualitative research include gaining access to private experiences, how to interpret data, accuracy of information, establishing objectivity and subjectivity, handling potentially large amounts of data, and, reliability and trustworthiness of findings (Easterby-Smith, Thorpe, and Lowe, 2002). These issues will be addressed through careful design and implementation of the research methodology as described further in this chapter and in Chapter 4.

3.5.2 Qualitative Research Strategies

Qualitative researchers may 'study things in their natural setting, attempting to make sense of, or to interpret phenomena in terms of the meanings people bring to them' (Denzin and Lincoln, 1994: 3). Strategies for qualitative research inquiry comprise 'a bundle of skills, assumptions, and practices that the researcher employs as he or she moves from paradigm to the empirical world' (Denzin and Lincoln, 2000: 22). A large number of strategies exist, for example: Tesch (1990) identified 28 approaches; Wolcott (2001) described 19 types; and Creswell (1998) recommends that qualitative researchers choose from among five dominant strategies to carry out qualitative research including: ethnography, grounded theory, case studies, phenomenological research and narrative research (2002; Easterby-Smith et al., 2002; Creswell, 2003). A summary of these five strategies (Creswell, 2003: 14) is provided in the box below:

Ethnographies: in which the researcher studies an intact cultural group in a natural setting over a prolonged period of time by collecting, primarily, observational data (Creswell, 1998). The research process is flexible and typically evolves contextually in response to the lived realities encountered in the field setting (LeCompte & Schensul, 1999)

Grounded theory: in which the researcher attempts to derive a general, abstract theory of a process, action, or interaction grounded in the views of participants in a study. This process involves using multiple stages of data collection and the refinement and interrelationship of categories of information (Strauss & Corbin, 1990, 1998). Two primary characteristics of this design are the constant comparison of data with emerging categories and theoretical sampling

of different groups to maximize the similarities and the differences of information

Case studies: in which the researcher explores in depth a program, an event, an activity, a process, or one or more individuals. The case(s) are bounded by time and activity, and researchers collect detailed information using a variety of data collection procedures over a sustained period of time (Stake, 1995)

Phenomenological research: in which the researcher identifies the 'essence' of human experiences concerning a phenomenon, as described by participants in a study. Understanding the 'lived experiences' marks phenomenology as a philosophy as well as a method, and the procedure involves studying a small number of subjects through extensive and prolonged engagement to develop patterns and relationships of meaning (Moustakas, 1994). In this process, the researcher 'brackets' his or her own experiences in order to understand those of the participants in the study (Nieswiadomy, 1993)

Narrative research: a form of inquiry in which the researcher studies the lives of individuals and asks one or more individuals to provide stories about their lives. This information is then retold or restoried by the researcher into a narrative chronology. In the end, the narrative combines views from the participant's life with those of the researcher's life in a collaborative narrative (Clandinin & Conelly, 2000)

The five types of research described by Creswell (1998) are different from each other, but they all share the essential characteristics of qualitative research that includes 'the goal of eliciting understanding and meaning, the researcher as primary instrument of data collection and analysis, the use of fieldwork, an inductive orientation to analysis, and findings that are richly descriptive' (Merriam, 1998: 11). Merriam (1998: 20) also noted that the five types of qualitative research could be distinguished in terms of: disciplinary orientation (ethnography, phenomenology); function (grounded theory); form (case study, basic or generic qualitative study) and also highlighted that the five types are often used in conjunction with one another.

All research is historical to the extent that it is e.g. impossible to analyse data at exactly the same time as it is collected (Bennet, 1983). With regard to this research, the 'historical' aspect lies in the fact that this research is aiming to understand and investigate the challenges for implementation of IWRM and AM by examining what factors have influenced and affected the implementation process of these concepts. In other words, the (historical) implementation

pathways of IWRM and AM are investigated as different stakeholders involved have experienced them. In addition to the aim to understand the 'lived experiences', the researcher also aims to derive a more general, abstract concept of the implementation process grounded in the views of the relevant stakeholders. This intention, however, is secondary to the aim to develop greater understanding about the factors that mediate and influence the implementation of IWRM and AM.

As is emphasized in contemporary literature (see Chapter 2), implementation of IWRM and AM is context dependent. It is therefore important to investigate and understand the implementation pathways of IWRM and AM in specific contexts. In order to develop a more extensive understanding of the process, it is appropriate to select contexts (and participants) in which IWRM or AM have been applied for a relatively long period of time. In other words, where there is a more deep-rooted understanding of the implementation pathways.

In line with what has been described above, the dominant research strategy for this study is the case study approach, as the main purpose is to gain an in-depth understanding of a phenomenon and meaning for those involved: the interest lying in the process rather than the outcomes, in context rather than a specific variable, in discovery rather than confirmation. According to Merriam (1998: 8) the use of a case study approach is 'determined by four factors: the nature of the research questions; the amount of control the researcher has over the variables under investigation; the desired end product; and the identification of a bounded system as the focus of investigation'. The most essential element of a case study approach is the identification of the case(s) itself as this allows a 'bounded system' to be identified with certain features occurring within the boundary of the cases (Denzin and Lincoln, 2000).[2]

[2] The selection criteria and selection of case studies as well as participants are described in Chapter 4

Yin (2003) provides six kinds of case study types that are based on a two-by-three matrix (see Table 3.8).

	Single Case Study	Multiple Case Study
Exploratory	Type 1	Type 2
Descriptive	Type 3	Type 4
Explanatory	Type 5	Type 6

Table 3.8 Different Types of Case Studies (Source: Yin, 2003: 5)

Research can be based on a single case study (focusing on only one case) or on multiple cases (including two or more cases within the same study). Yin (2003: 5) describes the different types of case studies as follows:

- *Explanatory case study:* aims at defining the questions and hypotheses of a subsequent study or at determining the feasibility of the desired research procedures.
- *Descriptive case study:* presents a (complete) description of a phenomenon within its context;
- *Explanatory case study:* presents data that explains how events occurred and reflects a cause and effect relationship.

Some of the best and most famous case studies have been both descriptive and explanatory (Yin, 1994). In the case of this research, and in line with the research intent and research aims, the case study types that are being followed are mostly of a descriptive as well as exploratory nature.

Jacelon and O'Dell (2005) also state that a case study approach can be designed to consider a single case, or multiple cases. Multiple cases are used when the researcher is interested in the same issue or phenomenon in different situations, or to understand a particular situation or process from different perspectives. The case studies that are being used in this study have been chosen with the aim of investigating the same phenomenon (for this study, the implementation process of IWRM or AM) in different contexts. As is emphasized

by Stake (1995: 3) the end product of research using a case study approach is 'sometimes the case itself, but often case studies are used in an instrumental way to investigate a broader phenomenon'. A case is an integrated system with patterns of behavior and greater understanding about a phenomenon may be reached by studying across cases (Stake, 1994).

A case study approach is of direct relevance to the secondary aim of this study - to derive a more general, abstract framework of the implementation process and its mediating factors. Eisenhardt (2007) describes the process of building theory from case studies as a strategy that 'involves using cases to create theoretical constructs, propositions and/ or midrange theory from case-based empirical evidence'. Furthermore, theory from case studies emerges from the 'recognition of patterns and relationships among constructs within and across cases and their underlying logical arguments' (Eisenhardt and Graebner, 2007: 25). While single case studies can richly describe the existence of a phenomenon (Siggelkow, 2007), multiple case studies typically provide a stronger base for theory building (Yin, 1994). In other words, multiple cases enable comparisons that clarify whether an emergent finding is simply 'idiosyncratic' to a single case or consistently replicated by several cases (Eisenhardt, 1991).

The following sub-section will describe in more detail the methods that can be applied for collection of data from the selected case studies for this research.

3.5.3 Data Collection Methods

Case studies can accommodate a 'rich variety of data sources, including interviews, archival data, survey data, ethnographies, and observations' (Eisenhardt, 2007: 28). Data collection steps include setting the boundaries for the study; collecting information through unstructured (or semi-structured) observations and interviews, documents and visual materials, as well as establishing the protocol for recording information (Creswell, 2003: 185). With regard to setting the boundaries for a study, Creswell (2003) further describes that the aim of a qualitative research strategy is to purposefully select

participants and sites that will best help the researcher in findings answers to the research questions. Miles and Huberman (1994) identified four aspects that should be included in discussions about possible sites and participants:

(a) *Setting:* where will the research take place;
(b) *Actors:* who will be observed or interviewed;
(c) *Events:* what the actors will be observed or interviewed doing or having done;
(d) *Process:* the evolving nature of events undertaken by the actors within the setting.

These aspects are described in detail in the next chapter of this thesis. Creswell (2003) describes four basic types of collection procedures in qualitative research: observation, interviews, documents and audiovisual materials (see Table 3.9 for an oversight including the advantages and disadvanteges).

Data Collection Types	Options within Types	Advantages of the Type	Limitations of the Type
Observations	▪ Researcher conceals role ▪ Role of researcher is known ▪ Observation role of researcher is secondary to participant role ▪ Researcher observes without participating	▪ Firsthand experience with participants ▪ Possible to record information as it is revealed ▪ Unusual aspects can be noticed ▪ Useful in exploring topics that may be uncomfortable for to discuss	▪ Researcher may be seen as intrusive ▪ 'Private' information may be observed that the researcher cannot report ▪ Possible lack of good observing skills ▪ Certain participants may present special problems in gaining rapport
Interviews	▪ Face-to-face: one on one, in person interview ▪ Telephone: researcher interviews by phone ▪ Researcher interviews participants in a group	▪ Useful when participants cannot be observed directly ▪ Participants can provide historical information ▪ Allows researcher 'control' over the line of questioning	▪ Provides 'indirect' information filtered through the views of the interviewees ▪ Provides information in a designated 'place' rather than the natural field setting ▪ Researcher 's presence may bias responses ▪ People are not equally articulate & perceptive
Documents	▪ Public documents such as minutes of meetings and newspapers ▪ Private documents such as journals, diaries and letters ▪ E-mail discussions ▪ Archival records	▪ Enables a researcher to obtain landuage and words of participants ▪ Can be accessed at a time convenient to the researcher ▪ Represents data that participants have given attention to compiling ▪ As written evidence, it saves a researcher the time and expense of transcribing	▪ May be protected information unavailable to public of private access ▪ Requires the researcher to search out the information in hard-to-find places ▪ Requires transcribing or optically scanning for computer entry ▪ Materials may be incomplete ▪ The docuements may not be authentic or accurate
Audiovisual materials	▪ Photographs ▪ Videotapes ▪ Art objects ▪ Computer software ▪ Film	▪ May be an unobtrusive method of collecting data ▪ Provides an opportunity for participants to direcly share their 'reality' ▪ Creative in that it captures attention visually	▪ May be difficult to interpret ▪ May not be accessible publicly or privately ▪ The presencet of an observer (e.g. photographer) may be disruptive and affect responses

Table 3.9 Qualitative Data Collection Types, Options, Advantages and Limitations (Source: Creswell, 2003: 186-187)

Yin (2003: 80) highlights the same types of collection procedure in his description of different sources of evidence for case studies. It should be noted that no single source has a complete advantage over all the others. In fact, Yin (2003) states that the various sources are highly complementary, and that a good case study will therefore use as many sources as possible.

The four selected case studies are all located outside the country of residence of the researcher. Due to practical limitations (time and financial constraints), observation has not been a possible source of evidence for this research. Also, taking into account the fact that this research is focusing on (historical) implementation pathways of IWRM and AM (going back more than ten years in time), observations do not seem a logical source to reveal data and information other than about more recent and contemporary developments. In order to acces the rich descriptions and individual points of view and perspectives of participants, semi-structured interviews were selected as the primary data collection method. Semi-structured interviews will produce data lending themselves strongly to this kind of qualitative research because of the volume and depth of exploratory and descriptive data this can produce. In addition, public documentation is used mostly to describe relevant contextual background information about the case study contexts.

Conducting interviews is about finding out what people do, know, think or feel (Brenner *et al.*, 1985; Robson, 2002) by asking them, and thereby developing a perception about the distinctions between the people involved (Brenner *et al.*, 1985). This involves questioning as part of a two-way conversation, usually, though not always, between two people, face-to-face (Zikmund, 1988; Bennet, 1983; Robson, 2002; Easterby-Smith et al., 2002), with the intention for one of those people at least to learn something from the other(s) (Brenner et al., 1985). A qualitative method such as this enables the researcher ‘to get close to the data’, which in turn facilitates the development of analytical, conceptual and categorical explanations (Brenner et al., 1985).

Interviews do not differ only according to their structure, formality and flexibility, but these are, however, the key themes in differentiating between the different types of interview formats. In the case of this research, structured interviews are not required as the aim of the interviews is not to control a specific outcome, rather to explore the process of implementation of the IWRM and AM concepts. Semi-structured interviews, also known as qualitative research interviews (Robson, 2002), go someway towards meeting this more explorative aim. The name implies that the interviewer has set up a general structure and decided in advance what (broad) themes will be addressed and what main questions will be asked, but in such a way, that will permit the detailed structure to be worked out during the interview in order that the respondent can answer at length in her own words (Drever, 1995).

While, as Drever (1995) asserts, the general aim of semi-structured interviews is to encourage people to talk at some length and in their own way, irrespective of whether what they say is 'right' or not, Eysenck (1998: 691) highlights a source of conflict: 'that of obtaining full, rich and genuine accounts from each respondent, and that of asking only a certain range of questions within a well-prescribed research topic area'. In this way, the predetermined questions provide bounded flexibility, since question order can be modified based upon the interviewer's perception of what seems appropriate at the time, in addition to the making of on the spot decisions regarding dropping certain questions or the inclusion of additional ones (Robson, 2002).

Depending on the type of interview undertaken, an array of questioning styles is available, including prompts and probes in order to gain more insight or clarification on certain themes and to go beyond the framework of a questionnaire (Zikmund, 1988). In other words, the researcher can use techniques such as prompting and probing to stimulate the respondent to give more information or to consider also other themes.

The technical content of the semi-structured interviews prepared by the researcher in advance includes questions and sub-questions - which depend on

the respondent's responses, probe and prompt suggestions, in addition to a changeable question sequence (Robson, 2002). Prompts and probes are intended to assist and stimulate the respondents in saying what they want to say. While prompts, which are often open-ended questions seeking to encourage broad coverage of issues, are directed towards what respondents know but have not yet mentioned in order to jog their memory and encourage them to talk, probes, that seek to explore answers in more depth, are directed at what people have already said for purposes of clarification and explanation.

Semi-structured interviews guarantee good coverage of topics, however, they take time to conduct and analyse and therefore require significant planning (Drever, 1995). In the case of more focused and (semi-) structured interviews, in order to make use of the interview in terms of wider research, the researcher can record the content of the interview digitally, on tape or by taking notes (Bennet, 1983). A more detailed explanation of the semi-structured interview design and the data collection process is provided in the next chapter.

3.6 Interpretation of Qualitative Data

With regard to qualitative research, there may be significant overlaps between data collection and analysis activities, although analysis always continues after data collection has ceased. Vast amounts of raw data are obtained through qualitative research and the process of analyzing and interpreting this data includes organizing and reducing these data so that the researcher can bring meaning to it (Marshall and Rossman, 1995). This section will discuss the steps of the research cycle that follow planning and data collection: data analysis, reflection, theory building and re-examination of literature in line with the emergent theory.

3.6.1 Data Analysis

In qualitative research there is only interpretation: nothing speaks for itself. 'Confronted with a mountain of impressions, documents and field notes, the qualitative researcher faces the difficult and challenging task of making sense of

what has been learned' (Denzin and Lincoln, 1994: 500). The data analysis process entails organizing what the researcher has seen, heard and read so as to create explanations, develop theory and link a particular research story to other stories. To do this requires categorizing, synthesizing, and a search for patterns that will allow interpretation of the data (Glesne and Peshkin, 1992).

Analysis is not a one-off activity, rather an ongoing, iterative task that may evolve reading and re-reading transcripts in order to gain deep understanding of the data and its underlying patterns. The initial understanding of the researcher then guides the process of analyzing data, which leads to new understanding that guides further exploration of the data (Hirschheim *et al.*, 1995). Therefore, while the conceptual framework structures the data collection and analysis, it is not entirely restrictive. As initial analysis continues, new concepts or themes may emerge.

Analyzing qualitative data as it is collected is recommended as it enables the researcher to focus and shape the study as it proceeds. This kind of simultaneous data collection and analysis was not completely feasible for this research as the time span between the fieldwork activities in the four selected case studies was not leaving enough time for transcription of interviews and analysis of the data parallel to the planning of the next case study.[3] However, insights were gained during the interview process itself and an initial analysis and reflection was done through reading the transcripts of the case study interviews before starting the next case study. However, this initial analysis and reflection was not possible between two case studies as their location in combination with time and financial constraints did not allow space between the fieldwork activities of these two case studies.[4]

[3] The planning schedule of the four case studies can be found in Chapter 4

[4] The two case studies referred to here are the GCDAMP and the KRRP, both located in the United States

For this study, the data analysis process is divided into three data analysis actions, all three in line with the research questions that form the basis of this study (see Chapter 1).

ACTION 1 – Similarity Analysis

The aim of the first data analysis action is to assess the degree of congruency or similarity between the respondents' descriptions of IWRM and AM (as articulated in the interview responses) and formal statements of IWRM and AM as found in literature. For the purpose of this thesis, congruency and similarity are taken to be synonyms.

According to Aldenderfer and Blashfield (1984), the term 'similarity' is not immune from varied meanings and in order to recognize objects or statements as similar or dissimilar, a process of classification is fundamental. A very relevant question they raise with regard to the measurement of similarity is 'how useful and abstract concepts can be formed to arrange and organize what is known' (1984). To answer this question, Aldenderfer and Blashfield (1984) state that one must be able to categorize objects or phenomena and the process of categorization requires lumping together of things that are perceived as similar. Thie difficulty with similarity 'does not lie with the simple recognition that things are either alike or not alike, but instead in the ways in which these concepts are expressed and implemented'.

With regard to this first action of the data analysis process, short statements provided by the respondents are compared to short statements coming from academic literature. In order to establish the similarity between these statements, the coders considered the statements with great detail, not only winnowing themes, but also comparing the statements, line-by-line and word-by-word. In addition to that, the meanings of the words should also be taken into account. In other words, a refined systematic comparison is required in order to establish similarity between statements.

Ryan and Bernard (2003) describe different techniques (with different outcomes) that are available for analyzing qualitative data and text. They provide three different methods for analyzing similarities and differences between texts (see Box below for a summary of the three methods).

Similarity and Differences

- The *constant comparison method* (Glaser and Strauss, 1967: 101-116) involves searching for similarities and differences by making systematic comparisons across units of data, beginning with a *line-by-line analysis*, asking: What is this sentence about? How similar is it to or different from the preceding or following statements?
- A *comparative method* that involves taking *pairs of expressions* (from the same or different informants) and asking: How is one expression different from or similar to the other? The similarities or differences generated are themes. If a theme is present in both expressions, the next question is: Are there differences in degree or kind, in which the theme is articulated in both expressions? (Ryan and Bernard, 2003)
- An approach to compare *pairs of whole texts*, while asking: How is this text different from the preceding text? What kinds of things are mentioned in both? Bogdan and Biklen (1982: 153) recommended reading through passages of text asking: What does this remind me of? Also asking hypothetical questions such as: What if the informant who produced this text had been a woman instead of a man?

As the statements are generally not longer then a few sentences, the second methods (comparative method) for comparison suggested by Ryan and Bernard (2003) will be applied for this similarity analysis (see Section 4.5.2 for a detailed explanation of how this method is applied).

ACTION 2 – Evaluation of mediating factors

A wide range of literature exists that documents the underlying assumptions

and procedures associated with analyzing qualitative data. Many of these are associated with specific approaches or traditions such as grounded theory (Strauss and Corbin, 1990), phenomenology (e.g. van Manen, 1990), discourse analysis (e.g. Potter and Wetherall, 1987) and narrative analysis (e.g. Leiblich, 1998). However, some analytic approaches are generic and not placed specifically under one of the before-mentioned traditions of qualitative research (e.g., Silverman, 2000). A considerable and growing number of authors reporting analysis of qualitative data describe a strategy that can be labeled as a 'general inductive approach' (Thomas, 2003) or 'thematic analysis' (Braun and Clarke, 2006). According to Dey (1993) this inductive strategy is evident in much qualitative data analysis, often without an explicit label being given to the analysis strategy. An inductive approach means the themes identified are strongly linked to the data themselves (Patton, 1990) and as such this form of thematic analysis 'bears some similarity to grounded theory' (Braun and Clarke, 2006: 83).

Braun and Clarke (2006: 78) divide qualitative analytic methods into two camps:

1. Those methods *stemming from a particular theoretical or epistemological position.* These are divided into two sub-groups:
    a. Those methods with relatively limited variability in how they are applied (one recipe guides analysis): e.g. conversation analysis (e.g., Hutchby and Wooffitt, 1998) and interpretative phenomenological analysis (e.g., Smith and Osborn, 2003);
    b. Those methods with different manifestations of the method, from within the broad theoretical framework: e.g. grounded theory (Glaser, 1992; Strauss and Corbin, 1998), discourse analysis (e.g., Burman and Parker, 1993; Willig, 2003) or narrative analysis (Riessman, 1993; Murray, 2003)
2. Those methods that are essentially *independent of theory and epistemology*, and can be applied across a range of theoretical and epistemological approaches.

Braun and Clarke (2006) state that the inductive and thematic analysis approach fits firmly in the second camp, and through its theoretical freedom, inductive thematic analysis provides 'a flexible and useful research tool, which can potentially provide a rich and detailed account of data' (2006: 78). Thomas (2003: 2) defines an inductive (thematic) approach as 'a systematic procedure for analyzing qualitative data where the analysis is guided by specific objectives'. This research will follow the inductive thematic approach, as the research questions and aims determine the design of data collection methods as well as the analysis of data collected.

Ryan and Bernard (2003) state that analyzing text (inductively) involves several tasks (2003: 85):

a. Discovering themes and subthemes;
b. Winnowing themes to a manageable few (i.e., deciding which themes are important in any project);
c. Building hierarchies of themes or code-books;
d. Linking themes into a theoretical model.

The idea is that these themes should have some sort of conceptual or structural order, rather than being a random collection of categories (Miles and Huberman, 1994). In other words, the data analysis needs to be related to the research topic at the start of the research cycle, so that the findings can be related back to the research objectives. A conceptual framework expresses the researcher's understanding of the research topic at the start of the research cycle (see Figure 1.1). The concepts in the conceptual framework are used as initial codes to guide the analysis, along with "any other" codes to incorporate new themes (Carroll *et al.*, 1998). This ensures the connection between the data, the data analysis and the research topics.

ACTION 3 – Investigating the relations and dynamics between factors

The third data analysis action involves the inductive process of close readings of text and consideration of the multiple meanings that are inherent in the text.

Subsequently, texts segments are identified that contain meaning and creates a label for a theme or category into which the text segment is assigned. After this, Braun and Clarke (2006) state, is when you start thinking about the relationships between codes, between themes, and between different levels of themes (e.g. main overarching themes and sub-themes within them). In other words, the different categories or themes may also be linked to other categories in various relationships such as: a network, a hierarchy of themes, or a causal sequence.

In order to investigate cause and effect relations between the different factors highlighted by the interview respondents, the last section of the interview design[5] contains questions that follow the structure of a so-called 'pathways approach'. The pathway approach is a technique of cognitive mapping (Lemon et al., 2004). Swan (1995) describes cognitive mapping as '*an individual's internal representation of concepts and relations amongst concepts that the individual uses to understand their environment*'. Huff (1990) gives an overview of different techniques that have been developed for the formulation of cognitive maps; however, those techniques do not seem to take into account and analyse the processes and the dynamics and links between elements of the process. Lemon *et al.* (2004) recognize this omission and propose a technique that stimulates respondents to '*reconstruct their perceptions of change as process in a transferable and comparable way that can be easily facilitated and responded to*'. They represent these processes of change as 'pathway diagrams' where related causes and effects are included and linked (see Figure 3.2).

[5] Refer to Chapter 4 and Apendices for an oversight of the interview design structure

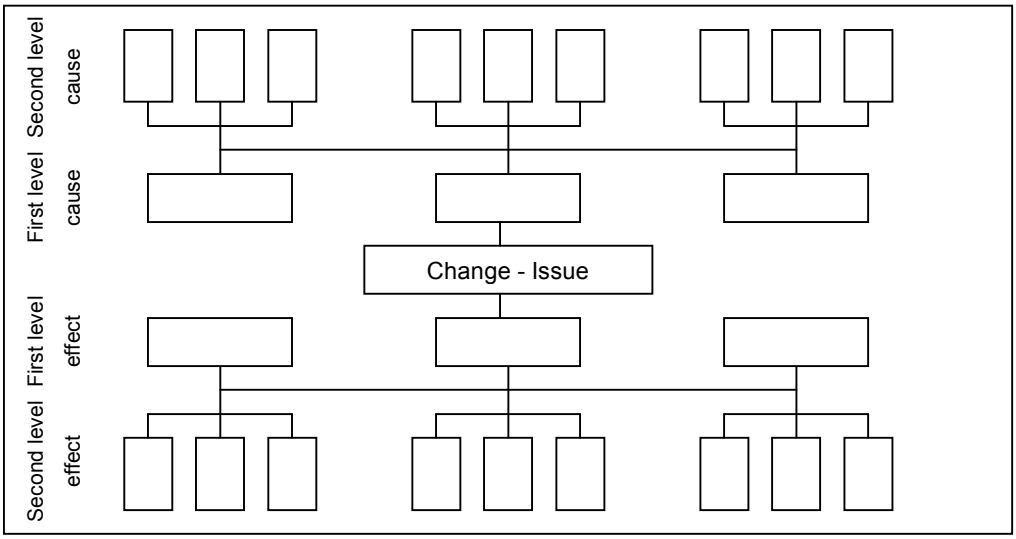

Figure 3.2 Template of Pathway Diagram (Lemon et al., 2004)

The pathway approach is used for this research, as it supports the interview section where respondents are asked to describe cause and effect relations between different factors. It allows the researcher to elicit a process at one time (through identification of causes and effects of an issue or phenomenon); it encourages respondents to be more expansive in their answering; and it helps the respondents to view their initial answers and views from a broader perspective (by stimulating them to place their answer in the context of a cause and effect process).

To summarize, this third analysis action will investigate the (cause-effect) relationships and dynamics between the mediating factors (that have been identified through data analysis Action 2). However, it also aims to identify links between the findings coming from data analysis Actions 1 and 2. The ultimate aim of this third action is to develop a more abstract theory or conceptual framework of the process from transferring IWRM and AM theory in to practice grounded in the experiences of the participants of four case studies.

3.6.2 Theory Building and Re-examining Literature

Eisenhart (1989: 546) argues that induced theory is likely to be empirically valid when it is tightly linked to the data. Walsham (1995) supports this view with his

emphasis on the importance of detailed descriptions of how findings were derived. Theory building is creative and intellectual work (Coffey and Atkinson, 1996). The purpose of data analyis and reflection is to move beyond the data to explore ideas, link themes, note patterns, and examine tentative topics. Themes or categories are developed and clarified, and relationships and dynamics between themes or categories are specified so that theory can be inferred.[6] Theory denotes the sense of a system of interconnected ideas that condense and organize knowledge" (Neuman, 1991: 30). Usually, by the time three or four sets of data have been analysed, the majority of useful concepts will have been discovered (Pandit, 1996). In the case of this study, four sets of data have been collected for analysis.

The interplay between the conceptual framework and the data collection and (initial) analysis cycles through the four selected case studies and enables the iterative construction of knowledge and theory. The initial conceptual framework (Figure 1.1) expresses the researcher's current understanding and lays out the research territory: forming the pre-understanding of the research cycle. After each of the case studies (except between the second and third case study as they were conducted in quick succession) the conceptual framework has been reviewed and when necessary updated to incorporate the understanding gained.

In other words, in case studies, theory is built through a conscious process of reflection. In this process, the researcher returns not only to the data collected during previous case studies, but also refers to the literature, and the insights of experts to extend these reflections. Thus, case studies build theory from multiple cases that sequentially enrich the conceptual framework (Eisenhart and

[6] Note that findings and insights coming from Action 3 of the data analysis process are discussed in Chapter 7. This third action in the analysis process informs a bridge and links the earlier two data analysis actions and works towards building a more theoretical framework

Graebner, 2007).

This iterative theory building process can be described as moving from substantive theory (specific to a particular case) to a mid-range theory that may be applied to a variety of situations (Glaser and Strauss, 1967). It is not only inductive (moving from the data to theory), but also tightly interrelated with practice: fieldwork leads to theory building, which leads to further research into practice. As a result, the developed theory reflects actions, problems, and issues that are faced by practitioners (Markus, 1997). This is very relevant for this study as its focus is on understanding the link between theory and practice.

After establishing an encompassing picture of the phenomenon (after analysis of all four case studies), the current conceptual framework is compared to a broad range of literature. This step differs from the reflection stage between each case study that may involve comparing and contrasting tentative findings with the literature. The final step in the theory building process is more in-depth and challenging as the input from the literature includes an extensive comparison of the findings with a wide selection of the literature. With regard to comparison with existing literature, there are two aspects that are considered:

(a) Agreement between the findings and the existing literature (replicating, consolidating or extending existing literature). The support of existing theory lifts theory to a higher conceptual level (Eisenhardt, 1989).
(b) Conflict between the findings and existing literature. The areas and nature of any conflict are examined to provide persuasive explanations that accounting for the differences.

3.7 Validity and Reliability of Research

Silverman (1998: 7) argues that ‘there is no agreed doctrine underlying all qualitative social research’ and that common elements of qualitative research are the collection of data in the form of words and statements, which are analysed by methods that do not include statistics or quantification. There are a

variety of views with regard to the requirements and criteria for sound interpretive research (Eisenhardt, 1989; Strauss and Corbin, 1990; Guba and Lincoln, 1994*;* Walsham, 1995; Klein and Myers, 1999) since there are a great variety of interpretivist approaches.

Any research design is supposed to represent a logical set of statements and the quality of any given research design can be judged according to certain logical tests. Four tests have been commonly used to establish the quality of empirical social research: evaluation of internal validity, construct validity, external validity and reliability (e.g. Kidder & Judd, 1986: 26-29; Yin, 2003: 33). Because case studies are a form of such empirical research, the four tests are also relevant to case study research. Yin (2003) identifies several tactics to deal with these tests when following a case study approach. Table 3.10 provides a description of these evaluation criteria as well as recommended case study tactics, cross-reference to the relevant phase of the research and some examples of how the criteria are met in a study (e.g. Kidder & Judd, 1986: 26-29; Yin, 2003: 33; Cepeda and Martin, 2005).

Evaluation criteria	Description	Case study tactics	Phase of research	Examples
Construct validity	Establishing correct operational measures for the concepts being studied	▪ Use multiple sources of evidence; ▪ Establish chain of evidence; ▪ Have key informants review draft case study report;	Data collection and composition	Explicit and detailed description of general methods and procedures; providing complete picture; availability of study data for re-analysis;
Internal validity [7]	Establishing the causal relationship, whereby certain conditions are shown to lead to other conditions, as distinguished from spurious relationships	▪ Do pattern-matching; ▪ Do explanation-building;; ▪ Do time-series analysis;	Data analysis	Rich and meaningful descriptions; internally coherent findings; systematically related concepts
External validity	Establishing the domain to which a study's findings can be generalized	▪ Use replication logic in multiple-case studies	Research design	Rich and meaningful descriptions of findings that allow assessment of transferability to other settings; congruency/ connection between findings and prior theory
Reliability	Demonstrating that the operations of the study – such as the data collection procedures – can be repeated, with the same results	▪ Use case study protocol; ▪ Develop case study data base;	Data collection	Clear research questions; congruency between research questions and features of study design

Table 3.10 *Predominant Criteria for Sound Interpretative Research* (Source: adapted from Kidder & Judd, 1986: 26-29; Yin, 2003: 33; Cepeda and Martin, 2005)

Construct Validity

The methods and procedures that are developed and applied to this research are explicitly described in this chapter and in Chapter 4. Besides an explicit and detailed description of the general methods and procedures, this study also provides a clear explanation of why the selected case studies were chosen.[8] In

[7] For explanatory or causal studies only, and not for descriptive or exploratory studies (Yin, 2003)

[8] The selection criteria for the case studies are provided in Chapter 4

addition, the findings from the different analysis actions are systematically related and all the data (interview records, transcriptions and category lists) are available for review.

Yin (2003) provides three tactics to improve construct validity:

(a) The use of multiple sources of evidence (different sets of data sources): for each of the four selected case studies data were gathered through semi-structured interviews. The data analysis was divided into three actions, in line with the research questions, with different methods of analysis appropriate for the respective analysis actions. For the first analysis action three different coders were used. The second and third actions received feedback through stakeholder checks;
(b) Describing the chain of evidence: this study establishes and describes a clear chain of evidence leading from the idenitifcation and selection of stakeholders, to case study analysis and findings to discussions and conclusions;
(c) Review and feedback on draft report and findings: the initial findings of the data analysis were reviewed by a large number of stakeholders (fourteen).

External Validity

External validity involves 'the extent to which the findings of one case study can be applied to other situations and therefore answers the question of how generalizable the results of a research study are' (Guba and Lincoln, 1994: 115). Aamodt (1994: 40-53) and Morse (1994: 24-43) discuss the aggregation of qualitative data and suggest that the findings of independent, similar research results when aggregated into a cohesive study, enhanced the generalizability of the individual (case) studies and therefore produces a relatively solid mid-range theory.

However, Erickson (1986) argues that the production of generalizable knowledge is an inappropriate goal for interpretative research. 'The search is not for abstract universals arrived at by statistical generalizations from a sample

to a population, but for concrete universals arrived at by studying a specific case in great detail and then comparing it with other cases studies in equal detail' (Erickson, 1986: 130). 'The general therefore lies in the particular and thus what was learned in a particular situation could be transferred or generalized to similar situations subsequently encountered' (Merriam, 1998: 210). This aggregation is maximized in this research through the study and comparison of four case studies.

A theoretical framework is developed that guides the research cycle of planning, data collection, analysis, reflection and theory building. This theoretical framework is revised throughout this cycle based on insights from the data collection and analysis stages of the case studies. In other words, there is an explicit prior theory and literature review that is guiding this research.

Reliability

Reliability of the case study based method was enhanced through adherence to the case study protocol as outlined in the next chapter, and documentation of each step as it was carried out. Reliability and validity were both maximized through triangulation of data sources: in the case of this research through semi-structured interviews conducted in four different case study contexts with wide diversity of stakeholders. The reason for conducting this research in different case study contexts was to reach greater understanding about a phenomenon may be reached by studying across case studies (Stake, 1994).

Denzin (1970) identified four basic types of triangulation, going beyond its conventional association with research methods and designs:

1. *Data triangulation*, which entails gathering data through several sampling strategies, so that slices of data at different times and social situations, as well as on a variety of people, are gathered;
2. *Investigator triangulation*, which refers to the use of more than one researcher in the field to gather and interpret data;

3. *Theoretical triangulation*, which refers to the use of more than one theoretical position in interpreting data;
4. *Methodological triangulation*, which refers to the use of more than one method for gathering data.

For this research the first two types of triangulation have been applied for gathering and interpreting data data. First of all, data triangulation by collecting data from a diversity of people in four different case studies with different social contexts as well as different history in the implementation of IWRM or AM. In other words, research data has been collected using a diversity of data sources. Secondly, investigator triangulation has been applied by using more than one coder to conduct data analysis and develop findings.

Generalizability of case study research is sometimes criticized. However, the use of a multiple case design is intended to overcome this drawback.

3.8 Strength and Weaknesses of Methodology

As mentioned earlier, challenges to qualitative research include: gaining access to private experiences; how to interpret data; accuracy of information; establishing objectivity and subjectivity of data; and, reliability and trustworthiness of findings (Johnson and Harris, 2002; Easterby-Smith, Thorpe, and Lowe, 2002). Social science research often has subtler, practical difficulties to contend to with respect to access to data than research in the 'hard' sciences. Such research cannot be confined to a lab bench with careful control of all the variables and the research process at hand is no exception.

The mere practicalities of visiting and interviewing a wide diversity of stakeholders in different case study contexts – such as time, money, access, geographic location – often make it difficult to obtain access to participants that represent a true cross section of the population of interest. However, in most case studies the researcher has achieved to interview at least one person of each of the identified main stakeholder groups. Although most of the interviews have been conducted face-to-face (visiting the respondents at their work

locations), the interviews of the Murray Darling case study were conducted over the phone due to time and resources constraints. However, this has had no negative impact on the availability of data and information from the Murray Darling case study respondents.

In research that has a commercially or politically sensitive topic as its core there may be a particular hard time getting through to the genuine views of participants in e.g. semi-structured interviews. Respondents may have reasons for not revealing all their views – or even be circumspect in what they reveal or actively shaping the outcomes of the interviews through providing misinformation. In the case of this research, however, there is no reason to believe that the topic of conversation was too politically or commercially sensitive and the majority of respondents were very keen and open to share their time and experiences.

It should be noted, however, that research data collected through interviews provide 'indirect' information filtered through the views of the interviewees and also that the data is collected in a designated location rather than the natural field setting. In addition, a researcher's presence may bias responses and some respondents may not be equally articulate and perceptive as others.

Interpretive research 'begins and ends with the biography and self of the researcher' (Denzin, 1989: 12). This notion of how ones' self influences one's research interests is generally the beginning of a discussion on the issue of bias in research. Certainly the researchers' own filters and perceptions must be acknowledged in qualitative research. This is both an acknowledged weakness and strength of the qualitative research approach. It may be seen as a limitation only insofar as the researcher's world's view is not declared 'up front' or if interpretive methods are rejected in whole or in part (Punch, 1994).

A researcher's personal beliefs and values are reflected not only in the choice of methodology and interpretation of findings, but also in the choice of a research topic. For example, Scheurich (1994) remarks that one's historical position, class, race, gender, religion, and so on all interact and influence, limit

and constraint production of knowledge. Another author, Krieger's (1991), arguments that the outer world, or our ‘external reality’ is inseparable from what we already know based on our lives and experiences - our inner reality.

Case study participants’ views are critical to creating findings for the research and to provide a specific and locally constructed reality and participation during interviews is crucial to testing the validity of the ‘set of ideas or theory’ that the researcher has brought in. However, it is important to remember while conducting qualitative research, that the interpretations made from the research data will be subjective interpretations - based on the researcher’s reality and worldview. It is therefore important that the interpretations are presented in a way that allows readers to see why the researcher reached a certain conclusion based on the available data.

3.9 Summary

This chapter has provided an overview of the broad scope of research methodologies considered in order to make decisions concerning the actual research undertaken. Figure 3.2 below visualizes the research process as discussed above and forms the basis for the description of the fieldwork process and data analysis presented in subsequent chapters.

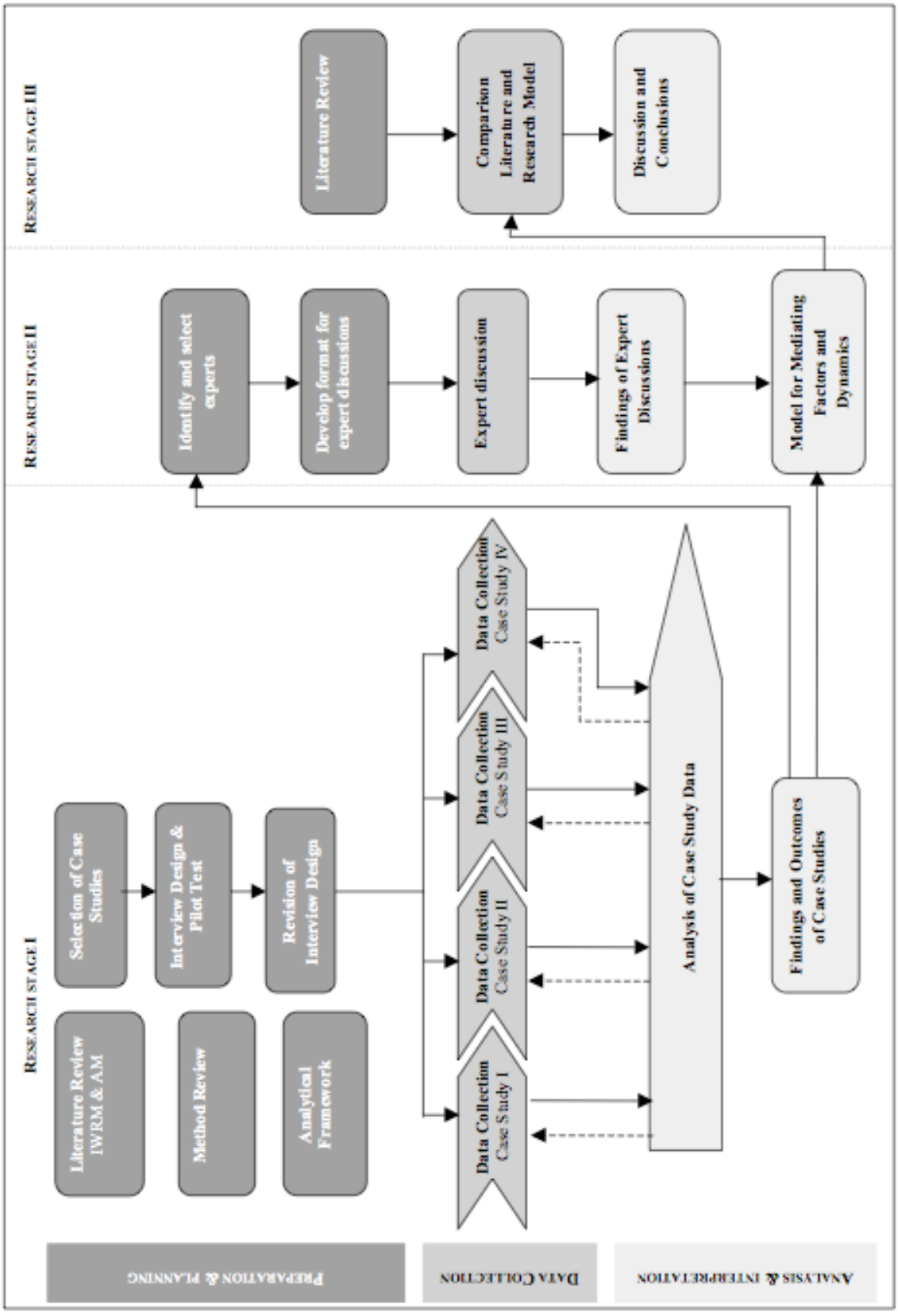

Figure 3.2 Research Process

4 Fieldwork and Analysis Techniques

4.1 Introduction

This chapter reports the planning and execution of the primary data collection activity and introduces the data analysis techniques used. Firstly, it details the criteria for selection of the appropriate case studies for this research as well as a description of the case studies themselves. In particular we will see how each basin is characterized by a particular IWRM or AM management regime. Thorough argumentation for the selection of data collection and analysis methods has been presented in Chapter 3. This chapter will provide further insight into the way the selected methods have been utilized within this research activity.

The design of the semi-structured interview template is then discussed as well as the pilot tests that have been conducted in order to improve the researcher's interviewing skills as well as to test the content of the semi-structured interview design. An explanation is also given as to how relevant respondents have been selected for each case study and how they represent the different stakeholder groups involved in the implementation of IWRM or AM. Data collection took place over a time span of seven months.

The last section of this chapter will elaborate the different steps that have been taken in order to analyse the data emerging from the stakeholder interviews. Although Chapter 3 presented the reasoning for taking a certain direction with regard to the data analysis process, this section will describe the actual methods used in more detail.

4.2 Selection of Case Studies

Based on the designed research questions and proposed research methodology (as described in Chapter 3), criteria for the selection of relevant case studies were developed:

- An extensive history in planning and implementation of IWRM or AM principles of at least ten years (main criterium);
- Experience with different phases and steps of the IWRM or AM cycles;
- Accessibility to at least 10 to 15 managers, practitioners and scientists with a minimum of five (preferably ten) years experience in implementation of IWRM or AM in relevant case study;
- The (native) language of the respondents in the case studies should be English or Dutch (as the researcher is fluent in these languages);
- Availability of and accessibility to information and documentation with regard to implementation of IWRM or AM;
- Potential access to information and relevant respondents within scheduled time span.

Subsequently, discussions were held - with regard to the selection of relevant case studies - with a number of experts from water management institutions across Europe as well as with attendants at the American Water Resources Association (AWRA) conference held in June 2006 in Missoula, Montana.

In addition, a thorough literature review on IWRM and AM (see Chapter 2) indicated that there is more extensive history in implementation of AM in the United States than there is elsewhere. For example, the book 'Adaptive Management for Water Resources Project Planning' (WSTB and OSB, 2004) identifies four key case studies on AM in the USA: Florida Everglades; Missouri River Dam and Reservoir System; Upper Mississippi River; and the Glen Canyon Dam and Colorado River ecosystem. During discussions with experts during the AWRA conference, it became clear that the Kissimmee River Restoration Project is a forerunner to the Florida Everglades project and the Director from CAMNet (network for AM practitioners and scientists in the USA) proposed the Kissimmee River Restoration Project (KRRP) and the Glen Canyon Dam Adaptive Management Program (GCDAMP) as the most appropriate case studies for this research.

Based on the above-mentioned discussions a short list of potential case studies was developed. Table 4.1 lists these and indicates the selection criteria and whether or not these are met by each of the suggested case studies. In instances where selection criteria have not been met or information with regard to those criteria is unknown, the cell has been left empty. The options highlighted (in grey) were selected as the case studies for this research: the Rhine and the Murray-Darling for IWRM, and the KRRP and GCDAMP for AM.

Case Study	AM or IWRM	> 10 years experience	Language	Access to Info	Willingness to participate	Access to respondents
Rhine	IWRM	√	√	√	√	√
Murray-Darling	IWRM	√	√	√	√	√
Nile	IWRM					√
Elbe	IWRM			√	√	√
Guadiana	IWRM			√		√
Tisza	Both			√		√
Orange	Both		√	√		√
Colorado	AM	√	√	√	√	√
Florida Everglades	AM		√	√	√	√
Kissimmee	AM	√	√	√	√	√
Missouri	AM		√			√
Mississippi	AM		√			√

Table 4.1 Potential Case Studies and Selection Criteria

4.3 Case Study Descriptions

This section provides descriptions of the four selected case studies, starting with the two IWRM case studies and then the two AM ones.

4.3.1 Rhine

The length of the Rhine is 1300 km, of which 880 km is navigable and the river basin covers seven countries: Switzerland, Austria, Germany, France,

Luxembourg, Belgium and The Netherlands (see Figure 4.1). The population in the basin is some 60 million. Favourable hydrologic characteristics of the Rhine explain why it became an important transport chain (Huisman *et al.*, 2000). Although the focus of this study is on that part of the Rhine basin in the Netherlands, international cooperation and transbounday issues with other Rhine riparian states are taken into consideration during the interviews.

International cooperation in transboundary river basins often starts with issues of common interest, e.g. in the case of the Rhine the promotion of navigation (NHV, 2004: 67). The promotion of opposing interests, such as the fight against pollution in transboundary river basins and seas, is more difficult. The pollution problems in northwest Europe have shown that international cooperation on this subject is a time-consuming process. For example, it took several decades to reach a mutual understanding on specific problems in the member countries of the Rhine basin as well as to take measures to reduce pollution. The first ministerial conferences, in 1972 on the pollution of the Rhine, and in 1984 of the North Sea marked the transition from mutual understanding to taking concrete measures (NHV, 1998).

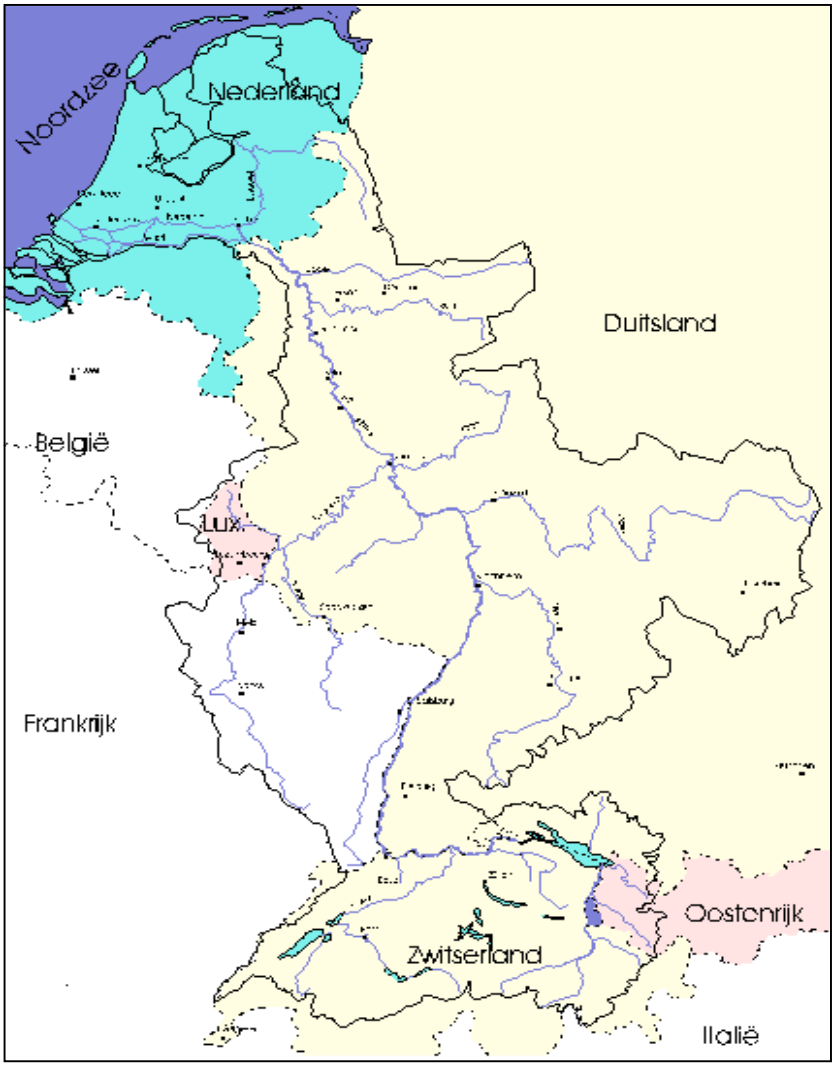

Figure 4.1 The Rhine Basin and its drainage Sub-basins in The Netherlands (Source: http://gis.esri.com/library)

In 1986, the store facilities of a chemical factory in Basle caught fire and in an attempt to stop the fire, the firefighting water became heavily contaminated by insecticides killing a number of organisms living in the Rhine (NHV, 2004: 75). This disaster led to several ministerial meetings and further cooperation and harmonization of activities between the Rhine member states with the aim of reducing pollution, rehabilitating the ecosystem and improving flood protection (Huisman, 1995). Immediately after the disaster, the International Commission for the Protection of the Rhine (ICPR) developed the 'Rhine Action Plan' (RAP) to deal with the above-mentioned objectives. The adoption of the RAP by the ministers in 1987 implied an integrated commitment of the riparian Rhine states

to the further reduction of pollution and to the rehabilitation of the ecosystem of the Rhine (NHV, 2004).

The ICPR (see Figure 4.2 for the organizational structure) was created in 1950 to deal with water quality issues and was formally established under the Treaty of Bern in 1963 (Dieperink, 1998). It is a negotiation platform with an advisory role to the Rhine Governments and the European Union (EU). Implementation of measures remains the responsibility of the individual basin states (ICPR, 2005).

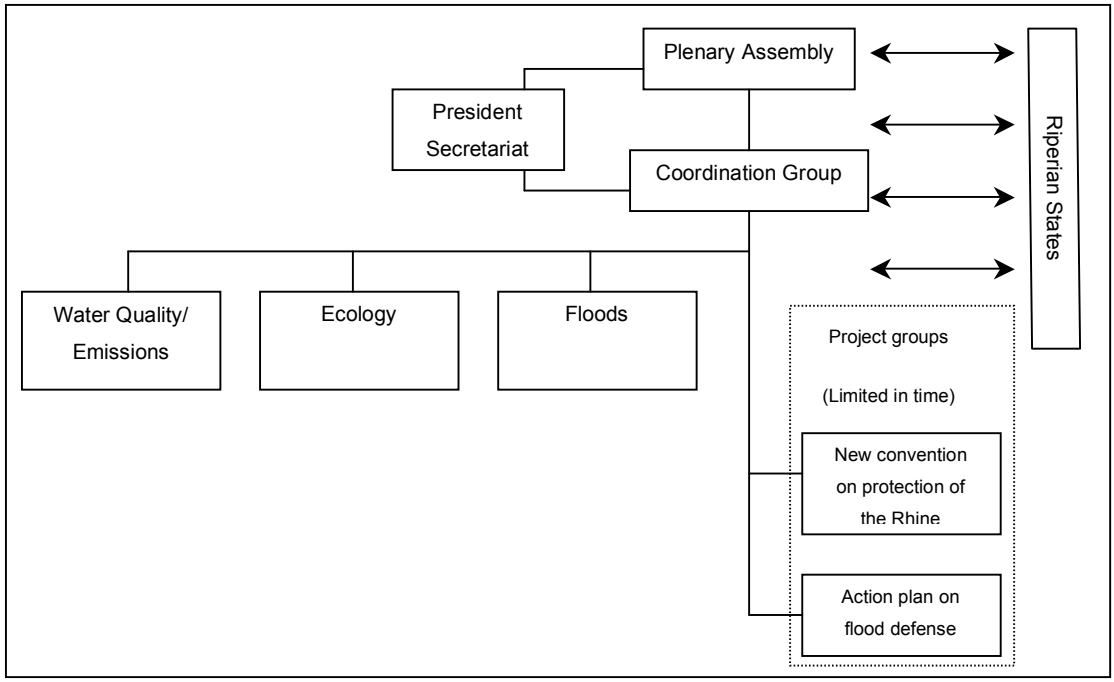

Figure 4.2 Organization Structure of the ICPR (Adapted from Huisman et al., 2000)

Since the beginning of 2001, the ICPR secretariat has seconded the countries in the Rhine watershed in their task to jointly implement the Water Framework Directive (WFD) of the European Union. IWRM forms the centar pillar of the EU WFD (EC, 1998). The WFD is widely accepted as the most significant piece of water legislation produced in the last 20 years and although it is still in its infancy in terms of implementation, it looks set to bring increasingly integrated decision-making and 'better' water outcomes (Fox et al., 2004). According to Raadgever and Moster (2005) it is the most influential directive for

transboundary water management and under the legal framework of the EU (Raadgever and Mostert, 2005). In other words, the WFD is based on IWRM principles. The ICPR Work Programme Rhine 2020 puts the requirements of the EU WFD into concrete terms.

The concept of IWRM also has had a significant influence on the working methods and organization of the water management authorities in the Netherlands and was first used in 1980 (Mostert, 2006). The term became well known following the publication in 1985 of the report 'Living with Water: Towards integrated water policy' and in 1989 IWRM became national policy (Ministerie van Verkeer en Waterstaat, 1985; 1989). Water management in The Netherlands is complex and decentralized with three different administrative levels (as explained below in Table 4.2). Minth (2008: 143) highlights that evidence from the Rhine suggests that a challenge to become a more adaptive and integrated international river basin regime lies primarily in the missing link between local and international domains of influence.

Levels	Authority		Responsibilities
National	Ministry of Transportation and Public Works & the State Water Management Agency	:	Coordinating preparation of national water policy and national water legislation; responsible for management of the major rivers and canals
	Ministry of Housing, Spatial Planning and the Environment	:	In charge of drinking water policy and legislation, environmental policy, and land-use policy
	Ministry of Agriculture, Nature and Food Security	:	Responsible for national policy and legislation in the field of nature protection and agriculture
Regional	12 provinces	:	Supervising the water boards and municipalities; preparing water, environmental and land-use plans; nature protection; and regulating ground water withdrawals
Local	Municipalities (458 of)	:	Responsible for the sewers
	Water Boards (26 of)	:	Responsible for management of most surface water and for sewage treatment

Table 4.2 Levels of Water Management in The Netherlands

In 1989, the Water Management Act was passed, which introduced a planning system to secure surface and ground water quantity and quality (Mostert, 2006). In theory, this planning system is coordinated with land use planning and

environmental planning, but in practice it does not work well because of differences in planning frequencies, planning procedures and status of the plans (Kuijpers and Glasbergen, 1990). The main research institutions involved in research related to IWRM is the Institute for Inland Water Management and Waste Water Treatment (RIZA). Only recently a re-organization has taken place in RIZA, which was not yet the case during the time of the interviews. RIZA is the research and advisory body for the Rijkswaterstaat (the Directorate-General for Public Works and Water Management) for inland water in the Netherlands as well as an international knowledge center on IWRM (IWRMNet, 2004). Some universities are also very active in the area of IWRM (e.g. Delft and Wageningen).

To summarize, IWRM is implemented in the Rhine basin by assessing the current water management situation, formulating a management strategy, intervening at the operational, organisational, and constitutional levels, and monitoring impacts (Van der Keur *et al.,* 2008). One of the major contemporary problems facing the catchment is the dealing with flooding and low flow situations leading to droughts also threatened by climate change (Middelkoop *et al.,* 2004). Another main issue is the transboundary pollution control. For example, extremes in Rhine discharges have caused severe problems for local water managers (water boards, in the Netherlands) which makes it necessary to co-manage strategies taken for the whole basin with measures taken at the local level. Measures and strategies for flood reduction do not stand alone, but are seen within the context of other river functions and part of the spatial planning process. In response to the 1993 and 1998 floods, rapid large scale upgrading of the dike system was followed by a more radical policy for the longer term: to create more room for the river. The flood action plan of the International Convention on Protection of the Rhine (ICPR) was also launched after these floods (Van der Keur *et al.*, 2008).

4.3.2 Murray Darling

The Murray-Darling Basin (see Figure 4.4) is located in southeastern Australia and covers over one million square kilometres comprising a variety of humid and sub-humid to semi-arid environments. According to Allan (2008: 62), the Murray-Darling Basin is sometimes called 'Australia's food bowl', although this obscures the significant role that other industries play in creating wealth and wellbeing for the country's 20 million residents.

The total annual economic output of the Murray-Darling Basin is around 12.5 billion Euros (Department of the Environment and Water Resources, 2004), but this great bounty has come at a substantial environmental cost (Allan, 2008). As Wong *et al.* (2007) describe, many sub catchments are seriously degraded and the Murray-Darling river system itself has appeared on the World Wildlife Foundation's (WWF) top ten rivers at risk list. Harris (2006) sums up the current environmental situation and describes how water use and infrastructure development continue growing with little indication that key indicators have improved over the last decade. Climate variability, population growth and changing land use patterns are also putting immense pressure on potential environmental improvements (Harris, 2006).

Allan (2008) states that the complex ecological systems of the Murray-Darling Basin are matched by complex governance arrangements and complex social expectations. From the early beginning 1980s, a desire for an integrated approach to water management emerged amongst the Basin States and the Murray Darling Basin Initiative (see Figure 4.3) was developed.

Figure 4.3 Murray Darling River Basin in Australia (Source: www.mdbc.gov.au)

The Murray-Darling Basin Commission (MDBC) was developed to operate under the Murray-Darling Basin Agreement - an interstate ministerial agreement between the five State governments (New South Wales; Victoria; South Australia; Queensland and Australian Capital Territory) and the Commonwealth Government (Reeve *et al.*, 2002). Meanwhile, the management of water resources in Australia has undergone further reforms since 1992(see Figure 4.4), as a result of the adoption of the National Strategy for Ecologically Sustainable Development by all Australian Governments, committing them to more effective and integrated water management policies and practices (Pigram, 2006).

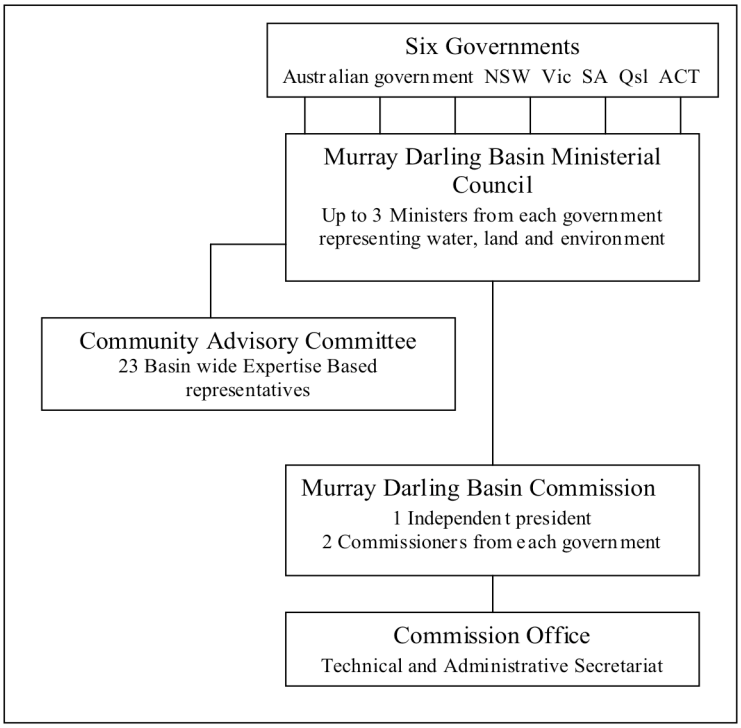

Figure 4.4 Governance Structure of the Murray Darling Basin Initiative (Source: http://www.mdbc.gov.au)

The MDBC uses IWRM as a foundational guiding principle which guides the processes in the basin through (Murray Darling Basin Commission, 2007): (a) the natural resources management strategy (outlining objectives, responsibilities and actions); (b) a basin sustainability plan (providing framework for coordination of planning, monitoring, evaluation); (c) strategic plans (guiding priority activities towards achieving the long-term objectives); (d) operational projects (for the development of policies and strategies); and (e) operational plans (for generating and sharing knowledge).

According to Jønch-Clausen (2004) the Murray-Darling case demonstrates that:

- The Commission has been successful in winning and maintaining community interest, involvement and support because of the participatory approach used with its Community Advisory Committee;
- The strategies for action, programs and frameworks have benefited from intergovernmental approaches to IWRM, coupled with bottom-up actions;

- The challenge has been in this process to specify who pays for what: how an equitable cost-sharing arrangement can be determined, implemented and maintained;
- The MDBC has established cross-border arrangements between the States to share water resources through a water trading scheme and increased use efficiency;
- The sustainability of the MDBC and its programs are still dependent on government funding, and will continue to be so.

However, in examining IWRM in Australia, both Bellamy and Johnson (2000) and Bellamy *et al*. (2002) have raised concerns regarding the balance of efforts between planning and implementation. Fullerton (2001) demonstrates how juggling the interests of powerful groups in achieving their own needs, has resulted in the mismanagement of the Murray-Darling basin.

The following case study descriptions are of the selected AM case studies.

4.3.3 Glen Canyon Dam Adaptive Management Program

The history of the Colorado River is one of rapidly changing social dynamics and pressures, including increasing population and consumption, water diversion and dam building, deteriorating water quality, changes in environmental and aesthetic values, variations in state laws and evolving federal, state, tribal and local interactions (WWPC, 1998). It also has a history of varying and changing physical and ecological conditions that control regional climate, hydrology and geomorphology. Pulwarty and Melis (2001) describe how these cumulative pressures have resulted in a limited regional capacity to implement plans for responding to environmental variability and change.

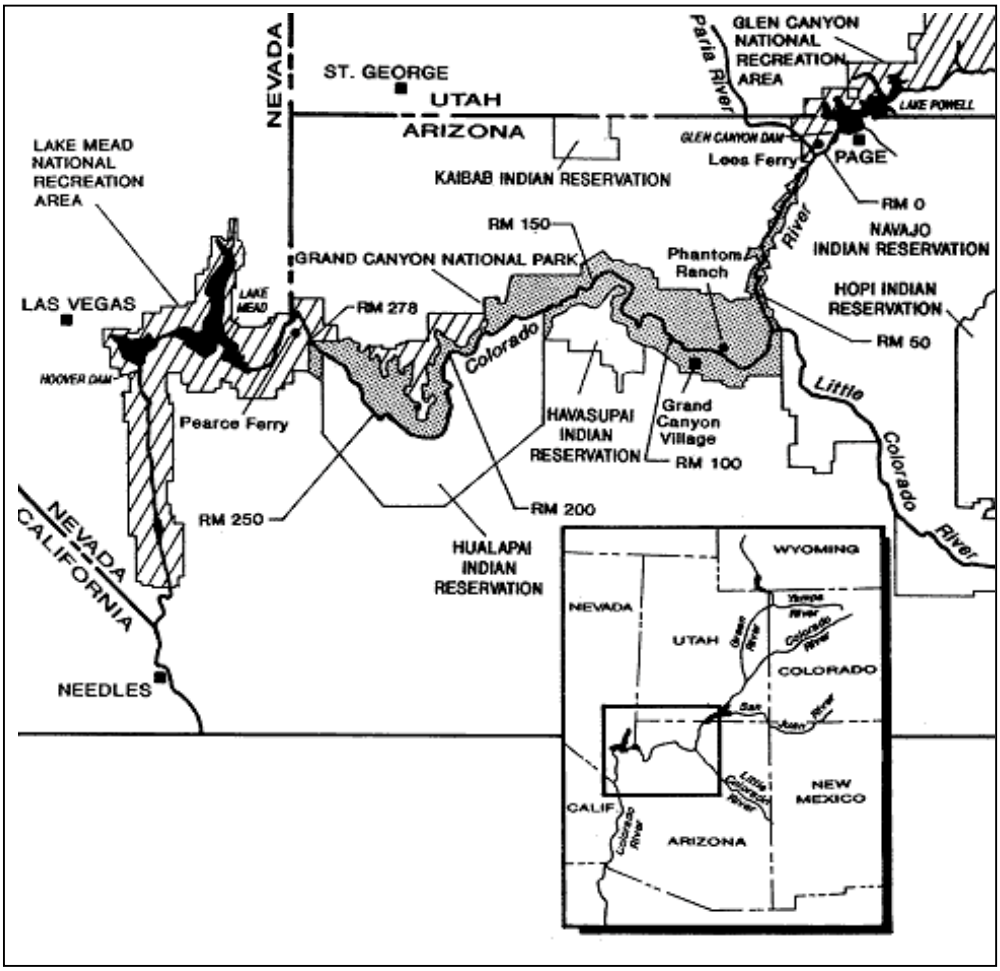

Figure 4.5 The Glen Canyon River Ecosystem and Colorado River Basin (Source: U.S. Bureau of Reclamation, 1995)

At present, the Colorado River (see Figure 4.5) exhibits the characteristics of a 'closed or closing' water system (Peabody, 1991). In such systems, management of interdependence becomes a public function and the development of mechanisms to allow resource users to acknowledge interdependence and to engage in negotiations and binding agreements on resource allocation become increasingly necessary (Pulwarty and Melis, 2001).

In October 1996, the Secretary of the US Department of Interior signed the Record of Decision (ROD) establishing the Glen Canyon Dam Adaptive Management Program (GCDAMP). The GCDAMP provides a process for incorporating scientific information and recommendations from a diverse group of stakeholders in the evaluation and management of dam operations for the benefit of downstream resources, as well as for water supply and hydropower

(Gloss *et al.*, 2005). The GCDAMP is composed of three equally balanced elements (see Figure 4.6 below):

1. A technical process, including the Grand Canyon Monitoring and Research Center (GCMRC), the advisory Technical Working Group (TWG) and external peer review panels;
2. An administrative coordination process that is headed by the Secretary's designee, and;
3. A decision process for making recommendations to the Secretary's designee on the Adaptive Management Working Group (AMWG).

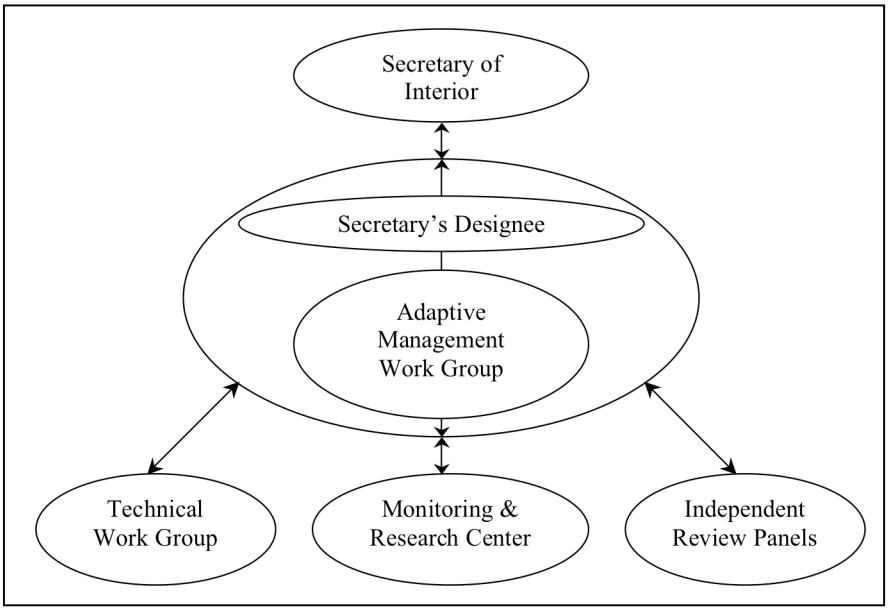

Figure 4.6 Organizations in the AM Program (Source: Center 1997)

This process parallels the decision sequences that determine the Annual Operating Plan (AOP) for the entire Upper Basin. The program is administered by a senior Department of the Interior official (designee) and facilitated by the AMWG, which is organized as a Federal Advisory Committee. The AMWG makes recommendations to the Secretary of Interior on how to best alter the operating criteria at Glen Canyon Dam or other management actions to protect downstream resources in order to fulfill the Department of the Interior's obligations under the GCPA (U.S. Department of the Interior, 1995). The

Secretary of the Interior appoints the group's 25 members, who include representatives from Federal and State resource management agencies, the seven Colorado River Basin States, Native American tribes, environmental groups, recreation interests and contractors of Federal power from the Glen Canyon Dam. Table 4.3 below provides a list of the stakeholder groups that are active in each of the elements outlined above.

Interior Secretary's Designee	
Tribes	**Colorado River Basin States**
Hopi Tribe	Arizona: Arizona Department of Water Resources
Hualapai Tribe	California: Colorado River Board of California
Navajo Nation	Colorado: Colorado Water Conservation Board
Pueblo of Zuni	Nevada: Colorado River Commission of Nevada
San Juan Southern Paiute Tribe	New Mexico: New Mexico Office of the State Engineer
Southern Paiute Consortium	Utah: Water Resources Agency
	Wyoming: State Engineer'sOffice
State and Federal Cooperating Agencies	**Nongovernmental Groups**
Arizona Game and Fish Department	Grand Canyon Trust
Bureau of Indian Affairs	Grand Canyon Wildlands Council
Bureau of Reclamation	Federation of Fly Fishers/ Northern Arizona Flycasters
National Park Service	Grand Canyon River Guides
U.S. Department of Energy, Western Area Power Administration	Colorado River Energy Distributors Association
U.S. Fish and Wildlife Service	Utah Associated Municipal Municipal Power Systems

Table 4.3 Agencies and Other Stakeholder Groups of GCDAMP (Source: http://www.gcdamp.gov/)

The GCDAMP also includes a monitoring and research center (USGS Grand Canyon Monitoring and Research Center), the TWG and independent scientific review panels.

Congress passed a Grand Canyon Protection Act in 1992 to provide guidance and legal support to the Secretary of Interior (SoI) in his efforts to protect Grand Canyon. In addition to directing the Secretary to operate the Glen Canyon Dam to protect and improve downstream resources, the act also validated the interim operating criteria, provided a deadline for the completion of the Environmental Impact Statement (EIS), required the creation of a long-term monitoring and research program, and allocated program costs. The act clearly states that it is

to be implemented in accordance with existing laws, treaties and institutional agreements that govern allocation, appropriation, development and exploration of the waters of the Colorado River Basin (GCPA, sec. 1802(b)).

The creation of an AM program was a common element for all alternatives considered in the EIS and the Record of Decision subsequently mandated its implementation. AM was selected to create a process whereby 'the effects of the dam operations on downstream resources would be assessed and the results of those assessments would form the basis of future modifications of dam operations' (U.S. Department of the Interior, 1995, p.34). The selection of AM and the focus on the effects of the dam operations on downstream resources have significant implications. First, the prominence of the Grand Canyon National Park elevates AM and the GCDAMP to national significance. Second, the program's focus on the effects of dam operations on downstream resources contains the range of management options and creates a relatively well-defined geographic area within which to operate.

Although incomplete, a substantial body of knowledge now exists for the Colorado River ecosystem within the Grand Canyon. The complexity of the natural system presents enormous challenges for determining how resources and population numbers vary in time and space and underscores the importance of longterm studies to describe patterns and processes..

4.3.4 Kissimmee River Restoration Project

Restoration of the Kissimmee River and floodplain in central Florida (Figure 4.7) involved restoring 70 km of river channel and riparian zone and 11,000 ha of wetland over a period of two decades and is one of the largest river restoration projects in the world. The goal of the project is to restore ecological function and biological communities to much of the river and floodplain, primarily by restoring lost hydrologic drivers (Cummins and Dahm, 1995).

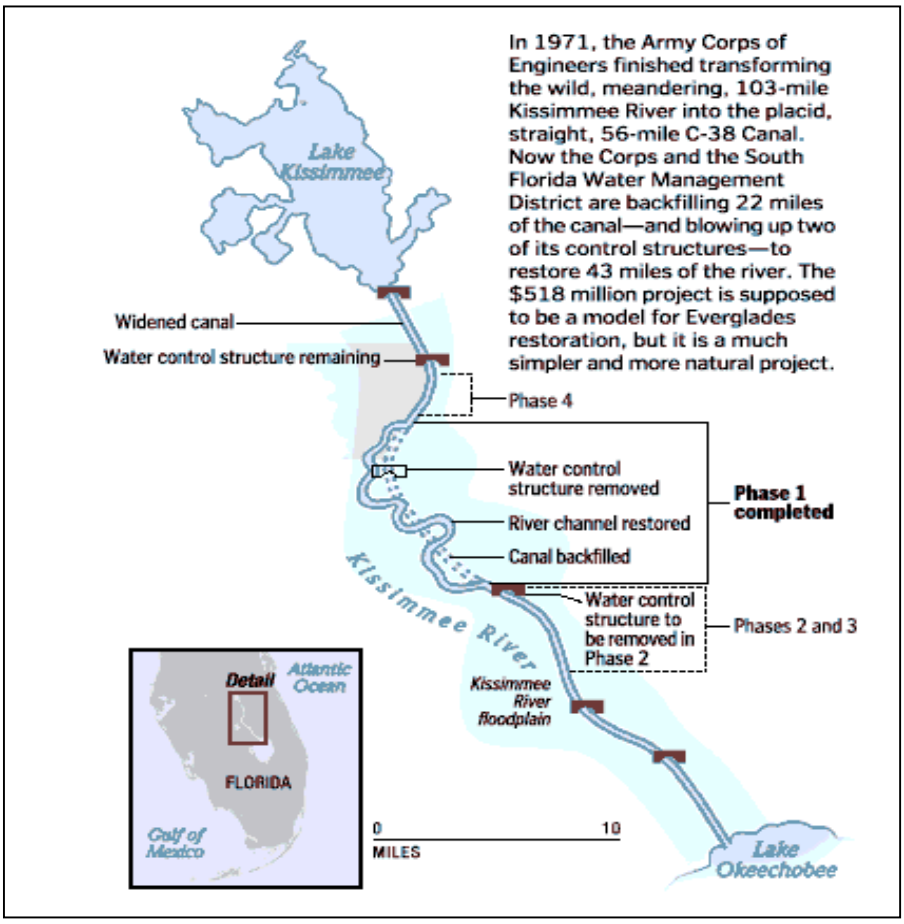

Figure 4.7 Map of the Kissimmee River (Lake Kissimmee to Okeechobee – Source: Loftin et al., 1990)

As part of the Central & Southern Florida (C&SF) flood control project, canal C-38 was excavated along the entire length of the Kissimmee River floodplain. This canal was designed to provide a high level of flood protection for surrounding communities and agricultural interests after a number of disastrous hurricanes and floods in the early half of the 20th century (Koebel, 1995). The primary flood protection strategy in the design of the canal was to contain all flow that the river and floodplain had formerly carried. The canal effectively eliminated flow in the river and ended seasonal overbank flow and inundation of the floodplain. This highly successful engineering project was decried for its environmental impacts even before it was completed in 1971. Even before

construction of the C&SF Project began, its potential for ecological damage was recognized (USFWS, 1959).

The flood control project resulted in the loss of almost 8000 ha of wetlands, drastic declines in bird, fish and other animal populations that depended on the wetlands and substantial reductions in water quality. An initial feasibility study explored ways to restore some portion of the river and floodplain while retaining the level of flood protection provided by the C&SF project. The Demonstration Project (1984-1990) was initiated by the SFWMD to assess the feasibility of the backfill plan (Toth, 1991; Koebel, 1995). Modeling and evaluation in the early stages of feasibility planning indicated that adequate flood protection could be sustained by a combined strategy of property acquisition and backfilling of over one-third of the canal's 56-mile reach (Toth, 1991; 1993).

Two federal feasibility studies were conducted to determine how the backfilling plan would be implemented ad how much federal participation would be granted. In 1992, the U.S. Congress jointly authorized ecosystem restoration of the Kissimmee River and the Kissimmee River Headwaters Revitalization Project (Headwaters) via the Water Resources Development Act. Headwaters was authorized primarily because modifications of the Upper Kissimmee Basin were necessary for successful restoration of the Kissimmee River (U.S. Army Corps of Engineers, 1996). The 1994 cost-sharing Project Cooperative Agreement between the U.S. Army Corps of Engineers and the SFWMD combined the restoration project and Headwaters into the single restoration entity called the Kissimmee River Restoration Project (KRRP).

The goal of the KRRP is to restore ecological integrity to the Kissimmee River and its floodplain. Ecological integrity is a characteristic of ecosystems that are 'capable of supporting and maintaining a balanced, integrated, adaptive community of organisms having a species composition, diversity and functional organization comparable to that of the natural habitat of the region' (Toth *et al.*, 1990 after Karr and Dudley, 1981). At the time it was authorized, the KRRP was the largest and most expensive river ecosystem restoration project ever

attempted. As a model for restoration of large river systems and ecosystems, KRRP acknowledged the need for AM both as a performance evaluation component of the de-channelization process itself as well as the long-term management of the re-established river. The restoration evaluation program, as distinguished from routine monitoring and assessment, has been summarized in a number of academic publications (Toth *et al.*, 1995, Toth, 1995). Published documents regarding the Kissimmee River restoration project explicitly link the fine-tuning of the restoration plan to AM of the recovering and restored ecosystem (Toth *et al.*, 1997).

But there is also a sense in which restoration of the Kissimmee River epitomized AM more broadly, even though it was not consciously stated at the time. Kissimmee restoration achieved new ecological understanding and fundamental reorganization of large-scale water resource management approaches through iterative interaction of science and management, in a process that engaged stakeholders and generated social learning (Loftin *et al.*, 1990).

4.4 Semi-Structured Interviews

4.4.1 Design and Testing

As described in Chapter 3, a face-to-face semi-structured interview was determined as the most reliable and robust means of eliciting the type of data required for this research. The target population of this fieldwork exercise is policy and decision-makers, managers, practitioners and scientists as well as other stakeholder groups affiliated with the implementation of IWRM or AM in the four selected case studies (selection of respondents is described in detail in Section 4.4.2).

The aim of the interviews was to explore the respondents' perspectives on the IWRM or AM concept with regard to its' definition, objective(s) and process. The respondents were also asked to describe experiences with IWRM or AM in the context of their case studies and, in line with this, to provide examples of

barriers and enabling factors that have affected the implementation of IWRM or AM. For this study barriers are described as those factors that have hindered or prevented the implementation and realization of IWRM and AM, whereas enabling factors are those factors that have facilitated or expedited their implementation. In addition to highlighting the mediating factors (barriers and enabling factors), the respondents were asked to describe the causes and effects relating to each factor. The respondents were asked to select one barrier and one mediating factor and to elaborate on the causes that led to these factors being influential as well as the effects of these factors on the implementation process. The aim of the last element of the interview design is to get a better understanding of the dynamics and relationships that exist amongst the different mediating factors.

The interviews were designed to last for between 45 minutes to an hour. Asking interviewees to devote more time may have reduced the number of respondents willing to participate, particularly those with busy schedules. However, the aim was to include as many different types of stakeholder as possible. The interview script has been provided as Appendix II.

Before starting the interviews in the case studies, a pilot was conducted with five researchers from Cranfield University. The main aims of these pilot interviews were to test the interview design and improve the interviewing skills of the researcher. As the five candidates for the pilot tests did not have experience in IWRM or AM, they were interviewed about associated or complementary theories that they had used and experienced in their own research. Insights and lessons learned from these pilot interviews were the following:

- No changes to the interview script, however, time was allocated to each section of the interview script to avoid running out of available time;
- Finding a balance in allowing respondents to answer in their own time without risking too elaborate answers with irrelevant information;

- Developing an interactive conversation while at the same time remaining objective, avoiding as much as possible to influence responses to questions.

4.4.2 Selection of Respondents

This section describes the general process of how potential research respondents were identified and contacted as well as how a final selection of respondents for each case study was concluded. A number of criteria were developed for the selection of interview respondents for each of the case studies:

- At least five and preferably ten years (or more) experience in research on and planning & implementation of IWRM or AM;
- Securing a variation of stakeholder groups and job functions;
- Willingness of potential respondents (to include decision-makers, practitioners and scientists) to participate in the interviews
- Willingness and ability of potential respondents to speak English or Dutch
- Availability of the respondents within the scheduled time span for interviews

In order to select appropriate case study respondents for the interviews, prominent individuals (whose work and activities are widely known through grey and public sources) of these case studies were approached. In the case of the Rhine and the Murray-Darling this was through the case study coordinators in the NeWater project and for the GCDAMP and KRRP the contact went initially through a contact person within CAMNet. These key contacts were approached to help identify and shortlist potential respondents that comply with the selection criteria. Emails providing necessary information material were sent to this list of potential respondents who were also asked to identify more appropriate key respondents (see Appendix III for email content).

Through this snowball technique the researcher eventually identified and prepared lists of around 25 to 35 potential respondents for each case study. Subsequently, these respondent lists were shortened and respondents were shortlisted depending on their willingness and availability to participate in an

interview during specified time spans (most of the interviews have been conducted face-to-face). Eventually visits were arranged for interviews: 10 interviews with Rhine respondents; 14 respondents for the Murray Darling; 14 for the GCDAMP; and 11 for the KRRP (for a list of information concerning selected respondents, refer to Appendix IV).

For those who agreed to be interviewed an email was sent which included the following information and requests:

a) A proposed date and time for the interview to take place and a request to conduct the interview in their workplace;
b) Statements to confirm that respondents would remain anonymous, unless they are happy to be named or cited in interview quotes;
c) A request to record the interviews in order to make sure that all shared information could be taken into account and the researcher can focus on the interview and not be distracted by the task of note-taking;
d) Respondents were also reminded that the interview would be transcribed and that these verbatim transcriptions would be send back to the respondents for them to check for accuracy and authorize for use.

4.4.3 Data Collection and Protocol

In line with the methodological framework of the research, it was decided to conduct data collection through semi-structured interviews in four different case studies. In order to ensure an environment in which the respondents would feel comfortable to share their experiences, it was decided to conduct as many interviews as possible face-to-face.

As the Rhine case study is geographically nearest, it was decided that data collection would start there (in March 2007); it would be easier to come back to this case study at a later stage and conduct additional interviews if that proved necessary. Two of the four case studies are located in the US. Whilst taking into account a limit in resources (time and money) for travelling, data collection was conducted there during one field trip that took place in May and June 2007. The

positive experience of conducting a total of 35 interviews in the first three case studies in combination with a constraint in time were important drivers in the decision to conduct the interviews for the Murray Darling case study over the phone. From the 14 interviews for this case study, 12 interviews took place over the phone and two interviews were conducted face-to-face as these respondents happened to be in Europe at a conference that the researcher also attended.

Data collection was primarily conducted through the use of a digital Dictaphone. Equipment failure during two interviews in the first two case studies, necessitated the use of a second 'back up' Dictaphone. In addition, short notes were taken during interviews.

As mentioned, the researcher conducted face-to-face interviews with 37 respondents, either at their place of work or at a location convenient to them, and 12 interviews over the phone. In reality, the interviews took between 45 minutes and two hours. Researcher personal safety procedures were followed and ethical research guidelines were followed using the British Sociological Society code of practise (2002). Data handling and management conformed with the requirements of the Data Protection Act (1998). The final confirmation of interview schedules was provided via email at least five working days before the interview date. The interviewer also either telephoned or emailed the day before the interview to confirm time and location of interview.

At the start of each interview, the researcher reminded the interviewee of the purpose of the interview and reiterated the ethical and confidentiality protocols of the research. Respondents were also reminded that they could withdraw from the interviews at any stage and that they would be given a copy of the interview transcript for their approval. Before the start of the interviews, each respondent was assigned a reference number in order to keep their identity confidential.[9]

[9] In order to be able to identify respondents from different case studies, the codes started with letters of the case study names: R for the Rhine, MD for Murray Darling, K for the KRRP and GC for the GCDAMP

The date of the interview was verbally logged onto the Dictaphone by the interviewer, along with the reference number at the beginning of the interview.

In order to prepare for data analysis, each interview was transcribed verbatim.[10] During transcription, the transcriber noted when responses were inaudible. No sophisticated transcribing annotations were included in the transcription process. Usually these annotations are employed to highlight, amongst other things, brief pauses, hesitations in response and points at which interviewer and interviewee talk over each other. These annotations also include the numbering of lines to help the person using the transcription refer to appropriate passages. This level of detail was not included in the transcription process for a number of reasons:

1 The type of analysis being undertaken with the transcripts is not essentially linguistic in nature i.e. the analysis is not overly concerned with detail such as syntax construction, deliberate stress on a syllable or confusion of words. The analysis focused on the content of what is being said.
2 The transcription process was subject to time and financial constraints, both of which would have been severely exacerbated by including a much more detailed approach to the transcription process.

Although transcriptions were conducted for the first case study by the researcher, for the other case studies a transcriber was employed to prepare the transcripts. The researcher back-checked the accuracy of these transcripts by selecting a number of random points within each interview while replaying the audio interview against the transcript to validate consistency. Besides a few minor errors, such as e.g. misspelling of names and places, no significant errors were found.[11]

[10] Interview transcripts are available for examination

[11] The original audio versions of the interviews are available on request

4.5 Data Analysis

4.5.1 Introduction

Chapter 3 provided a thorough description of options with regard to possible data analysis methods for this research. This section will elaborate on the different data analysis steps as well as the selected approaches.For this study, data has been collected through semi-structured interviews that have been conducted in four different case studies with an extensive history in the implementation of either IWRM or AM. These semi-structured interviews have been transcribed verbatim. Table 4.4 below provides an overview of each action that has been undertaken during data analysis developed in line with the research questions. It also indicates which sections of the interview script relate to which research question and analysis approach.

	Research Question	Relevant Interview Section	Data Analysis Actions
1)	Are perceptions of IWRM and AM across policy makers and practitioners congruent with the formalised concepts of IWRM and AM?	Section 2 & 3	Similarity analysis between formal statements and respondents' statements of IWRM and AM (Chapter 5)
2)	What is the nature and role of mediating factors that influence the planning & implementation of IWRM and AM interventions and the realisation of their desired goals?	Section 4, 5 & 7	Evaluation the mediating factors that affect the planning and implementation of IWRM and AM as described by the respondents (Chapter 6)
3)	What are the dynamics between the mediating factors that influence the planning and implementation of IWRM and AM interventions and the realisation of their desired goals?	Section 5, 6 & 7	Investigating the dynamics between different mediating factors (Chapter 7)

Table 4.4 Research Questions, Interview Sections and Analysis Steps

The approach developed for the first data analysis action, a similarity analysis between formal statements and respondents' descriptions, is described in more

detail in the next sub-section.[12] The methods used for the second and third analysis steps are elaborated in Section 4.5.3.[13]

4.5.2 Similarity Analysis

As described in Chapter 1, the first research question aims to evaluate the congruency between formal statements of the definition and objectives of IWRM and AM (as found in contemporary literature) and respondent perspectives of IWRM and AM. The most often quoted formal definition of IWRM is that provided by the Global Water Partnership (GWP). Table 4.5 shows the formal statements for the IWRM definition and objective that are described in GWP-TAC (2000) and that have been adopted for this study as the formalized statements of the IWRM concept.

	Formal statements on nature of IWRM
Definition	A process that promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems
Objective	To provide a framework within which to consider tradeoffs between different development objectives and, where possible, to identify win-win water investments. By aligning and integrating interests and activities that are traditionally seen as unrelated or that, despite obvious interrelationships, are simply not coordinated, IWRM can foster more efficient and sustainable use of water resources

Table 4.5 Formal Statements for Definition and Objective of IWRM (GWP-TAC, 2000)

In the case of AM, there are a variety of definitions (and objectives) that are provided by different authors. A composite definition and objective of AM has been developed for this study based on several of the most recognized authors

[12] Findings of the similarity analysis will be described in detail in Chapter 5

[13] Findings of the second and third data analysis actions are provided in Chapter 6 and 7 respectively

on the AM topic. Table 4.6 presents these composite statements for the formalized AM definition and objective.

	Formal statements on nature of AM
Definition	A systematic process for continually improving management policies and practices by learning from the outcomes of operational programs and implemented management strategies. In other words, 'learning to manage by managing to learn'. AM refers to implementation of policies and management activities as experiments to fill critical knowledge gaps and is a process entailing problem assessment, design, implementation, monitoring, evaluation and feedback
Objective	An integrated, multidisciplinary approach for dealing with uncertainty in natural resources issues and is proposed to serve as a compass in our search for a sustainable future. Whether policy or management activities succeed or fail, an adaptive design permits learning, so that future decisions can proceed from a better base of understanding. So AM aims to incorporate new knowledge into management approaches that are based on scientific findings and the needs of society, and results are used to modify management policy, strategies, and practices.

Table 4.6 Formal statements for definition and objective of AM (Adapted from Holling, 1978; Walters, 1986; Lee, 1993; Bormann et al., 1999; Nyberg and Taylor 1995; Gunderson and Holling, 2002; Gleick, 2003)

During the interviews, respondents were asked to provide a definition and objective for IWRM or AM and to draw a diagram of the IWRM or AM process and the activities or elements that are included in such a process. The aim of this first action in the data analysis process is to assess the degree of congruency or similarity between the respondents' descriptions (as articulated in the interview responses) and the formal statements. For the purpose of this thesis congruency and similarity are taken to be synonyms. Of all the interviews, only two statements were in Dutch and have been translated by the researcher.

As described in detail in Chapter 3, a method is selected to conduct the similarity analysis: referred to by Ryan and Bernar (2003) as a *comparative method* and involves taking pairs of statements (formal and respondent

statements) to analyze the differences and similarities between these statements.

For this similarity analysis, three different coders compared and rated the similarity between the formal statements and respondents' statements. Multiple coders were used to increase the reliability of similarity ratings. Carmine and Zeller (1979) define reliability as 'the extent to which a measuring procedure yields the same results on repeated trials'. For this study, the coders were not only asked to rate the similarity between the statements, but in addition to that, to provide written comments to explain their ratings. The following selection criteria are used to identify coders to conduct the similarity analysis:

- Fluent in English language: this will avoid possible misinterpretation by coders of the statements, keywords and synonyms;
- Previous experience with coding and rating: reducing the risk of selecting a coder incapable of conducting similarity analysis appropriately;
- Willingness to rate the similarity of all statement pairs: as approach allows a more efficient basis for evaluating intercoder agreement;
- Some basic understanding of the research topics: making it easier for the coders to understand the formal statements and respondents' descriptions of IWRM and AM in an appropriate context.

Rating sheets were prepared (see Figure 4.8 for template), containing on the left side of the sheet the formal statement of IWRM or AM and on the right the statement of IWRM or AM as provided by a respondent. To ensure anonymity, codes were provided in place of respondent names.

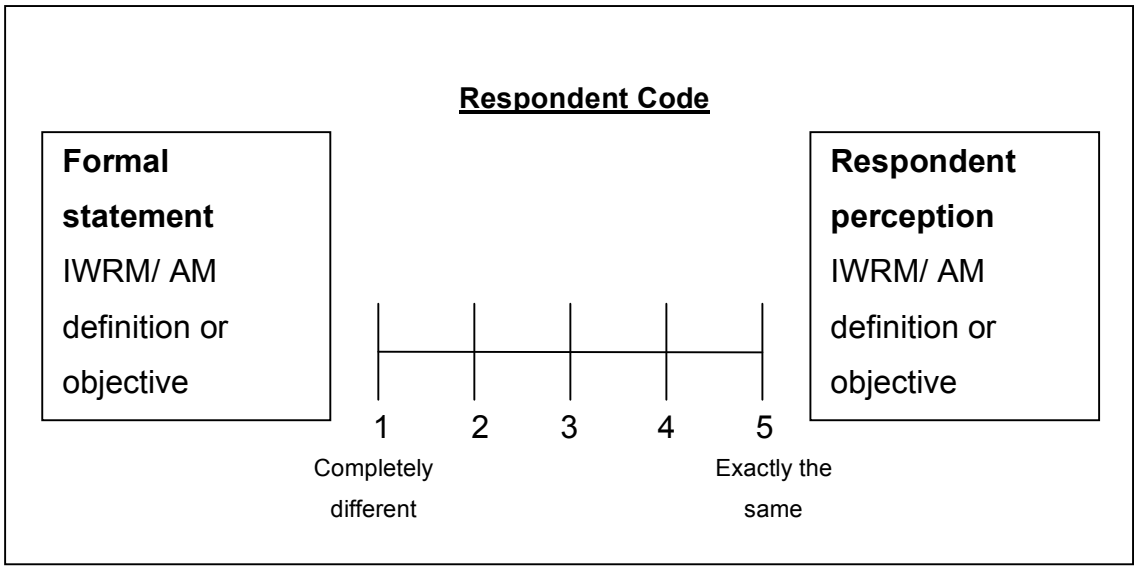

Figure 4.8 Template for Similarity Ratings

Coders were provided with a briefing on how to conduct the similarity analysis and the aim of the exercise. Any questions raised by coders were discussed before the start of the analysis. The coders were instructed to rate the similarity of the two statements using a 5-point scale with an operational definition of valence ranging from '1' being 'completely different' to '5' being 'exactly the same'.

As mentioned, three coders conducted the similarity analysis. Neuendorf (2002: 142) states that 'there is a growing acknowledgement in the research literature that the establishment of intercoder reliability is essential, a necessary criterion for valid and useful research when human coding is employed'. The various measures of agreement that are used to determine intercoder reliability are discussed in the next section.

4.5.3 Inter-coder Reliability Measures

Intercoder reliability measures aim to assess the consistency (level of agreement) of coders' ratings. High levels of disagreement among coders would suggest weakness in the analysis methods or in the way the coders were instructed of the procedures to be followed for determining the similarity ratings

(Kolbe and Burnett, 1991). Intercoder reliability refers in this instance to the extent to which the coders agree on the level of similarity between statements. Although intercoder reliability, in its generic use as an indication of the consistency measurement, is widely accepted, Tinsley and Weiss (2000:98) note that 'a more specific term for the type of consistency required in content analysis is intercoder (or interrater) agreement' and that intercoder agreement is needed because it measures the 'extent to which the different judges tend to assign exactly the same rating to each object'. The following review of guidelines for the calculation and reporting of intercoder reliability are based on literature concerning reliability as well as a detailed examination of reports of content analyses as described by Lombard *et al.* (2003).

There are a significant number of different methods available to quantify the amount of agreement among coders on a variable. Popping (1988) identified 39 different 'agreement indices' for coding categories (especially used in communication) of which only a handful are widely used. Neuendorf (2002:148) states that 'the most popular coefficients in business and the social and behavioral sciences seem to be: raw percent agreement (the 'measure of crude association'), Scott's pi, Cohen's kappa, Krippendorff's alpha, Spearman rho, and Pearson r'.

It seems that, although scholars, methodologists and statisticians have devoted a lot of effort to developing and testing agreement indices, there is no consensus on 'best' choice. Percent agreement seems to be used most widely and is intuitively appealing and simple to calculate, but an important drawback with this method is it's failure to account for chance agreement as well as the rigid requirement of the precise matching of coder ratings (Neuendorf, 2002). In order to consider the coders' agreement to be due to chance, measures such as Scott's pi, Cohen's kappa or Krippendorff's alpha can be applied.

Although Krippendorff's alpha is a well-regarded and flexible measure it requires tedious calculations that are not recommended to conduct by hand and software to support this is not widely available. Cohen's kappa was planned as

an improvement over Scott's pi in the sense that Cohen (1968) also took into account the different ways that misses between coders can be treated by giving weights to those misses. In this case, the term 'misses' means that particular ratings of two coders are not the same. Since the ratings of the coders focus on one variable, 'the level of similarity' between statements, it seems unnecessary to follow Cohen's method. It should be noted that the difference between a one- and two-rating is less significant than that between a one- and a four-rating, however, it would be difficult to give a weight to those differences. Therefore Scott's *pi* method is followed to calculate the intercoder reliability.

Different authors (e.g., Potter and Levine-Donnerstein, 1999; Neuendorf, 2002) recommend that all coders evaluate the same sets of units, although (e.g. due to time and other constraints) it can also be decided to systematically assign coders to rate overlapping sets of units. Following the first approach allows a more efficient basis for evaluating intercoder agreement. The calculation of the measurements are provided in Chapter 5 and the next section discusses the second and third analysis actions and the techniques applied for these actions.

4.5.4 Evaluation of Mediating Factors and Dynamics

The second part of the semi-structured interviews aimed to identify the mediating factors - barriers and enabling factors - that mediate the planning and implementation of IWRM and AM and the realization of their desired ambitions.

As indicated and described in detail in Chapter 3, a wide range of literature exists that documents the underlying assumptions and procedures associated with analysing qualitative data. The method applied to this data analysis action is called a 'inductive thematic analysis' (Thomas, 2003: 2), which provides 'a flexible and useful research tool, which can potentially provide a rich and detailed account of data' (Braun and Clarke, 2006: 78).

The last two steps of the data analysis process are determined by both the research questions (deductive) and multiple readings and interpretations of the raw data (inductive). The primary mode of analysis is the development of

categories from the raw data into a model or framework that captures key themes and dynamics as judged to be important by the researcher. It is inevitable that findings are shaped by the assumptions and experiences of the researcher conducting the research and carrying out the data analysis.

A rigorous and systematic (repeated) reading and coding of the relevant sections of the interview transcripts allowed major themes to emerge. Emerging themes (or categories) were developed, by considering possible meanings and how these fitted with developing themes. Transcripts were also read 'horizontally', which involved grouping segments of text by theme. Towards the end of the study no new themes emerged, which suggested that major themes had been identified and saturation reached (Marshall, 1999: 419). In addition to that, an investigation has been done (based on interview data) into how certain themes or categories are linked to other themes and categories in various relationships such as: a network, a hierarchy of categories or a causal sequence.

Table 4.7 indicates the steps that have been followed to develop themes and categories. This process is based on that proposed by Thomas (2003) and provides key features of categories or themes that come forth from an inductive approach.

Key features of categories	Description
Label for category	Word or short phrase used to refer to category, often carrying inherent meanings that may not reflect the specific features of the category
Description of category	Description of the meaning of category including key characteristics, scope and limitations
Text associated with category	Examples of text coded into category that illustrate meanings, associations and perspectives associated with the category
Links	Each category may have links (commonalities in meaning) or causal relationships with other categories. In a hierarchical category system (e.g., tree diagram) these links may indicate superordinate, parallel and subordinate categories (e.g., parent, sibling or child relationships).
Type of model in which category is embedded	The category system may be incorporated in a model, theory or framework. Such frameworks include; an open network (no hierarchy or sequence), a temporal sequence (e.g., movement or time), or a causal network (one category causes changes in another). It is also possible that a category may not be embedded in any model or framework

Table 4.7 Key Features of Categories or Themes (Source: Thomas, 2003)

An overview of the coding process is shown in Table 4.8 and the suggested outcome of this process is to create three to eight summary categories (Creswell, 2002). These summary categories capture the key aspects of the themes in the raw data. In the case of this research, there are four main categories that have come forth from the analysis, each divided into a number of sub-categories.

Initial read through text data	Identify specific segments of information	Label the segments of information to create categories	Reduce overlap and redundancy among the categories	Create a model incorporating most important categories
Many pages of text	Many segments of text	30-40 categories	15-20 categories	3-8 categories
→	→	→	→	

Table 4.8 The Coding Process in Inductive Analysis (Adapted from Creswell, 2002: 266)

Looking for themes in the transcriptions, initially involved screening through the text and marking it up, to identify the barriers and enabling factors that were highlighted by the respondents during the interviews. Subsequently, each highlighted segment was coded indicating a theme and theme labels were attached to segments of text using comment 'balloons' (reviewing tool in Word) placed alongside the text. Re-reading the transcripts several times enabled double-checking of the naming of themes as well as finding out if any relevant segments had not been highlighted.

Bogdan and Taylor (1975:83) state that some of the most obvious themes and categories in a text are those '*topics that occur and reoccur',* or, as Guba and Lincoln describe it: are '*recurring regularities'*. To identify and understand the dynamics between the different factors, cause and effect relations were investigated through questions during the interviews. In order to find out about cause and effect relations between different mediating factors, the final questions during the interviews followed the structure of a *'pathway approach'* as developed by Lemon *et al.* (2004). This approach and its aim have been described in detail in Chapter 3.

From each interview transcript the relevant, and original, text segments were copied and pasted into lists of barriers and enabling factors created for each of the case studies, with the codes for each interviewee placed behind the text segments to be able to identify which respondent has highlighted the text segment. This approach also enables the identification process of how many respondents highlighted one particular theme or category. The text segments corresponding to a specific theme or category were classified into bullets lists with the theme and category labels as list headings. The resulting lists were 'double-checked' by a colleague to ensure that the segments corresponded well with the categories that they were assigned to. The interview tapes and transcripts and the thematic lists are available for inspection if required. The interview findings by each theme and category are narrated in Chapter 6 and 7.

Stakeholder Checks

The trustworthiness of findings has been assessed through stakeholder checks. Stakeholder checks might involve opportunities for people with a specific interest in the research, such as participants, service providers, funding agencies, to comment on categories or the interpretations made (Erlandson, Harris, Skipper & Allen, 1993:142).

A total of fourteen stakeholders (of whom some had also been interview respondents) were asked for a discussion and provided with a list of the categories and sub-categories (including relevant examples coming from the interview transcripts). These stakeholders were asked to comment on and assess the categorizations, research findings and interpretations. These discussions were held one-on-one and lasted in average around fourty-five minutes. During these discussions, the participants were asked to comment on whether the constructions of the researcher relate to their personal experiences and to provide feedback on any (in their view) wrong or missing elements or categories. However, the aim of these discussions was not only to establish the credibility of the research findings from the case studies, but also to further discuss the dynamics between the mediating factors. The findings with regard to the dynamics between mediating factors will be discussed in more detail in Chapter 7 based on the findings from the Chapter 5 (similarity analysis), Chapter 6 (analysis of mediating factors) and the above described stakeholder discussions.

Stakeholder checks are different from triangulation, where data from one source is checked for consistency with data from other sources. In the case of this research, triangulation has been taking place by comparing the findings of the different case studies and the themes and categories coming from them. During the analysis process it became apparent that most categories and themes are relevant to all four case studies focused on in this research. There is, however, a difference in the intensity with which some categories are more relevant than

others. This is described in more detail in Chapter 6.

4.5 Summary

This chapter has presented criteria for the selection of case studies and provided relevant background information on selected case studies with the support of documentation and reports. It also introduced selection criteria for case study respondents as well as a thorough explanation of how these participants were identified, approached and selected. Finally, the data analysis techniques, used in this study, were described. Chapter 5 will present the data from the similarity analysis between formalized statements of IWRM and AM and the descriptions provided by the case study respondents.

5 Similarity Analysis

5.1 Introduction

This chapter is the first of two chapters that describe and analyze the data from the semi-structured interviews. As described in Chapters 3 and 4, different actions have guided the process of analyzing data from the interviews and have been developed in line with the research questions that form the basis of this study:

1. *Similarity analysis* between formal statements and the respondents' descriptions of IWRM and AM;
2. *Evaluating the mediating factors* that affect the planning and implementation of IWRM and AM as described by the respondents;
3. *Investigating the dynamics* between different mediating factors.

The first action, the similarity analysis between formal statements and respondents' descriptions, is presented in this chapter and contributes towards answering the first research question. The second and third analysis actions are elaborated in Chapters 6 and 7 and relate to research questions two and three. Before discussing the findings of the similarity analysis, intercoder reliability between the ratings provided by the three coders is calculated in the next section in order to ensure the reliability of this analysis action and its results.

5.2 Intercoder Reliability Analysis

Tables 5.1 and 5.2 illustrate the similarity ratings given to respondents' statements by each coder (1= completely different; 5= exactly the same). Table 5.1 relates to statements supplied by respondents from the Rhine and Murray Darling, and Table 5.2 to those from the GCDAMP and KRRP case studies. The mode rating is also indicated for each respondent.

	Coder 1		Coder 2		Coder 3		Mode	
	Definition	Objective	Definition	Objective	Definiton	Objective	Definition	Objective
R01	3	3	2	2	2	3	2	3
R02	3	2	1	1	3	2	3	2
R03	3	2	2	2	3	2	3	2
R04	4	4	4	3	4	4	4	4
R05	-	3	-	3	-	3	-	3
R06	3	2	2	1	2	2	2	2
R07	3	3	2	1	2	1	2	2
R08	3	3	2	2	2	2	2	2
R09	3	4	2	4	2	4	2	4
R10	3	3	3	3	3	3	3	3
MD01	3	4	3	4	3	4	3	4
MD02	3	3	3	2	3	3	3	3
MD03	3	3	3	3	3	3	3	3
MD04	3	4	3	4	3	4	3	4
MD05	2	2	2	1	2	1	2	1
MD06	3	4	3	5	3	4	3	4
MD07	2	3	3	3	2	2	2	3
MD08	3	4	4	5	3	5	3	5
MD09	-	2	-	1	-	1	-	1
MD10	3	3	3	4	3	3	3	3
MD11	3	5	2	4	2	5	2	5
MD12	4	2	4	2	4	3	4	2
MD13	4	3	5	2	4	3	4	3

Table 5.1 Similarity Ratings of Respondents' Statements for IWRM Definition & Objective

For different reasons (that are described later in this chapter), the coders were not able to provide a similarity rating for some of the respondents' descriptions, in which case the tables indicate no number in the cell but a dash.

	Coder 1		Coder 2		Coder 3		Average rating	
	Definition	Objective	Definition	Objective	Definiton	Objective	Definition	Objective
GC01	4	3	5	3	5	3	5	3
GC02	4	3	4	3	4	3	4	3
GC03	3	3	4	3	3	3	3	3
GC04	3	2	3	3	3	2	3	2
GC05	3	2	2	3	2	2	2	2
GC06	2	3	2	3	2	3	2	3
GC07	2	1	2	1	2	1	2	1
GC08	2	3	2	4	2	3	2	3
GC09	4	3	4	3	4	3	4	3
GC10	3	2	4	2	3	3	3	2
GC11	3	2	2	2	3	2	3	2
GC12	-	-	-	-	-	-	-	-
GC13	3	3	3	2	3	2	3	2
GC14	3	2	3	3	3	3	3	3
KR01	3	2	3	3	3	3	3	3
KR02	4	3	4	3	4	3	4	3
KR03	3	3	4	3	3	3	3	3
KR04	4	3	4	3	4	2	4	3
KR05	3	2	3	3	3	2	3	2
KR06	3	3	3	3	3	3	3	3
KR07	3	3	4	3	3	3	3	3
KR08	3	4	4	5	3	4	3	4
KR09	4	4	5	4	5	4	5	4
KR10	3	3	3	4	3	4	3	4
KR11	4	4	5	5	4	5	4	5

Table 5.2 Similarity Ratings of Respondents' Statements for AM Definition & Objective

The similarity ratings from the coders have been arrayed into separate contingency tables in order to prepare for the calculation of intercoder reliability. As three coders were involved in the rating process, separate contingency tables have been developed for each pair of coders:

- IWRM definition (Tables 5.3 a, b and c);
- IWRM objective (Tables 5.4 a, b and c):
- AM definition (Tables 5.5 a, b and c);
- AM objective (Tables 5.6 a, b and c.

Observed freq / *Expected freq*		Coder 2 — Valence of assertions about similarity					
		1	2	3	4	5	Row total
Coder 1 — Valence of assertions about similarity	1	0 *0*	0	0	0	0	0
	2	0	1 *0.76*	1	0	0	2
	3	1	7	7 *6.1*	1	0	16
	4	0	0	0	2 *0.43*	1	3
	5	0	0	0	0	0 *0*	0
	Column total	1	8	8	3	1	N=21

Table 5.3a Contingency Table IWRM Definition - Coder 1 & 2

Observed freq / *Expected freq*		Coder 2 — Valence of assertions about similarity					
		1	2	3	4	5	Row total
Coder 3 — Valence of assertions about similarity	1	0 *0*	0	0	0	0	0
	2	0	7 *3.05*	1	0	0	8
	3	1	1	7 *3.81*	1	0	10
	4	0	0	0	2 *0.43*	1	3
	5	0	0	0	0	0 *0*	0
	Column total	1	8	8	3	1	N=21

Table 5.3b Contingency Table IWRM Definition - Coder 2 & 3

Observed freq / *Expected freq*		Coder 3 — Valence of assertions about similarity					
		1	2	3	4	5	Row total
Coder 1 — Valence of assertions about similarity	1	0 *0*	0	0	0	0	0
	2	0	2 *0.76*	0	0	0	2
	3	0	6	10 *7.62*	0	0	16
	4	0	0	0	3 *0.43*	0	3
	5	0	0	0	0	0 *0*	0
	Column total	0	8	10	3	0	N=21

Table 5.3c Contingency Table IWRM Definition - Coder 1 & 3

Observed freq / *Expected freq*		Coder 2 Valence of assertions about similarity					
		1	2	3	4	5	Row total
Coder 1 Valence of assertions about similarity	1	0 *0*	0	0	0	0	0
	2	4	2 *1.565*	0	0	0	6
	3	1	4	4 *2.174*	1	0	10
	4	0	0	1	3 *1.304*	2	6
	5	0	0	0	1	0 *0.087*	1
	Column total	5	6	5	5	2	N=23

Table 5.4a Contingency Table IWRM Objective – Coder 1 & 2

Observed freq / *Expected freq*		Coder 3 Valence of assertions about similarity					
		1	2	3	4	5	Row total
Coder 2 Valence of assertions about	1	3 *0.65*	2	0	0	0	5
	2	0	2 *1.304*	4	0	0	6
	3	0	1	3 *1.74*	1	0	5
	4	0	0	1	3 *1.087*	1	5
	5	0	0	0	1	1 *0.174*	2
	Column total	3	5	8	5	2	N=23

Table 5.4b Contingency Table IWRM Objective – Coder 2 & 3

Observed freq / *Expected freq*		Coder 3 Valence of assertions about similarity					
		1	2	3	4	5	Row total
Coder 1 Valence of assertions about similarity	1	0 *0*	0	0	0	0	0
	2	2	3 *1.304*	1	0	0	6
	3	1	2	7 *3.48*	0	0	10
					1.304		
	5	0	0	0	0	1 *0.087*	1
	Column total	3	5	8	5	2	N=23

Table 5.4c Contingency Table IWRM Objective – Coder 1 & 3

Observed freq / Expected freq		Coder 2 – Valence of assertions about similarity					
		1	2	3	4	5	Row total
Coder 1 – Valence of assertions about similarity	1	0 *0*	0	0	0	0	0
	2	0	3 *0.625*	0	0	0	3
	3	0	2	7 *4.083*	5	0	14
	4	0	0	0	4 *2.625*	3	7
	5	0	0	0	0	0 *0*	0
	Column total	0	5	7	9	3	N=24

Table 5.5a Contingency Table AM Definition – Coder 1 & 2

Observed freq / Expected freq		Coder 2 – Valence of assertions about similarity					
		1	2	3	4	5	Row total
Coder 3 – Valence of assertions about similarity	1	0 *0*	0	0	0	0	0
	2	0	4 *0.833*	1	0	0	5
	3	0	0	7 *3.792*	0	0	7
	4	0	0	5	4 *1.875*	0	9
	5	0	0	0	1	2 *0.25*	3
	Column total	0	4	13	5	2	N=24

Table 5.5b Contingency Table AM Definition – Coder 2 & 3

Observed freq / *Expected freq*		Coder 3 – Valence of assertions about similarity					
		1	2	3	4	5	Row total
Coder 1 – Valence of assertions about similarity	1	0 *0*	0	0	0	0	0
	2	0	3 *0.5*	0	0	0	3
	3	0	1	13 *7.583*	0	0	14
	4	0	0	0	5 *1.458*	2	7
	5	0	0	0	0	0 *0*	0
	Column total	0	4	13	5	2	N=24

Table 5.5c Contingency Table AM Definition – Coder 1 & 3

Observed freq / Expected freq		Coder 2: Valence of assertions about similarity					
		1	2	3	4	5	Row total
Coder 1: Valence of assertions about similarity	1	1 *0.042*	0	0	0	0	1
	2	0	2 *0.875*	5	0	0	7
	3	0	1	10 *8.125*	2	0	13
	4	0	0	0	1 *0.375*	2	3
	5	0	0	0	0	0 *0*	0
	Column total	1	3	15	3	2	N=24

Table 5.6a Contingency Table AM Objective – Coder 1 & 2

Observed freq / *Expected freq*		Coder 3: Valence of assertions about similarity					
		1	2	3	4	5	Row total
Coder 2: Valence of assertions about similarity	1	1 *0.042*	0	0	0	0	1
	2	0	2 *0.75*	1	0	0	3
	3	0	4	11 *8.125*	0	0	15
	4	0	0	1	2 *0.375*	0	3
	5	0	0	0	1	1 *0.083*	2
	Column total	1	6	13	3	1	N=24

Table 5.6b Contingency Table AM Objective – Coder 2 & 3

Observed freq / *Expected freq*		Coder 3: Valence of assertions about similarity					
		1	2	3	4	5	Row total
Coder 1: Valence of assertions about similarity	1	1 *0.042*	0	0	0	0	1
	2	0	4 *0.875*	3	0	0	7
	3	0	2	10 *3.52*	1	0	13
	4	0	0	0	1 *0.125*	2	3
	5	0	0	0	0	0 *0*	0
	Column total	1	6	13	2	2	N=24

Table 5.6c Contingency Table AM Objective – Coder 1 & 3

Percentage of Observed Agreement

To compute the percentage agreement between coders, the following formula is used (Holsti's method, 1969: 137):

$$2A / n_1 + n_2 \qquad \textit{(Equation 5.1)}$$

Where:
A = Number of times coders agree (see diagonal cells in the contingency table)
n_1 and n_2 = Number of coding decisions each coder made

The percentage agreement ranges from .00 indicating 'no agreement' to 1.00 indicating 'complete agreement', and can be interpreted as the *percentage of observed agreement* between the coders. For each of the three pairs of coders, the percentage of observed agreement has been calculated and is shown in Table 5.7 (for IWRM) and 5.8 (for AM) below:

Coder pairs	IWRM definition	IWRM objective
Coder 1 and 2	.48	.39
Coder 2 and 3	.76	.52
Coder 1 and 3	.71	.70

Table 5.7 The % of Observed Agreement Between Coder Pairs on IWRM

Coder pairs	AM definition	AM objective
Coder 1 and 2	.58	.58
Coder 2 and 3	.71	.71
Coder 1 and 3	.88	.67

Table 5.8 The % of Observed Agreement Between Coder Pairs on AM

Scott's Pi

As indicated in Chapter 4, the percentage of observed agreement gives a somewhat inflated view of inter-coder agreement as it does not take into account the fact that the coders would probably agree part of the time simply due to chance. Scott's pi method corrects this by differentiating between the

percentage of observed agreement and the *percentage of expected agreement*. The latter must be separately calculated. The diagonal cells in the contingency tables represent agreement between coders and the expected frequencies for those cells are calculated and summed. The expected frequency for each cell is calculated individually as follows:

(row total) (column total) / number of statement pairs being rated

(*Equation 5.2)*

The expected frequencies per cell are shown as the second numbers (in italic) at the right bottom of each diagonal cell.

The percentage of expected agreement calculated for each pair of coders is then calculated as follows (for outcomes see Table 5.9 for IWRM and 5.10 for AM):

$$2E / n_1 + n_2 \qquad \textit{(Equation 5.3)}$$

Where: *E = Expected frequency for the cells along the diagonal*

Coder pairs	IWRM definition	IWRM objective
Coder 1 and 2	.35	.22
Coder 2 and 3	.35	.22
Coder 1 and 3	.42	.27

Table 5.9 The % of Expected Agreement Between Coder Pairs on IWRM

Coder pairs	AM definition	AM objective
Coder 1 and 2	.31	.39
Coder 2 and 3	.28	.39
Coder 1 and 3	.40	.19

Table 5.10 The % of Expected Agreement Between Coder Pairs on AM

As stated, *Scott's pi calculations* will help eliminate agreement due to chance and the formula for this calculation is as follows (Holsti, 1969:140 – refer to Table 5.11 and 5.12 for outcomes):

Scott's pi = % observed agreement - % expected agreement *(Equation 5.4)*

1 - % expected agreement

Coder pairs	IWRM definition	IWRM objective
Coder 1 and 2	.20	.22
Coder 2 and 3	.63	.38
Coder 1 and 3	.51	.59

Table 5.11 Scott's pi Calculations for All Coder Pairs for IWRM case studies

Coder pairs	AM definition	AM objective
Coder 1 and 2	.40	.31
Coder 2 and 3	.60	.52
Coder 1 and 3	.80	.59

Table 5.12 Scott's pi Calculations for All Coder Pairs for AM case studies

As we are dealing with more than two coders for this study a *composite reliability coefficient* must be calculated (Holsti, 1969:137).

Composite reliability = N (average intercoder agreement) *(Equation 5.5)*

1 + [(N-1) (average intercoder agreement)

Where: N = Number of coders

	Composite Reliability
IWRM definition	.71
IWRM objective	.67
AM definition	.82
AM objective	.73

Table 5.13 Composite Reliability Calculations

It should be noted that the composite reliability coefficient is larger than the average inter-coder agreement since it assumes that the more coders there are, the more valid their combined observations will be. The composite reliability coefficient is justifiably used as all coders have coded all available units. The

calculated composite reliability for the three coders is respectively 71% and 67% for the IWRM cases and 82% and 73% for the AM ones. An interpretation of these reliability results shows that the lowest intercoder reliability lies with coder-pair 1 and 2, whereas coder-pair 1 and 3 score overall the highest intercoder reliability. It is, however, difficult to determine what the possible reasons could be for this as backgrounds of the three coders are quite similar as well as the level of understanding of IWRM and AM. Coders 1 and 3 are of similar gender, but it seems questionable whether that could be a possible cause for high reliability.

Taking into account the fact that for these intercoder reliability measures only precise matchings of coder ratings have been taken into account and that closeness of rates (such as e.g. one and two ratings) has not been considered, the reliability values are sufficient and the mode similarity ratings of the three coders will be used for further analysis (see Table 5.1 and 5.2 – mode ratings).

5.3 Similarity Analysis – Findings for IWRM

The findings from the similarity analysis of the IWRM case studies – the Rhine and Murray Darling – are elaborated in detail in this section, whereas the findings of the AM case studies will be discussed in Section 5.4. In addition to investigating the similarity ratings that are given to the respondents' statements, comments and notes provided by the coders during the rating process are included in the evaluation of respondents' statements with the aim of providing a more qualitative explanation for the ratings. Based on the written comments provided by the coders, criteria and descriptions for each rating level are described as follows:

1. 1-rating or 'completely different': showing no representation of the keywords in the correct context and may also contradict with the formal statement;
2. 2-rating or 'limited similarity': poorly structured, or even contradictory or ambiguous. Also showing limited understanding or scope with keywords or synonyms not present;

3. 3-rating or ‘average similarity’: showing understanding of the main spirit of IWRM or AM with no obvious misconceptions or contradictions. Structure may be uncertain with not all keywords represented;
4. 4-rating or ‘high similarity’: most of the keywords are represented without too much incoherency or ambiguity and no misconceptions;
5. 5-rating or ‘exactly the same’: clear structure and all keywords or synonyms present. No contradictions.

The numbers at the end of the direct quotes provided in these two sections are the respondent identification codes. Based on the comments and notes provided by the coders, the differences and similarities between the formal statements of IWRM and AM and the respondents’ statements have been investigated for each of the two case studies. The overall findings from the cases are also compared. The final section (5.5) of this chapter provides a comparison between the findings of the IWRM and AM case studies.

5.3.1 Frequency of Ratings

The last two columns of Table 5.1 showed the mode of ratings given to the statements provided by the respondents in the Rhine and Murray Darling case studies with regard to the definition and objective of IWRM. The frequencies of these similarity ratings are visualized in Figures 5.1 and 5.2.

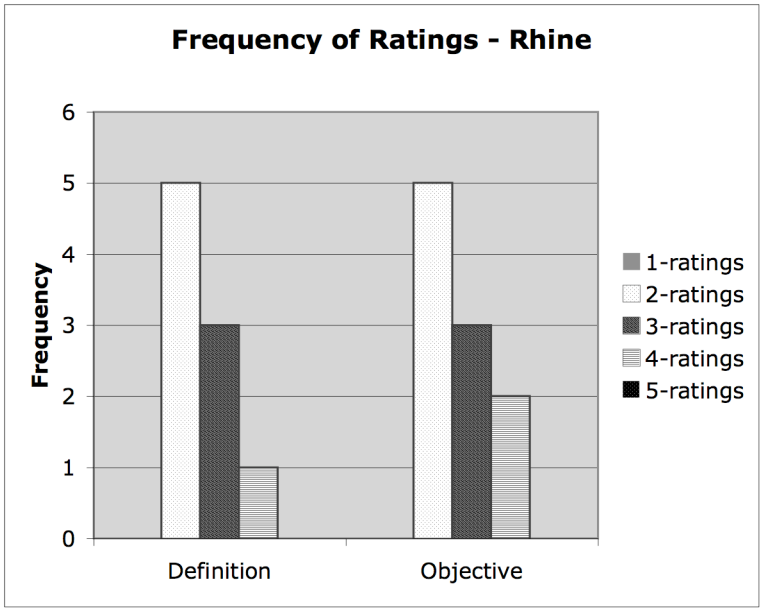

Figure 5.1 Frequencies of Similarity Ratings for the Rhine

For the Rhine case study, the majority of the respondents' statements with regard to the definition and objective of IWRM have been rated a '2' or '3', which indicates that a majority of the respondents were not able to give a convincing definition or objective of IWRM that displays a (high) similarity with the formal definition and objective of IWRM. One of the respondents (R05) found it '*very hard to come up with one clear description*' of the definition of IWRM and therefore provided no response at all.

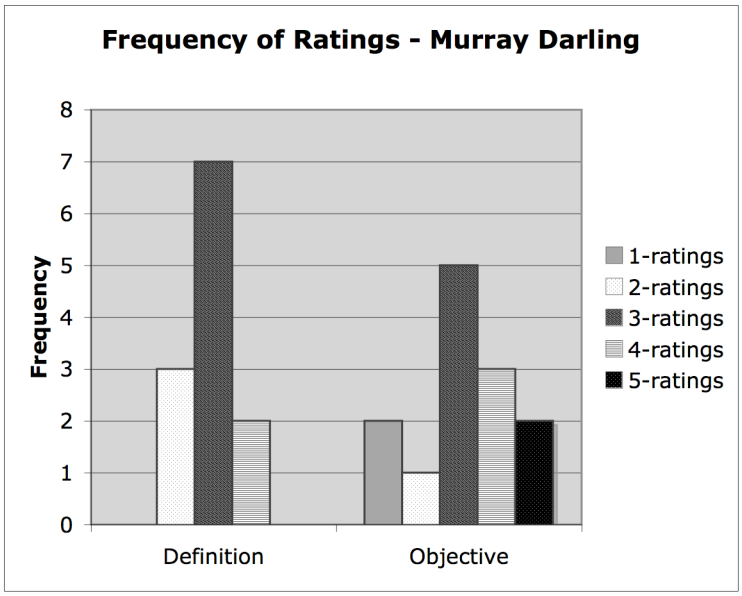

Figure 5.2 Frequencies of Similarity Ratings for the Murray Darling

Figure 5.2 indicates that seven out the thirteen Murray Darling respondents provided a definition of IWRM that is viewed as 'moderately similar' to the formal definition of IWRM, whereas the majority of their descriptions of the IWRM objective are evaluated as ranging from 'moderately similar' to 'highly similar'. This indicates that a majority of the respondents of the Murray Darling case study were able to provide definitions and objectives of IWRM that display similarity and in a few cases a high similarity to the formal definition and objective. In only one case, a respondent (MD09) was not able to give a definition of IWRM that could be taken into account for the similarity ratings. This respondent was unwilling to provide a clear definition of IWRM as he had developed a negative mindset about the IWRM concept:

> *'It's the wrong way to think about resource management, it's the wrong approach. I would define it as fighting over the slices of a cake' (MD09)*

Although this respondent showed an understanding of the IWRM concept and process in the interview transcript, he was not interested in giving a thorough definition although he might have very well been able to.

Based on the comments and notes provided by the coders, the following section reports in more detail the differences and similarities, gaps and overlaps between the respondents' descriptions and the formal statements of IWRM. The reader should refer back to Table 5.1 for the formal ratings given to the respondents' statements.

5.3.2 Definitions of IWRM – Coherencies and Omissions

None of the respondents' definitions of IWRM (from both the Rhine and Murray Darling case studies) were judged as being 'completely different' from the formal definition of IWRM. Most of the respondents' definitions that were considered of 'limited similarity' to the formal definition were described to be very narrow in focus and in some cases incoherent and poorly structured. Five out of ten respondents from the Rhine case study received a 2-rating (limited similarity) for their definition of IWRM, compared to a significantly lower number of respondents from the Murray Darling case – three out of thirteen respondents.

To give an example of the narrow definition alluded to above, here is how one of the respondents from the Rhine case study defined IWRM:

> *'IWRM integrates upstream as well as downstream of a river basin system, but also includes social, economical and environmental perspectives' (R06)*

An example of a rather incoherent and poorly structured definition of IWRM is provided by one of the Murray Darling respondent:

> *'You need to use the resource in an integrated way… the use of one resource should not affect the orther uses. For example, if you've got more flow in the stream and use the surface water as a resource then to some extent you can also store water underground and you can use the underground water… So look at water resource and manage it in an integrative way so that it won't affect the use of one on the other' (MD05)*

This respondent seems to contradict the underlying idea of an integration process as he states that '*the use of one resource should not affect the other*

uses'. Most of the respondents whose definitions were perceived of 'limited similarity' failed to recognize the importance of coordination in the IWRM process and described only narrow fields to include physical resources but not (e.g.) socio economic interests or ecosystem sustainability. To provide an example, one of the Rhine respondents gives the following definition:

> *'Integration of water quantity and quality, and to make a connection between water management and the environment' (R09)*

Another respondent does imply that you need to '*understand all of the elements of an issue*' (MD07), but does not describe in more detail what those elements are. All in all these respondents' definitions do not seem to characterize the IWRM concept very well. Based on the coders' comments, an oversight of the missing aspects is given below:

- *Process:* respondents seem to understand to an extent the underlying meaning of the IWRM ethos, but they do not explicitly describe integration as being a process. They show the need for integration as well as some of the elements that need to be integrated, but not the process of doing it.
- *Coordination:* in line with the limited recognition that IWRM is a process, the respondents with 2-ratings also did not elaborate on the importance of coordination between the different aspects and interests in the IWRM process. One respondent mentions that in IWRM *'you are looking at different aspects'* (R09), but does not explicitly describe the necessity of coordination between those aspects.
- *Different elements:* most respondents implied the biophysical elements of the ecosystem as a part of IWRM, but did not explicitly describe this in relation to socio-economic interests and ecosystem sustainability.

The Murray Darling case study counts seven respondents that received a 'moderately similar' rating for their definition of IWRM, a significantly higher number of respondents than that of the Rhine with only three respondents. These respondents were able to give a more coherent and better-structured definition. And they either explicitly or implicitly recognized the process and

coordination between the aspects of IWRM. For example, one respondent specifically refers to 'coordination' in his definition:

> *'To manage all the development features in a coordinated way so that if you have a group of people or a group of organizations, they would be doing things to enhance the natural resources of the region…' (MD01)*

Another respondent used the word 'interaction' which suggests a dynamic relationship between the aspects:

> *'Handling and managing water systems in such a way that the interaction between ground water and surface water is taken into account, as well as between water quality and quantity all within the context of human demand and concumption as well as the environment' (R03)*

They all seem to get the main gist of the IWRM process but are still not including explicitly all key elements of the formal definition, such as socio economic interests or in some cases ecosystem sustainability. Most of these respondents do recognize the need for fostering coordination and interaction between the different aspects; they all understand the process and need for coordination, but do not include all key issues as described in the formal IWRM definition.

For both the Rhine and Murray Darling case study, only a few respondents (one for the Rhine and two for the Murray Darling) provided a definition of IWRM that received a similarity rating implying a 'high similarity'. None of the respondents' definitions, however, were rated as 'exactly the same' to the formal IWRM definition. The respondents whose definition of IWRM was ranked 'highly similar' gave a very inclusive and clear definition that was almost identical to the formal IWRM definition including all or most facets of the integration process. These respondents not only indicated the importance of integration and coordination between the different aspects, but also elaborated on what constitutes an integration process:

> *'Managing resources sustainable while taking into account a wide variety of possible users and balancing the different needs and interests of users including the environment. So integration… across all economic and*

social sectors and through all different levels of government and representation… from small scale to large scale, local to global..' (MD12)

And another respondent:

'IWRM means you look at different aspects and functions of water. You look at how water is part of the environment, including land resources, and socioeconomic functions… And for implementation you need a lot of coordination… you need collaboration between different disciplines…' (R04)

5.3.3 Objectives of IWRM – Differences and Similarities

With regard to the Rhine case study, five respondents (out of ten) provided a statement of the IWRM objective that was considered of 'limited similarity' and none of the Rhine respondents' statements were perceived as 'completely different' from the formal objective. Only three (out of thirteen) Murray Darling respondents were given a rating below '3' (moderately similar). These three respondents' statements showed similar differences in their statements to the formal objective of IWRM and offered perceptions that showed limited scope of understanding or ability to formulate a coherent and detailed objective for IWRM.

For example, one of the respondents (MD05) when describing the aspects only mentioned surface and ground water objectives. He or she states that IWRM:

'Aims to conserve both surface and ground water as a resource and use it wisely' (MD05)

In other words, there is no reference made to different possible development objectives and the need to consider trade-offs and align different interests as well as to the dynamic nature of water use. One of these three respondents did elaborate on different objectives in his statement, however, his description is narrow and does not describe the process of aligning and trading offs made between those objectives and was therefore not given a three rating:

'It should cater to different functions, sustainable use of the water for the different functions. For instance, one negative function of water could be

> *flooding, so to prevent flooding could be an objective, achieving good quality for drinking water and for nature could be another objective. To me IWRM should have a multiple set of objectives; it should not be focusing on just one objective' (R02)*

Most of these respondents did recognize IWRM as fostering more efficient and sustainable management of water resources. One respondent (R07), for example, refers to '*handling our environment in a responsible way by seeing our water systems as the basis for our living environment*'. Although one respondent does not describe this aim towards more sustainability in their objective:

> *'To aim for some optimal outcomes: I think that IWRM leads to building and creating more government departments and bureaucrats… ' (MD09)*

As mentioned before, this respondent has quite a negative stance towards IWRM (as can be observed from the interview transcription) and was therefore not able to give an objective of IWRM unbiased by his former experiences in working with the concept.

Based on the coders' comments, an oversight of the missing aspects in the respondents' objective is given below:

- *Different development objectives and interests:* respondents acknowledge different uses and functions in the IWRM process, but they do not explicitly describe IWRM as including and focusing on different development objectives and interests.
- *Aligning and trade-offs:* they also do not describe the objective of IWRM as including different development objectives and interests that need to be aligned and where trade-offs need to be considered. One of the respondents does refer to 'including and bringing together different functions' but is too unclear with regard to how to do that. For example, the following statement only includes the aim towards sustainability and does not describe the process of aligning and trade offs to be made between different development objectives:

> *'To come to sustainable development of water systems which means to manage and develop water and land in such a way that also in the future people can make sustainable use of water in as many functions as possible' (R03)*

Three of the Rhine respondents and five of the Murray Darling respondents were given a three rating. These respondents all recognized and made reference towards the aim for efficient and sustainable management and use of water resources in their statements. They also recognize the different functions, objectives and interests in the IWRM process, but most of these 'three ratings' respondents do not explicitly refer to the importance of aligning interests and considering trade-offs between the different development objectives. One of the respondents makes a statement that contradicts this necessity to align objectives and make trade-offs by stating that '*the major goal is that the water course can meet all the requirements… Getting the ecological situation improved while at the same time safeguarding all the uses of water'* (R01)

Two out of the ten respondents of the Rhine gave quite an extensive description of the IWRM objective that suggested a very good understanding of IWRM's aims including all the key elements. One example of such extensive and encompassing description is the following:

> *'You aim for healthy water which can be used for many aspects, such as environment, physical planning, shipping and drinking water, etc. All these interests need to be put on the table to see what is possible and negotiate to make good choices while taking into account all the interests, water quality, quantity and connection with environment and physical planning. It is really complex but then you aim to succeed in making the best choices. These choices can change over time depending on the economy, willingness to pay for nature, as well as on government choices and decisions. What you really need is a good concept on what is important and what does society want?' (R09)*

A higher number of respondents from the Murray Darling case study, to be exact five out of thirteen, provided a description of the IWRM objective that suggested a very good understanding of IWRM's aim including all the key elements. Two out of those five respondents' objectives were even rated as

'exactly the same' indicating that these respondents were able to provide an objective that matched the formal statement very closely.

5.3.4 Comparing the Consistency of Respondent Ability to Define and Describe IWRM

This section conducts a brief analysis of the similarity of ratings given to the IWRM definition and objective statements of individual respondents. In other words, the aim is to investigate whether the ratings given to a specific respondent for his definition of IWRM has been similar to the rating given to his IWRM objective. Figure 5.3 below compares the ratings given to Rhine respondents' statements of the IWRM definition and objective:

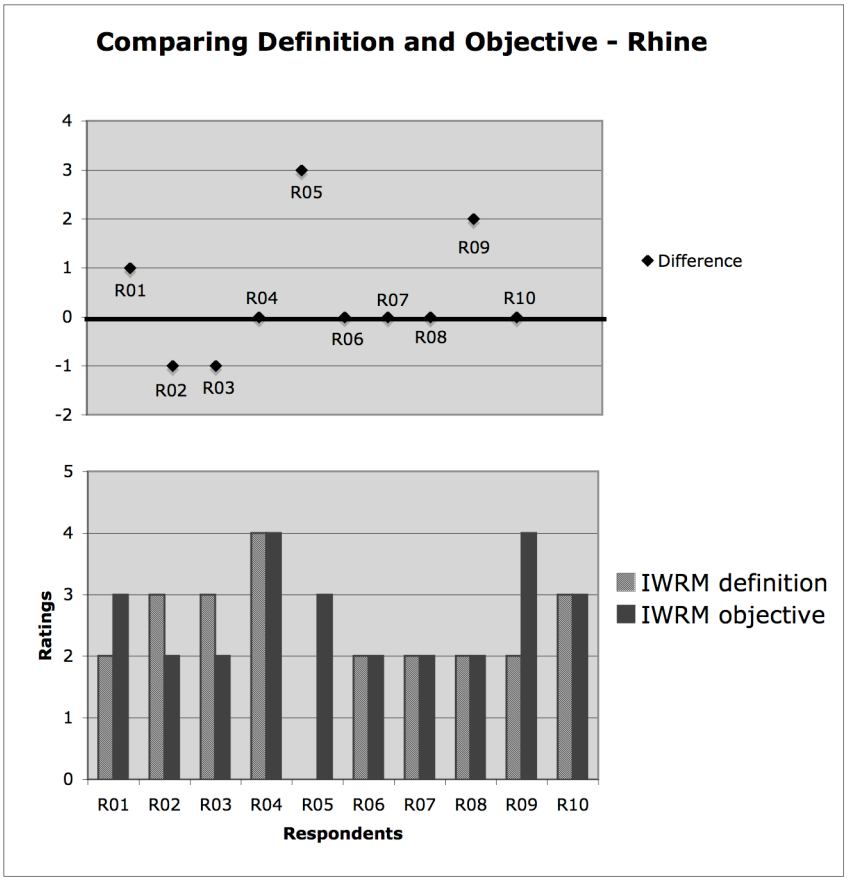

Figure 5.3 Comparing IWRM Definition and Objective for the Rhine

The lower part of this figure shows bar chart with the ratings (of their IWRM definition and objective) for each respondent. The chart above shows the differences between the rating for their definition and objective. Points on the zero-axis indicate that respondents received the exact same rating for both their definition and objective, whereas those points above the zero-axis show that the ratings for the IWRM objective was higher than those for the definition. It becomes clear that from the ten respondents of the Rhine case study, five respondents have given a definition of IWRM that was given the same similarity rating as the objective that they provided for IWRM.

It is quite intriguing to see how one respondent (R05) has been unable to provide a definition of IWRM (implied by the zero rating), but was, on the other hand, able to give a description of the objective of IWRM that was rated quite similar to the formal objective for IWRM. It has not been possible to find out in more depth from the interview transcript of this respondent why he was unable to give a definition. Two respondents (R01 and R09) were given a higher rate for their objective than for their definition of IWRM. This indicates that these particular respondents provided a statement for the IWRM objective that is closer in similarity to the formal statement of IWRM objective than their statement for the IWRM definition is to the formal definition. However, for two other respondents (R02 and R03) it is the opposite; the ratings for their definition were higher than for their objective. In only one case (R09), this difference counted more than one point. The reason for this is that the statement for the IWRM objective is much more extensive and coherent than that for the IWRM definition. The interview transcript, however, does not indicate what the reason is for this difference (two rating versus four rating).

Figure 5.4 below compares the average similarity ratings given to Murray Darling respondents' statements of the IWRM definition and objective:

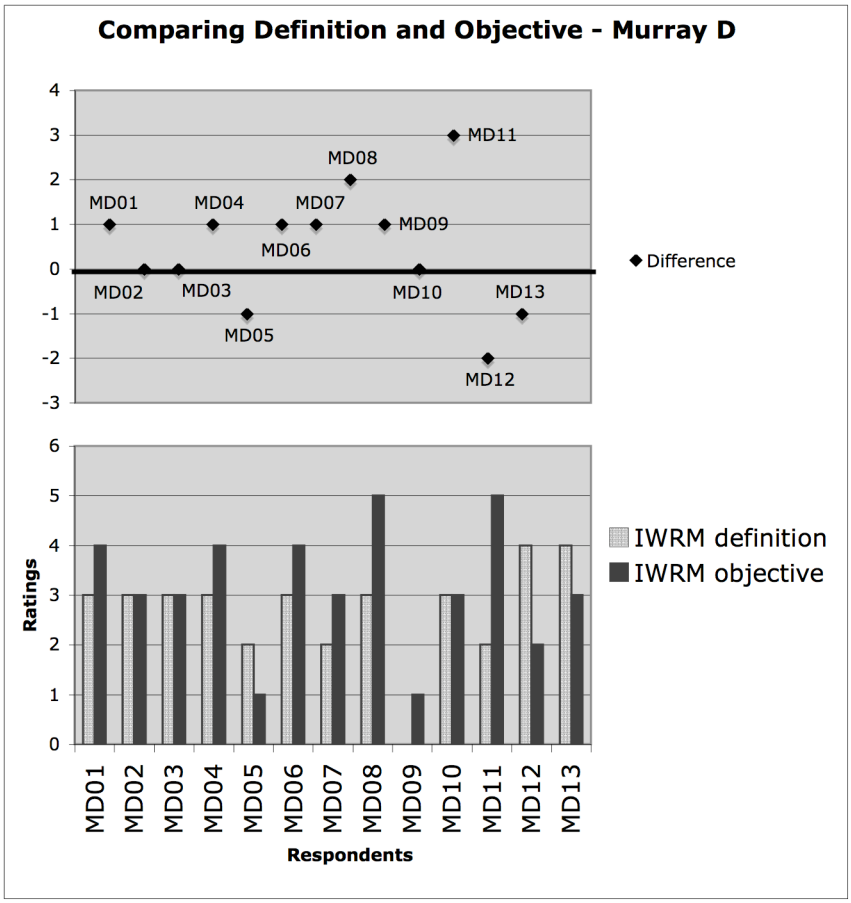

Figure 5.4 Comparing IWRM Definition and Objective for the Murray Darling

From the thirteen Murray Darling respondents, only three respondents (MD02, MD03 and MD10) provided a definition of IWRM that was given the same similarity rating as the objective that they provided. In the case of six respondents (MD01, MD04, MD06, MD07, MD08 and MD11) the statement for the IWRM objective received a higher rating than the statement for the IWRM definition and for only three respondents (MD05, MD12 and MD13) this was the opposite. This indicates that the majority of the Murray Darling respondents were more able to provide a congruent description of the IWRM objective to the formal IWRM objective than for the IWRM definition.

With regard to the low ratings, especially one respondent received very low rating (MD09) and did not provide a definition of IWRM that was measurable. This respondent did give a description of the IWRM objective, but his message

with regard to the IWRM concept is quite negative. This respondent seems to understand the underlying process of different interests, but does not elaborate at all on wider and deeper objective of IWRM.

For one respondent (MD12) the difference between the ratings for his or her IWRM definition is significantly higher (four rating) than the rating for the IWRM objective (two rating). The reason for this is that the respondent is quite able to explain the IWRM process and issues and elements that are part of this process, but does not clearly describe what this integration process aims for. Another respondent (MD11) shows the complete opposite with a five rating for the objective and a two rating for the statement on the IWRM definition. In this case, the respondent can explain the IWRM process and its purpose, but does not clearly describe the elements and issues that are part of this process.

In general it appears to be easier to describe IWRM objectives than to provide IWRM definitions close to the formals statements.

5.3.5 Understanding of IWRM Process and Education

During the interviews, the respondents of the Rhine and the Murray Darling case studies were also asked to draw a representation or describe the process of IWRM as well as to explain how they were educated and informed about the IWRM concept. The aim of these questions was to find out if the respondents were able to present a drawing and description of the IWRM framework or process and to get an idea of whether or not they spend time reading academic literature and reports on IWRM or if they are more educated about IWRM through practical experience.

When it comes to providing a sketch of the IWRM process, most respondents came up with differing drawings and some were not able to develop one. For example two respondents from the Rhine case study (R01 and R05) expressed that they found it too difficult to put the IWRM process or framework into a drawing or provide a description. Another respondent (R10) referred to a figure that he found in a report, but was not able to remember the drawing and put it

on paper. Also some of the Murray Darling respondents were not able to provide a representation of the IWRM process (MD07, MD09 and MD11).

It was interesting to notice that especially on the Murray Darling side, there were a few respondents (MD01, MD03, MD05 and R08) that depicted the IWRM process as an adaptive management cycle. One of these respondents stated that:

> *'I don't see a clear difference between IWRM and AM and tend to think that when you're actually working at a policy level and in practice, the two tend to blur into each other' (MD03)*

Another description that refers to the AM cycle is following:

> *'A cycle that represents the cooperation between government, research, education, consultancy and other countries in order to create a community of practice that exchanges views, chances, obstacles, etc…. Learning by doing (R08)*

Some of the respondents focussed only on the stakeholder process in drawing a representation of IWRM. For example, one respondent (R02) implied that the IWRM process should be a '*simple drawing of the most essential acitivity: involving stakeholders, stimulating them to put their objectives on the board, what they want, what they see as important'.* Other respondents, however, emphasized the biophysical elements of the water system by drawing a river system and describing the different levels and scales (R06, R07 and MD08). For example, one of the respondents described the following representation:

> *'A sketch of the river: mountains, where the snow melts and the gletchers, hydropower, shipping, sluices, all the tributaries, spawning places for the fish, factories who are discharging, you have users like drinking water, bathing, we also have animals and of course also the coastal waters, taking into account the influx into the sea' (R07)*

In some cases, the respondents focus more on management structures and aspects describing IWRM more as a framework than as a process. One respondent (R09) depicts IWRM in the form of a matrix with '*internal aspects of society, such as shipping, safety, drinking water, nature'* and the physical aspects such as '*the water bed and banks'* as well as the '*different users of*

water'. He or she calls this part the '*internal integration'* but states that '*you also need external integration with land, environment, physical planning, etc'*. Yet another respondent (R03) provides a description of the IWRM process drawn at the same time in the form of a diagram:

> *'…with blocks of different stakeholders in the process: knowledge institutes, that have and manage knowledge and information of water systems.,. the users and the different functions of water. There are the managers who have the task to make a link between where the knowledge is and how to use that in managing their water systems' (R03)*

With regard to education on IWRM, most respondents stated that they were informed mostly through their experience of working in integrating programs and projects and through interaction with other people. One of the Rhine respondents (R01) stated that '*when I started to work in The Hague in 1986… I followed a course on ecology as well as on environmental sciences… that has formed my knowledge base, but the IWRM concept came from practice'.* Another respondent described that his understanding of IWRM '*has really been on the basis of applying some of the systems thinking within the work that I've been doing.. I have not been off studying literature associated with IWRM or participating in a course associated with it'* (MD08). Most respondents indicate not to spend much time on reading academic publications or follow formal training on topics related to IWRM. Although a number of respondents do express to spend some time reading project reports, for example:

> *'I learned a lot about IWRM (how water boards and managers function and what kind of changing awareness took place during introduction of IWRM) from practise through projects in how to deal with water and with people responsible for water. Reading some project reports from Water Boards and STOWA (research agency for water boards), but most of this knowledge comes from practice' (R03)*

Finally, a number of respondents (e.g. MD01) stressed the importance of regular interaction with other people and the availability of good managers and leaders leading the way towards integration:

> *'I learned through experience with people who were good (project) managers and through interaction with people who were involved in a*

similar sort of process. I think IWRM is probably just a good management cycle anyway for going around the learning and feedback loop and when you deal with people who know about IWRm and AM, their concepts and ideas seem to rub off on you' (MD01)

5.3.6 Summary of IWRM case study findings

In the preceding sub-sections the level of similarity between respondents' statements and the formal definition and objective of IWRM has been analyzed and explored. The use of this information, however, needs some critical evaluation of the main or significant points. The findings of the similarity analysis are therefore summarized in this sub-section:

1. Half of the Rhine respondents' statements were rated of 'limited similarity', although the entire other half was given a three rating, both with regard to their statements for the IWRM definition as well as for the IWRM objective.
2. With regard to the Murray Darling respondents, there is a high majority of respondents' statements of the IWRM definition that were rated 'moderately similar' to the formal definition. However, this majority is less obvious with increased four and five ratings for their IWRM objective, although also here the peak is still in three ratings.
3. The respondents' statements of IWRM definition that did not received a rating above 'moderately similar' (3) were often incoherent, contradicting or ambiguous to an extent or missing some or, in the case of one and two ratings, all key elements of IWRM:
    a. No description or acknowledgement of the integration process and the elements that need to be integrated;
    b. No elaboration on the importance of coordination between different elements and aspects in the integration process;
    c. Only focus on e.g. the biophysical elements and not include and recognize other aspects, such as socio-economic, environmental as well as the different layers of management.
4. For both the Rhine and Murray Darling case studies, only very few respondents (three in total) provided a definition of IWRM that was rated

'highly similar' and none of the respondents were rated 'exactly the same' for their definition.

5. With regard to the IWRM objective and certain respondents' statements were not rated 'highly similar' or 'exactly the same' because of the following missing key elements:
    a. Acknowledgement of different development objectives and interests;
    b. No description of the alignment of different interests and the necessity of considering trade-offs between development objectives.
6. Only two of the Rhine respondents received a four-rating for their objective, whereas a higher number of Murray Darling respondents were given a four or five rating.
7. As can be observed in Figure 5.3 and 5.4, for both the Rhine as well as the Murray Darling case study, the ratings of the IWRM objective was relatively higher than those for the IWRM definition.
8. Most respondents gave a differing representation of the IWRM process and also a few respondents were not able to give a drawing or description. A number of respondents depicted the IWRM process as an adaptive cycle. Other respondents focused mostly on the stakeholder process or on the biophysical system. So the divide lies in whether they recognized IWRM as being more a structure or framework, or in other descriptions as a process.
9. With regard to their education on IWRM, most respondents stated that they are informed mostly through their experience of working in integration programs and projects and through their interaction with other people. Most of the Rhine respondents and a number of the Murray Darling respondents indicate not to spend much time on reading academic publications related to the IWRM topic. However, a small number of respondents do express to spend some time reading project reports and grey literature on IWRM.

5.4 Similarity Analysis – Findings for AM

This section presents the results and findings from the similarity analysis of respondents' statements from the AM case studies, the GCDAMP and the KRRP. Similarly to Section 5.3, comments and notes provided by the coders during their rating process are included in the evaluation of respondents' statements in order to identify the differences and similarities between the formal statements of AM and the respondents' statements.

5.4.1 Frequency of Ratings

The last columns of Table 5.2 show the average ratings for the statements provided by the respondents in the GCDAMP and the KRRP case studies with regard to the respondents' definition and objective of AM. The frequencies of these similarity ratings are visualized in Figures 5.5 and 5.6.

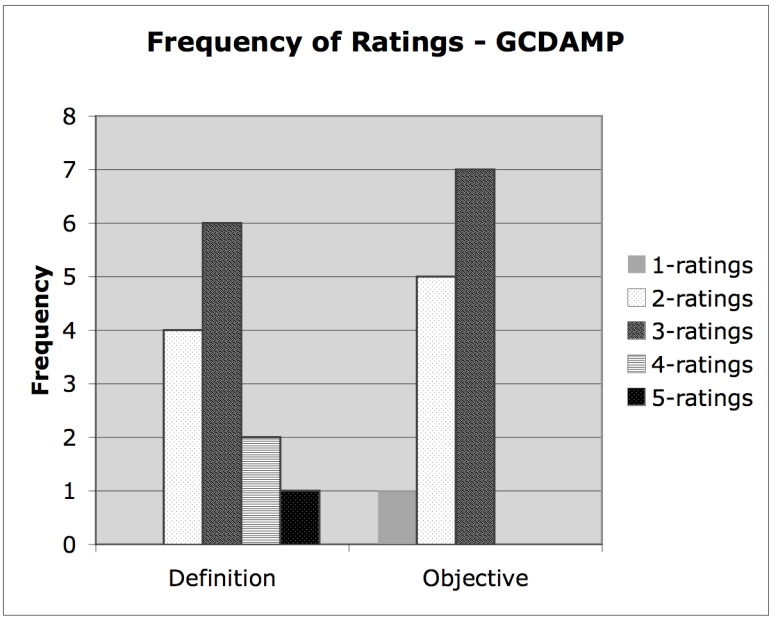

Figure 5.5 Frequencies of Similarity Ratings for the GCDAMP

For the GCDAMP case study, the majority of the respondents' statements with regard to the definition and objective of AM have been rated of 'limited similarity' or 'moderately similar', which indicates that a majority of the respondents were

not able to give a definition or objective of AM that displays a (high) similarity with the formal definition and objective of AM. The statement of AM definition and objective is not available for one of the respondents (GC12) as an error occurred while recording the interview and unfortunately the first part of the interview did not get recorded.

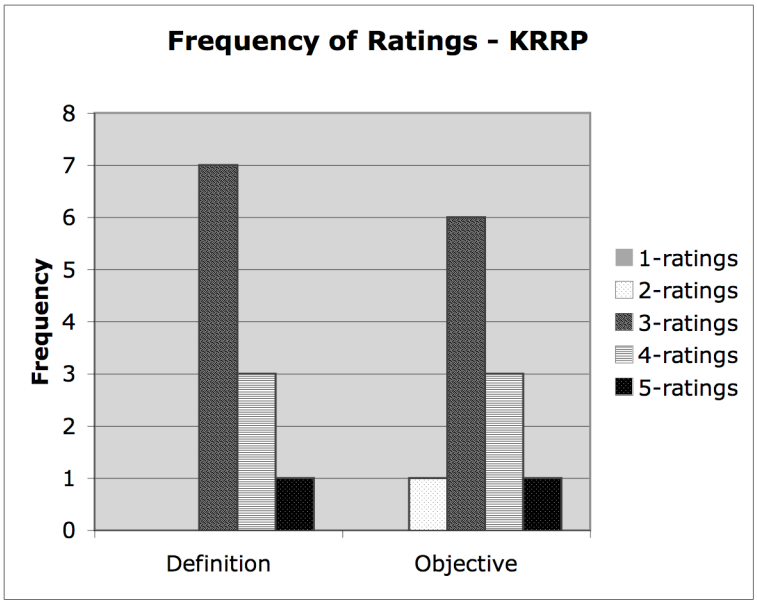

Figure 5.6 Frequencies of Similarity Ratings for the KRRP

The ratings and their frequencies shown in Figure 5.6 above indicates that the KRRP respondents have stated a definition of AM of which most are rated 'moderately similar'. Their descriptions of the AM objective are slightly more spread out, although the emphasis is still on 3-ratings. This indicates that a majority of the respondents of the KRRP case were able to give a definition and objective of AM that display moderate similarity to the formal definition and objective of AM. Based on the comments and notes provided by each coder, the differences and similarities between the respondents' perceptions and the formal statements of IWRM are analyzed in more detail in the following section.

5.4.2 Definitions of AM– Coherencies and Omissions

None of the GCDAMP and KRRP respondents' definition of AM was judged as being 'completely different' from the formal definition of AM. In fact, only the GCDAMP case study includes respondents that received ' limited similarity' ratings, precisely four out of fourteen respondents. None of the KRRP respondents received a rating below 'moderate similarity' for their definition of AM. The definitions of AM provided by the GCDAMP respondents with a 'limited similarity' rating contained some of the AM aspects but were described very narrowly and, in some cases, were even incoherent and poorly structured. To give an example of such a narrow definition, here is how one respondent defined AM:

> *'Well the AM that applies to GCDAMP is different from the academic version of AM which would mean that you would start operating a river system with one set of goals and as society values changes, you adaptively manage the way you're operating the river to meet changing and new goals…' (GC06)*

This respondent covers the issue of AM in a very vague way and also fails to bring in learning and iteration processes. Although the following definition of AM addresses some of the key topics of AM, it contradicts with the formal statement of AM as this respondent assumes that goals are fixed:

> *'In my view with AM you can't change the goals. You set out a set of goals and won't change those but you adaptively manage the actions that are available to you in order to achieve those goals... the science of it, the establishment of cause and effect relationships is what is an AM approach… you're conducting a large field experiement… how well your tools are accomplishing your goals…' (GC05)*

The other two respondents with a 'limited similarity' rating only focussed on the stakeholder side of AM, not recognizing its continual and iterative process. For example, one respondent (GC07) describes that the AM approach '*is a process that should provide an equal distribution of decision-making where people's issues and concerns are adequately addressed'.* Whereas the other respondent (GC08) proposes AM as '*a mechanism for bringing together groups of*

stakeholders with different interests to resolve issues… outside of the legal process in a way that is collaborative and mutually beneficial to all the stakeholder… it is a consensus building mechanism'.

Both the KRRP and GCDAMP case studies count an equally high number of respondents with a 'moderate similarity' rating for their AM definition – six respondents for the GCDAMP and seven for the KRRP. In comparison to the respondents with a two-rating, these respondents were able to give a more coherent and better-structured definition of AM, although these respondents still fail to recognize some of the key issues with regard to AM. For example, the formal definition of AM describes that AM is '*a systematic process for continually improving management polices and practices by learning from the outcomes of operational programs and implemented management strategies'.* However, a number of respondents fail to recognize this learning process explicitly. For example one respondent defines AM as follows:

> *'It's very practical in its application of a logical process that integrates science at the appropriate stage in an effort to increase knowledge and reduce uncertainty, leading to better management decisions. AM brings stakeholders to the table and tells them that they're an active part of the process, so at the least it provides a forum for people to express their views' (GC03)*

Many of the respondents with a 'moderate similarity' rating also do not elaborate on the continual and iterative process that is entailed in the AM approach. The formal statement describes this process as '*entailing problem assessment, design, implementation, monitoring, evaluation and feedback'.* Some respondents do refer to this process implicitly, such as a respondent (GC04) who describes it as '*a process whereby you make (technical) assumptions on what you need to do, you do those things in the form of an experimental operation, you evaluate the results and then you change'.* However, an example of a statement that lacks to recognize this process is as follows:

> *'AM is a credible process of improving management… it is a process of learning about things we don't know very much about and using that information to move forward. In theory AM is more scientific, but in reality*

> *it's more of a social process, led by the stakeholders who are bickering back and forth about directions to take… ' (GC11)*

Another example of a respondent statement on the AM definition that does not acknowledge implicitly the iterative process:

> *'AM is a way of tenuously moving forward to better manage an environmental situation. As it is a scientific driven process that provides us with information that shows us better ways of managing and then based on that we adapt. We are also adaptive in a sense of existing needs while at the same time making sure that you don't just totally hurt the ecological environment. So AM is working with all the different entities, agencies and their differing needs' (GC13)*

In the cases of two respondents, the coders stated that the respondents' definition of AM was going more in the direction of an IWRM definition than that of AM. One of these respondents states that *'it's purpose or mindset can be used to negotiate some of the more complex issues that we face in resource management'* emphasizing the aspect of negotiating interests without going into more depth about the AM approach.

A total of five respondents (two from GCDAMP and three from KRRP) provided a definition of AM that was rated as 'highly similar'. And each case study only had one respondent that delivered a 'perfect' (or 'exactly the same') statement of the AM definition. These respondents gave a very comprehensive and coherent definition that was almost identical to the formal statement for the AM definition in the sense that the statements included all or most facets of the adaptive process. These respondents not only indicate the importance of the learning aspect but also emphasized the necessity of following an iterative process as described in the formal definition. An example of such coherent and clear defintion is the following:

> *'AM includes monitoring and building on findings from former initiatives. Through experiments and monitoring you collect scientific information which shows how later projects should be planned and implemented… recognizing uncertainties AM aims to collect information over time using modelling and science and taking a system wide view… AM helps to figure out whether something is working or not...' (KR09)*

And another respondent:

> *'It's a concept to learn about the problem that you are trying to work on: you apply some solutions, you monitor to see how effective those solutions were and then you circle back and decide if other actions, or similar actions or no actions is to be taken… it is a continuous cycle, taking an action, monitoring, evaluating and reviewing that whole process, seeking the continuous proof… it is managing adaptively, adapt to what you know and learn as time goes on…' (GC01)*

5.4.3 Objectives of AM – Differences and Simmilarities

Only one of the respondents (GC07) of the two case studies was given a one rating for the statement on the objective of AM meaning that the statement was completely different from the formal objective of AM. The coders explained in their comments that the reason was that the described objective is context specific without a clear mention of aspects found in the formal objective of AM:

> *'The objective of AM in this case is to manage the Colorado River by the Glen Canyon Dam, by addressing adverse or positive effects that the dam creates. That's the main objective' (GC07)*

With regard to the GCDAMP case study, five respondents (out of fourteen) provided a statement of the AM objective that was given a 'limited similarity' rating wheras only one of the KRRP respondents received this rating. These respondents showed similar differences in their statements of the AM objective to the formal statement and offered perceptions that showed limited scope of understanding or ability to formulate a coherent and comprehensive objective for AM. Some respondents do show an understanding of the spirit of AM, but their statements are too brief and do not encompass all key issues with regard to AM. As an example, one of the respondents gives the following objective:

> *'AM aims to improve the management of in this case an ecosystem, but it could aim at improving management of any kind of system. In other words, AM is a process of learning about things we don't know very much about and using that information to move forward' (GC11)*

One of the respondents (KR05) does imply an integrated approach by describing the '*multiple and often conflicting objectives*' that are a part of an AM

process. However, the statement of this respondent is limited in its' framing. Some of the respondents were only able to give a very context specific description of the AM objective, for example:

> *'The objective is to find a way to operate the dam to preserve the endangered species and characteristics of Glan Canyon National Park and other environmental factors while at the same time trying to meet as best as possible the original purposes of the dam…' (GC04)*

Another respondent seems to suggest more of a calibration process than an adaptive process including learning objectives:

> *'AM does not necessarily mean river restoration, it means what the policy makers goals aim for. So I would set the goals, determine what your tools are, establish empirical criteria that relate to achieving your goals and then establish a monitoring program so you know whether you are achieving your goals and adjust your tools when you are not' (GC05)*

The majority of respondents, seven for the GCDAMP and six for the KRRP case studies, were given a 'moderate similarity' rating for their objective. Some of these respondents focus in their statements on the importance of collaboration in the integration process and do not elaborate on the learning aspect. An example of such statement is the following:

> *'It is a process that allows you to deal with uncertainties with regard to engineering, policy, funding, stakeholder issues, etc. and can be a great approach to break the gridlock among stakeholders' views as it can generate a very positive collaboration between stakeholders and government agencies. When done well, the planning process is more open and transparent and builds trust among stakeholders…' (KR01)*

Another respondent (KR03) states that '*AM is dealing with situations where there are a lot of uncertainties for the future',* however he or she does not mention that AM is an integrated approach and iterative process that aims for learning outcomes. However, there are also some respondents (KR06) that emphasize the learning aspect without including other elements, for example:

> *'To gain better understanding and learning through experiences and data coming from former actions that have been implemented' (KR06)*

All these statements of respondents with 'moderate similarity' ratings contain the main thrust or spirit of AM with no obvious misconceptions or contradictions to the formal statement. However, the structure of these statements is at times uncertain with focus only on single elements of the AM objective. As described above, some of these respondents focus only on the integration aspect, others on the learning objective whereas again other only on the iterative process of AM, as the example below shows:

> *'defining a target that has a scientific basis and in monitoring progress towards meeting that target, AM would allow us to look routinely at whether the conditions are approaching the expectations. So in that event that you are not meeting that, you determine what factors are preventing you from doing that. You would evaluate operations and tools and determing how you might modify those operations to improve conditions and you continue monitoring…' (KR07)*

Another example that indicates focus on the iterative process while not recognizing the integration aspect as well as the aim to deal with uncertainties is as follows:

> *'It is really designed to try to follow a scientific approach (cycle) to improvements in the management of resources while using a cause and effect type of relationship. For an AM approach you have to periodically test the system or the individual resources and see their responses to actions and then adapt overall operational aspects to improve whatever resources you're trying to deal with' (GC02)*

None of the GCDAMP respondents were given 'high similarity' or 'exactly the same' ratings for their statements of the AM objective, wheras three KRRP respondents received a 'highly similar' rating and there was also one KRRP respondent whose statement was considered 'exactly the same'. This suggests that at least four out of the eleven KRRP respondents have a very comprehensive understanding of AM and its' purpose. One example of such extensive and comprehensive description is the following:

> 'AM aims for transformation, changing the way we think and the way we behave so that we can reach sustainability through understanding resilience. So the sustainability is a goal and AM is the process that helps transform and start actions. It is the knowledge that you're going to

have to survive adversity. It is all about learning from past initiatives and experiments, testing hypotheses and challenging assumptions' (KR11)

5.4.4 Comparing the Consistency of Respondent Ability to Define and Describe AM

This section will compare the ratings given for the respondents' statements on definition and objective of AM in order to evaluate whether the ratings given to s specific respondent for his or her definition is similar or significantly different to his or her statement of the objective of AM. If for example the rating for the definition is a four rating and that for the objective is a two rating, this would imply that the respondent has been more able to provide a statement of the AM definition that is consistent with the formal statement than for the objective.

Figure 5.7 below compares the average similarity ratings given to GCDAMP respondents' statements of the AM definition and objective:

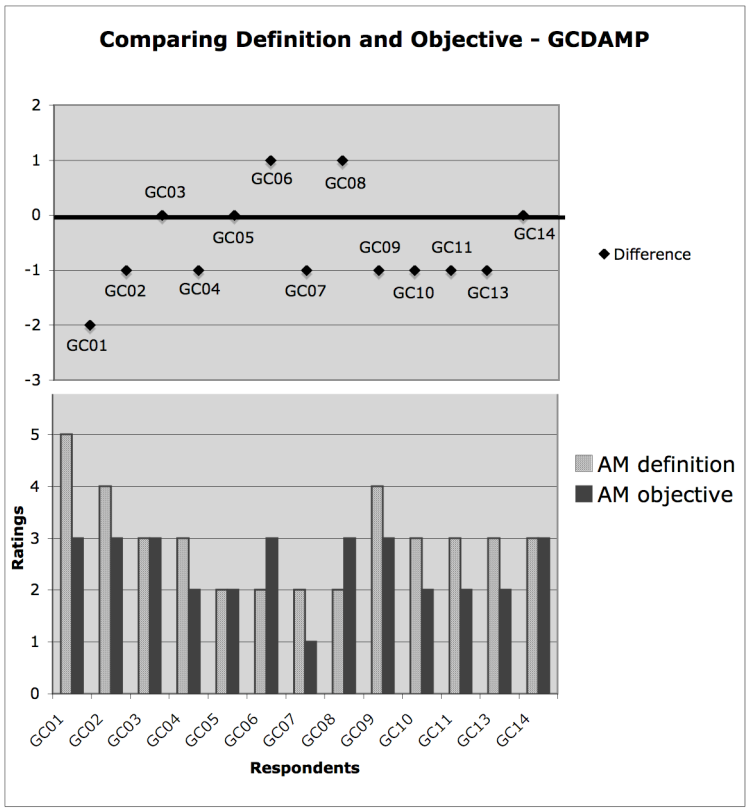

Figure 5.7 Comparing AM Definition and Objective for the GCDAMP

This figure shows that from the fourteen respondents of the GCDAMP case study, three respondents (GC03, GC05, GC14) have given a definition of AM that was given the same similarity rating as the objective that they provided for AM. Unfortunately, the definition and objective of AM of one respondent is not available because of an error that occurred during the recording of this interview.

Eight (GC01, GC02, GC04, GC07, GC09, GC10, GC11 and GC13) out of fourteen respondents were given a higher rate for their definition than for their objective of AM. This indicates that these particular respondents provided a statement for the AM definition that is closer in similarity to the formal statement of AM definition than their statement for the AM objective is to the statement for the formal objective. Only two respondents (GC06 and GC08) received a rating for their objective that was higher than for their definition. This indicates that the majority of the GCDAMP were more able to provide a congruent definition of AM to the formal definition of AM than for the AM objective.

In only one case (GC01), this difference counted more than one point as the statement of the objective appears to more of a definition. The only specific thing this respondent mentions with regard to an objective is that AM '*aims for continuous improvement, but is not goal specific'.*

Figure 5.8 compares the average similarity ratings given to KRRP respondents' statements of the AM definition and objective.

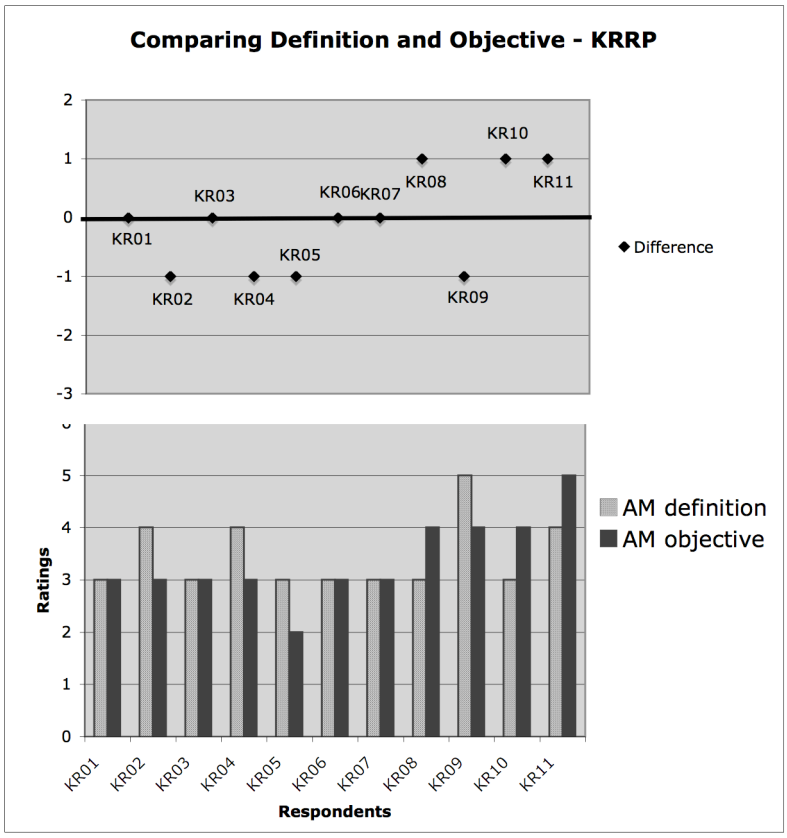

Figure 5.8 Comparing AM Definition and Objective for the KRRP

From eleven respondents of the KRRP case, four respondents (KR01, KR03, KR06 and KR07) provided a definition of AM that was given the same similarity rating as the objective that they provided. Four respondents (KR02, KR04, KR05 and KR09) received a higher rating for their definition of AM than for their statement of the AM objective. In only three cases (KR08, KR10 and KR11) this was the opposite. There are no cases were there is a significant difference (more than one point) between the ratings for the definition and objective of AM for any particular respondent.

Although it was the other way around for IWRM, with AM it appears easier to provide a definition close to the formal statement than to state to objectives.

5.4.5 Understanding of AM Process and Education

During the interviews, the respondents of the GCDAMP and KRRP case studies were asked to draw a representation of AM as well as to explain how they were

educated and informed about the AM concept. The aim of these questions was to find out if the respondents were able to present a description and drawing of the AM process and to get an idea of whether or not they spend time reading academic literature and reports on IWRM or if they are more educated through practical experience.

When it comes to the question to make a drawing of AM, most respondents came up with drawings, however, the representations are not available for two respondents (GC07 and GC12) as the interview of one of these respondents was not recorded properly and with regard to the other respondent, the interview was conducted while driving which made it impossible to ask this respondent to develop a drawing. The respondent was asked afterwards to email the drawing, however, this never happened.

Many of the respondents (e.g. GC02, GC04, GC08) from the GCDAMP case study, when asked to draw a representation of the AM process, gave a drawing that contained the structure of the program itself. An example of such explanation is the following:

> *'The process would start with the decision process, for which you've got the AM work group, the technical work group and the science and out of that would come the recommendation which would be to test a certain parameter. So it starts with the identification of the parameter and then the test itself and then a period of time for monitoring with the identification of effects and then adjusted operations if necessary. One identifies the effect and then there would be some kind of report back to the AM work group with a recommendation for change' (GC02)*

Another respondent (GC04) started drawing the representation by stating that he or she '*would draw the structure or flow diagram of the AM process for this project with the AM work group and the Technical Work Group*'. Although these respondents draw the structure of the GCAMP program, while explaining the drawing they do describe to an extent (some in more detail than others) the steps of an AM cycle. A good example of an extensive description of the AM process in combination with a drawing of the GCDAMP structure is the following:

> *'The river ecosystem is the primary concern and Grand Canyon dam impacts that river ecosystem. The Secretary of Interior decides on how to operate the dam, but doesn't know about all the concerns of the stakeholders, so receives recommendations from the Federal Advisory Committee stakeholders. These stakeholders need to base their recommendations on good information so there is the GCMRC and the science advisors that provide scientific information to the technical work group. The stakeholders tell the scientists what their concerns are and the scientists develop scientific methodologies, do research and monitoring to provide information on those concerns to the advisory committee (GC08)*

Most of the other respondents (e.g. KR03, KR05, GC01 and GC03) draw the AM process as it is depicted in academic literature, in the shape of a cycle including different steps. To give an example, one of the respondents (GC01) describes AM as:

> *'…having cyclical direction and being continuous, it is things like act, monitor and assess or analyze. Prior to acting, you should be planning and identifying objectives. It's a continuous circle where you've taken action, you've monitored the impact of the action, you then assess what you've learned from monitoring, then you plan, then you act and you just go around the circle again' (GC01)*

The following respondent (KR09) draws and describes the AM process in the form of a cycle, but also clearly includes the element of stakeholders in the drawing. This respondent states that his or her drawing of an iterative adaptive process is still too '*simplistic'* as the process of involving and including stakeholders is not easily depicted but very crucial part of the process. Another respondent from the KRRP case study (KR01) agrees with this by stating: *'I have been struggling with this for about six or seven years and I'm convinced it can't be drawn in 2D, even a 3 D is not adequate*'. This respondent explains that '*there are a lot of things that go on simultaneously that almost defy depicting it in one picture'* and also emphasizes the importance of understanding the stakeholder process that is linked to and part of the AM process. In addition to these respondents, another respondent (GC03) also emphasize the importance of acknowledging the stakeholder process as part of the adaptive cycle: '*there is a process within the AM process, the stakeholder process that is very important in order to be successful*'. This respondent also

states that '*a lot of times this is not represented but you have to be sure that these stakeholders are engaged in each part of the process*'.

A few respondents came up with a drawing of the AM representation that neither represented the structure of the program or the adaptive cycle. One of these respondents (KR02) referred specifically to river restoration and made a drawing of a chart with the following explanation:

> *'You start with a reference condition that reflects what it (river system) looked like before you had human impact and then you have your human impact, those are your baseline conditions. So you knew what it looked like before it was disturbed (reference condition) and where you are now (baseline conditions) and then you develop a trajectory path to what you are expecting to achieve…You may expect never to get to the reference conditions (prior to impact), you may expect to get to here and you expect a certain amount of time to lapse before you get there, so that's your trajectory. Once you construct your project, you monitor to see if you are hitting this trajectory. If what you end up with is somewhere down here, you realize that you need to do something to raise it and get back to your initial trajectory... this is where AM comes in in my opinion…' (KR02)*

With regard to education on AM, most respondents stated that they were informed through their experience of working in integrating programs and projects and through interaction with other people. One of the respondents states for example that:

> *'One of the difficulties of the AM program is getting everybody to agree and so where you may think that you can just do these things from a scientific point, you can go and do these things, you'd have a lot of people who's interests and concerns kind of overshadow the ability to do those kinds of tests. So the dilemma has been in this AM process to get a clear agreement on how it is perceived. That's been I think a lot of the education. AM has been a more a stakeholder driven process than it is as much a scientific process' (GC02)*

Another respondent, (GC04) shares that his or her understanding of AM has developed '*through the experience in the program and other programs that I have been involved in'*. And a respondent from the KRRP case study (KR04) explains that his or her understanding was developed '*mostly through working with experts on this topic and through projects'.* Especially in the case of the

KRRP study, most respondents attribute a large extent of their education on AM to their interaction with AM 'fathers' as well as reading academic literature and reports on AM. This has been much less the case for the GCDAMP respondents. To give an example, one of the KRRP respondents (KR01) declares that his or her education began:

> 'Mostly through working closely with people such as Steve Light and Carl Walters who informed and educated me about the AM concept which also stimulated me to study the theory more and become more educated and aware of AM and its purpose' (KR01)

5.4.6 Summary of AM case study findings

In the preceding sub-sections the level of similarity between respondents' statements and the formal definition and objective of AM has been analyzed and explored. The findings of the similarity analysis are summarized in this sub-section:

1. The majority of the GCDAMP respondents were given a 'moderate similarity' rating for their definition and objective of AM, although in both cases there were also quite a number of 'limited similarity' ratings. Very little statements were considered as 'highly similar' or 'exactly the same' and in the case of the statements for the AM objective even none.
2. With regard to the KRRP respondents, there is also a high majority of 'moderate similarity' ratings when it comes to both their definition and objective of AM. However, for the KRRP, there are also respondents' statements perceived as of 'high similarity' and 'exactly the same' for both their definitions and objectives and there is only one 'limited similarity' rating.
3. The respondents' statements of AM definition that did not received a rating above 'moderately similar' were to an extent incoherent, contradicting or ambiguous or missing some of the key elements of AM:
    a. No recognition of the learning objective and process;
    b. Lack of description of the continual and iterative adaptive cycle including the steps as described in the formal definition;

   c. Focus only on stakeholder process and therefore show too limited scope.
4. For both the GCDAMP and the KRRP case studies, a minority of respondents (seven out of 24) provided a definition of AM that was rated 'highly similar' to 'exactly the same'.
5. With regard to the AM objective and certain respondents' statements were not rated 'high similarity' or 'exactly the same' because of the following key elements:
   a. Only describing a very context specific objective;
   b. No recognition of the learning objective and process;
   c. Lack of recognizing that AM is an integrating and iterative process that aims for learning outcomes.
6. None of the GCDAMP respondents received a 'high similarity' or 'exactly the same' rating for their objective, whereas four (out of 11) KRRP respondents were given a 'high similarity' or 'exactly the same' rating.
7. As can be observed in Figure 5.7 and 5.8, for both the GCDAMP as well as the Murray Darling case study, the ratings of the AM definition was relatively higher than those for the AM objective.
8. A number of respondents gave a representation of the AM process that reflected the structure of their program, whereas a group of respondents drew the AM cycle as depicted in academic literature. Some of those respondents, who depict the AM process as a cycle, also include elements of a stakeholder process. These respondents emphasize the importance of acknowledging the stakeholder process as a part of the adaptive cycle, but also state that it is difficult to visualize this.
9. With regard to their education on AM, most respondents stated that they are informed through work experience and interaction with other people. However, especially in the KRRP case study, respondents also claim to spend time reading and reflection on AM as described in academic literature.

5.5 Comparison of IWRM and AM Results

The aim of this section is to compare the main findings from the IWRM with those of the AM case studies.

The frequencies of ratings for the similarity of respondents' definition of IWRM and AM for all four case studies have been visualized in Figure 5.9. This figure shows that each of the four case studies have a clear peak, which lies for the Murray Darling, the GCDAMP and the KRRP in 'moderate similarity' ratings. However, for the Rhine the highest number of respondents received a 'limited similarity' rating and includes also a lower amount of 'moderate' and 'high' similarity ratings than the other case studies. It should be noted that English is not the native tongue of the Rhine respondents, which could be one explanation for this situation, as well as the fact that the total number of respondents of the Rhine (ten) is less than those for the other three case studies (respectively 13 for the Murray Darling, 14 for the GCDAMP and 11 for the KRRP). The peaks in 'limited' and 'moderate' similarity ratings indicate that most respondents have provided definitions of IWRM and AM that at worst are poorly structured, contradictory or ambiguous statements with limited scope. And at best the majority of respondents' statements show understanding of the main spirit of IWRM or AM with possibly uncertain structures and not including all keywords.

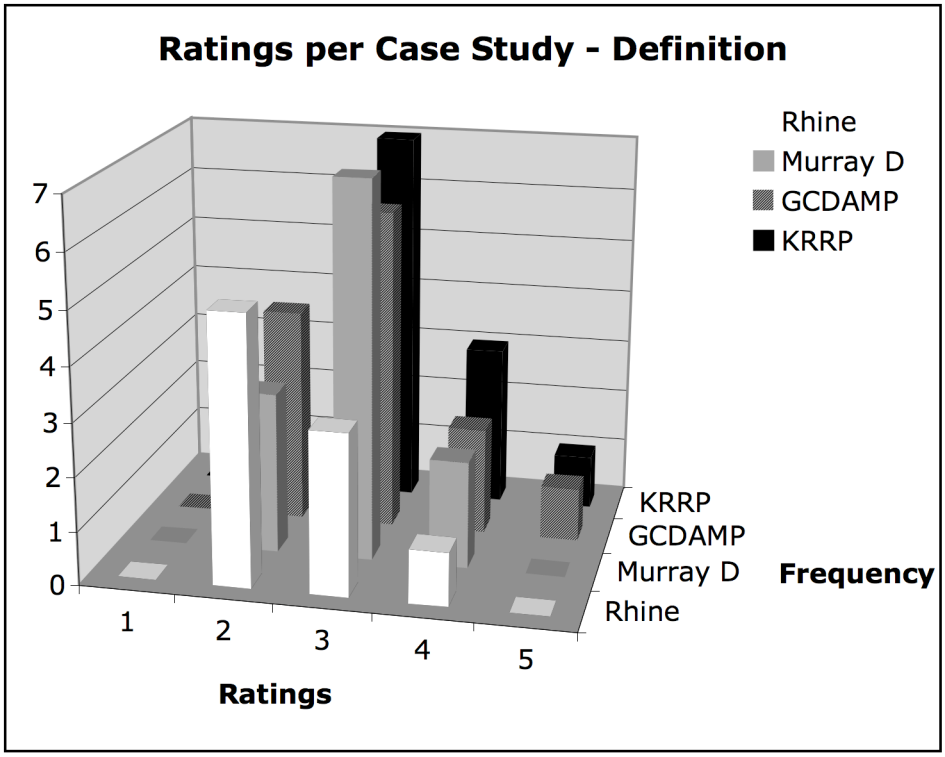

Figure 5.9 Comparing Similarity Ratings for Definition of IWRM and AM

A similar figure has been provided for the ratings of the IWRM and AM objective (see Figure 5.10). This figure shows a similar trend for the respondents' statements on the IWRM and AM objective with the peak for all case studies in 'moderate similarity' except for the Rhine, where the peak is in 'limited similarity'. When analyzing and comparing Figure 5.9 and 5.10, it can be concluded that for IWRM, the respondents score higher with their objective of IWRM than with their definition, whereas for the AM case studies it is mostly the other way around. This indicates that the IWRM respondents are better able to describe the purpose of the IWRM concept (as similar to the formal objective) than it is to describe the integration process and definition. And that it is the other way around for the AM cases.

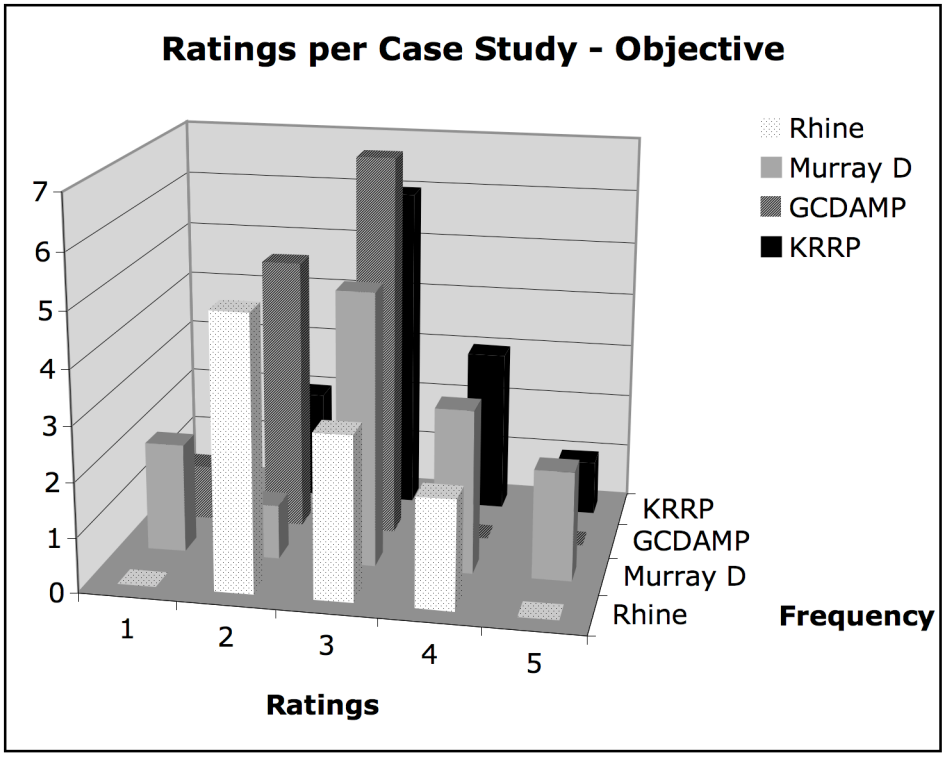

Figure 5.10 Comparing Similarity Ratings for Objective of IWRM and AM

A number of respondents stated that they did not see a clear difference between IWRM and AM, especially when it comes to implementing them in practice. A core aspect that both approaches seem to have in common is the strong emphasis (as stated by the respondents) on the stakeholder processes as well as the necessity to negotiate different interests. With regard to the IWRM process, many of the respondents describe an adaptive cycle similar as for the AM process.

To conclude this chapter, correlation between the amount of 'years of experience' of the respondents in applying IWRM or AM and the similarity ratings they received for their statements on IWRM and AM is investigated. The respondents have been divided into three groups with a certain amount of years of experience in IWRM or AM: 6 - 10 years; 11 - 15 years; and 16 - 20 years.

Table 5.14 a-b below shows the frequencies with which respondents from a certain experience categories have been given certain similarity ratings for their

IWRM definition and objective. Table 5.15 a-b does the same for AM. For the IWRM definition, for both the '6-10' and '11-15' groups, one respondent has not been able to provide a definition of IWRM. One respondent could not come up with a definition and another respondent expressed only a negative view of IWRM and made no real attempt to provide a comprehensive definition. All respondents of the IRWM case studies have been able to provide a description of the IWRM objective. This explains why the numbers of respondents (right columns in Tables 5.14 and Table 5.15) for the different age groups are different. The statements of AM definition and objective of one of the respondent from the AM case studies could not be taken into account because of an error during the first half of the interview recording.

Table 5.14 a: IWRM Definition

	1-rating	2-rating	3-rating	4-rating	5-rating	Average	# Res
6 to 10	0	0	2	1	0	3.33	3
11 to 15	0	4	6	2	0	2.83	12
16 to 20	0	4	2	0	0	2.33	6

Table 5.14 b: IWRM Objective

	1-rating	2-rating	3-rating	4-rating	5-rating	Average	# Resp
6 to 10	0	1	3	0	0	2.75	4
11 to 15	2	4	2	4	1	2.69	13
16 to 20	0	1	3	1	1	3.33	6

Table 5.14 a-b Matrix With Ratings Frequencies for Experience Groups - IWRM

With regard to the IWRM definition, Table 5.14 a above indicates that two out of three respondents in the category '6-10 years experience' were given a 'moderate similarity' rating for their definition of IWRM. However, surprisingly the other two experience groups (11-15 years and 16-20 years) have the majority of their ratings in 'limited' to 'moderate similarity' ratings. The reason for this could be that most of the respondents in the group with least experience have shown to be spending more time reading academic literature on the IWRM topic than the more experienced groups, whose knowledge has developed more through experience in long-term involvement in projects. This could also explain why the two longer experienced groups (11-15 years and 16-20 years)

have received relatively higher ratings when it comes to their statements of IWRM objective. Perhaps their practical experience made it easier for them to express the purpose of IWRM more so than giving a comprehensive definition. It could also be related to maturity of the field and longer serving practitioners not being exposed to or aware of more explicit formalisms with regard to IWRM definition as currently available.

Table 5.15 a: AM definition

	1-rating	2-rating	3-rating	4-rating	5-rating	Average	# Resp
6 to 10	0	2	3	0	0	2.6	5
11 to 15	0	1	7	2	1	3.27	11
16 to 20	0	1	3	3	1	3.5	8

Table 5.15 b: AM objective

	1-rating	2-rating	3-rating	4-rating	5-rating	Average	# Resp
6 to 10	1	1	3	0	0	2.4	5
11 to 15	0	4	5	2	0	2.81	11
16 to 20	0	1	5	1	1	3.25	8

Table 5.15 a-b Matrix With Ratings Frequencies for Experience Groups - AM

The above, however, does not apply to the AM definition and objective. In this case, it appears that the majority of the least experienced respondents received ratings from 'limited' to 'moderate similarity'. Although the other two experience groups also have a majority of their ratings in the 'moderate similarity' category, there seem to be a number of respondents also receiving 'high similarity' ratings, especially for their AM definitions. When comparing the average ratings for the AM definition to the AM objective, however, the different experience groups appear to do better for their definition than for their objective statements.

All of the interview respondents claim to have developed their knowledge with regards to IWRM and AM through interaction with other people in applying IWRM or AM in practice (through projects). A minority of all respondents stated that reading and reflecting on information in academic literature and public documents have supported the development of their understanding. However,

most of those respondents that claim to spend some time reading about IWRM and AM, focus more on national policy documents and project reports than on international academic literature.

6 Mediating factors and dynamics

6.1 Introduction

This is the second chapter describing and evaluating the data and findings from the semi-structured interviews (for a review of the interview design see Chapter 4). As described in the introduction to Chapter 5, several actions have guided the process of analyzing data from the interviews and these actions have been identified in line with the research questions. Chapter 4 discusses and explains in detail the methods that have been applied for the analysis of data coming from the semi-structured interviews. These analysis methods have formed the basis for the structuring of Chapter 5 as well as this chapter.

In this chapter, the mediating factors, that have been described and highlighted by case study respondents to influence and affect the planning and implementation of IWRM and AM approaches, are evaluated. The next sections will elaborate on the findings from the IWRM and AM case studies. After each section, a summary is provided (in greay boxes) that highlights and summarizes the key points coming from each section. Dynamics between the different types of mediating factors will be investigated and discussed in more detail in Chapter 7.

6.2 Barriers and Enabling Factors for IWRM

Before discussing in details the mediating factors that have been highlighted by the IWRM (Rhine and Murray Darling) case study respondents, this section provides an oversight of these factors that have emerged from the analysis of interview transcripts (see Table 6.1). Table 6.1 not only provides a list of the barriers and enabling factors that have been brought forward by the interview respondents, but also indicates the number of interview respondents of each case study (Rhine: 10 - Murray Darling: 13) that have highlighted a particular factor as a barrier or enabler. In other words, these numbers provide insight into the emphasis and intensity with which respondents have experienced the

mediating factors as either a barrier or enabler to the planning and implementation of IWRM.

A detailed explanation of the methods applied to analyze the data, as well as to generate themes and identify categories of mediating factors, has been provided in Chapter 4.

Category	Rhine		Murray Darling	
	Barrier	Enabling	Barrier	Enabling
CONTEXT FACTORS - External				
Government and policies	4	0	5	0
Political processes	5	1	5	2
Economic situation	5	1	3	3
Climate change and crisis events	2	5	6	4
CONTEXT FACTORS - Internal				
Existing structures	9	1	8	5
Legal Framework	5	4	2	5
Roles, responsibilities and accountability	6	2	5	2
Power, control and representation	4	0	8	5
Resources and skills	3	0	6	5
Time horizons	4	0	4	1
PROCESS FACTORS				
Competing interests and agendas	7	0	9	3
Stakeholder involvement and interaction	9	8	11	7
Communication and collaboration	3	6	5	4
Leadership and vision	4	4	8	8
Data and Information	2	4	6	5
INDIVIDUAL ATTRIBUTES				
Attitude to change	9	5	10	6
Level of trust	5	1	4	1
Sense of urgency and awareness	0	9	5	5

Table 6.1 Barriers and enabling factors for IWRM planning & implementation

It is important to note that, while conducting the interviews of the four case studies and doing an initial data analysis of the interview transcripts, it became evident that the categories of key mediating factors are similar across the different IWRM and AM case studies. This initial analysis also indicated that most of the factors have been described as both barriers and enabling factors by the respondents, depending on the situation or event that the respondents referred to. As an example, one of the Murray Darling respondents stated that '*climate change has been a trigger for people's [environmental] awareness to grow and to understand the necessity of managing resources in an integrated manner'* (MD05), whereas another respondent describes that '*climate variability is exerting incredible pressure on the planning framework adding greater degrees of [pursuing] self interests'* (MD04).

In the following sections each category is discussed in more detail using information from the interview transcripts. The numbers at the end of the direct quotes provided in this section are the interviewee identification codes. Other evidence from the interviews is paraphrased in the text. After each section, a summary will be provided that highlights the key points with the aim to create more understanding about the links between the different mediating factors that form a part of the main categories (external and internal context; process; and indivual attributes). A more detailed discussion of these dynamics is provided in Chapter 7 and the trends that can be found in Table 6.1 above and Table 6.2 (see Section 6.6) will be provided at the end of this chapter.

6.3 IWRM – External Context

6.3.1 Government and policies

With regard to governments and policies one of the Rhine respondent stated that '*IWRM is a very political process involving differing types of governments'* (R01). This respondent also described that '*some governments are more bureaucratic than others'* and this can have an impact on decision-making processes – e.g., making them more time consuming.

With regard to the Dutch context, a respondent explained that '*IWRM is by nature not covered very well by existing responsibilities of Dutch ministries and governmental bodies as [they] are designed to have very much their own segment of policy making'* (R08). As an example, a Rhine respondent described some issues with regard to the differing policy fields of physical planning and water management. He stated that in the Netherlands and in many other countries physical planning and water management '*are two different policy fields with very different cultures and practices'* (R03). He further explained that:

> *'Only since recently, these differences were hindering the integration process. It has taken at least ten years before coming to this point and in the meantime many decisions have been taken with regard to physical planning that are now hard to turn around' (R03)*

Some of the Murray Darling respondents referred to the differences in management and policy of ground and surface water resources, explaining that '*there are institutional differences between their management'* and that therefore '*it is very difficult to integrate [the management] of those two resources*' as '*surface water has a high public profile and a high degree of centralization and centralized investment, whereas ground water has a history of private investment and a low political profile'* (MD02). '*Disciplines are arguing over what are fundamental issues in terms of where surface and ground water are related*' (MD08). This respondent described that '*there is a lack of individuals who are prepared to move from separate surface and groundwater policies to a universal water policy'* (MD08).

One of the Murray Darling respondents described that in the not too far away past, when there was a localized problem, '*states rather dealt with things in their own state department than getting another organization involved and having to negotiate across borders'* (MD06). Another respondent (MD04) explained that tensions arise when you try to manage a system based on a governance arrangement of six jurisdictions (all having one vote in the decision making process) with very diverse interests and practices.

6.3.2 Political processes

A number of Rhine and Murray Darling respondents highlighted political processes as mediating the integration process. For example, one of the Murray Darling respondents described that politicians follow their agendas: e.g., '*in a state of complete drought we've still got politicians coming out to say it is unacceptable for people in cities to not be able to water their lawns'* (MD02), whereas, on the other hand, '*farmers can't give their sheep water to drink'*. This respondent highlighted the fact that politicians follow agendas in pursuit of votes. Another respondent described that '*it's quite a political process where constituents demand some degree of regulatory certainty*' (MD03), however '*reality may not always be in line with those political promises*'.

Another issue described by a Murray Darling respondent is that of political appointees heading governmental departments and authorities, which means that:

> '…*you have got people coming into those roles who have varied backgrounds and are tied directly to the minister of the day (and our ministers turn over a bit) and their interest really is to serve the minister of the day… So what you end up with is essentially a lot more fractious environment whereby people who are out in a position of making decisions are taking decisions that are far more short term and whereby they personally have less knowledge of the issues that they are dealing with … designed to please their ministerial master instead of their broader public responsibility' (MD08)*

One of the Rine respondents referred to the political process by linking it to resistance to change: '*the main problem [for integration] is that it's difficult for people and politics to change, because when you want to change something it affects other views and interests'* (R10). In many cases, respondents have described crisis situations and climate change as strong drivers to change. For example, Australia is subject to a very variable climate and through '*international influences and a growing awareness, there has been a strong push to respond to growing environmental issues'* (MD02). In other words, '*there has been greater political pressure… that has been quite effective in*

terms of ensuring that there's ongoing pressure in the system for reform' (MD08).

Another respondent highlighted that for an effective integration process *'you need a political support base, which needs to be created whilst developing the plans'* (R07).

6.3.3 Economic situation

One respondent highlighted that '*when the economic situation in Europe is good, there is more money available for environmental measures, but as soon as the economy is going down, there is less money available'* (R01). As an example, another Rhine respondent described that *'during the end 90's our economy was very good, so we could get a lot of money for sustainable water management, and then there were some years, the past years, where it was more difficult'* (R09). A Murray Darling respondent described how an open economy is a major barrier to integration as they put significant pressure on the livelihood of farmers in the basin:

> '*There is a big trade-off for the rural communities. With global and fair trade… farmers are basically competing with third world countries for their produce. And on top of that there are environmental pressures saying you need to be more efficient…' (MD02)*

One of the Rhine respondent described how political views and public opinion very much depend on the existing economic situation that is prevalent at any particular time: '*in the 60's and 70's: [there was] democratization and power to the people'* then in the 80s '*we had an economic crisis and e.g. stakeholder participation became less popular'* to find out again in the mid 90s '*that if you want to implement policy, it may be helpful to involve stakeholders and public early on'* (R04). In other words, priorities and issues can change depending on the economic situation and public opinion. As another example, a respondent explained that '*when the economy doesn't go so well, the willingness to pay for nature and things like that decreases'* (R09).

Although respondents have discussed the economic situation mostly in the light of being a barrier to the implementation of IWRM, some respondents have also highlighted more positive influences. One of the Rhine respondents stated that when dealing with many different types of governments and differing levels of economic development of countries, that this can cause challenges, however, he also stated that in the case of the Rhine '*all the member states have a similar level of economic development, and similar level of environmental consciousness, so the barriers are then not so big'* (R01).

6.3.4 Climate change and crisis events

'*Environmental issues and crisis has been a driver for the integration process'* (MD06). For example, the Sandos crisis in 1986 had an inmensely negative impact on the water quality of the Rhine and was '*the start of the reduction of industrial pollution and of [the mission] to get the salmon back into the Rhine'* (R01). A Rhine respondent explained how '*increasing water demands, issues of water quality and several crisis events have led to increasing awareness about having to integrate and include more perspectives in the management of the river system'* (R06). A Murray Darling respondent agreed and stated that '*climate change may be a trigger for people's awareness to grow and to understand the necessity of managing resources in an integrated manner'* (MD05). *'There is more awareness now and there has been a big push towards recognizing the environmental need for water'* (MD02). This respondent further stated that '*it's a process of evolution in terms of policy and people'* where '*climate change has prompted change in people's behavior'* (MD02). Another Rhine respondent explained that '*disasters are gifts from heaven'* (R10) as his experience is that the Netherlands does not undertake water management but disaster management. He stated that '*we are only coming into action after something has happened*' (R10).

Although crisis can be a driver to integration, another respondent is of the view that '*usually the response is still to solve a specific problem, but not necessarily to take an integrated approach'* (R04). Another Rhine respondent explained that

when water is scarce, '*this can lead to issues, such as an increased competition between economic activities'* (R08). *'Climate change can put extra pressure on people'* (MD02) *and 'exert incredible pressure on the planning framework'* (MD04). *'while there might be a political will to change, the reality is that people need to drink water'* and '*if you are in severe drought situation [it is harder to] implement change under those circumstances'* (MD02).

– External Context Factors –

- The integration process implies interaction between different governments, states, ministries, departments and policies depending on scale and issue. The Rhine is a transboundary river flowing through different countries, whereas the Murray Darling is running through different states in one country. Figure 6.1 below visualizes the different levels on which the interaction takes place. This structure could also be viewed as (part of) the *object* of change when it comes to IWRM. The aim of IWRM is to somehow integrate or unite these elements through increased cooperation. The main challenge is that these different elements have a diversity of (competing) interests and practices that need to be reconciled.

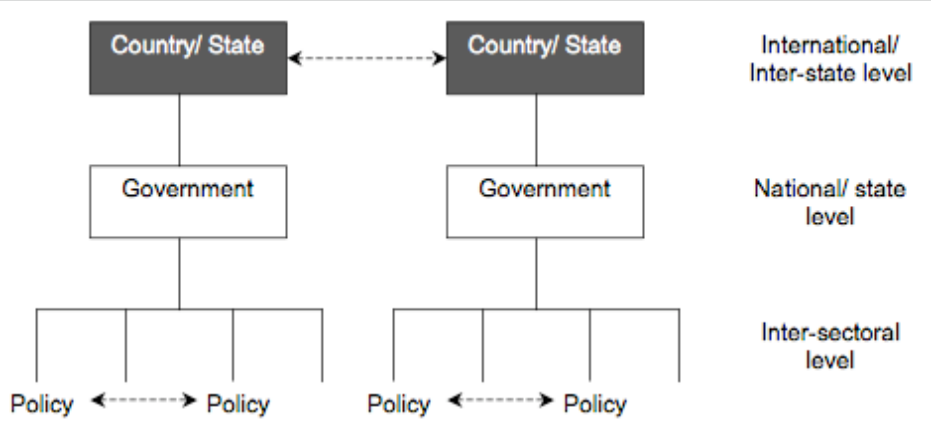

Figure 6.1 Multi-levels of integration process

- Although *political processes* are categorized under external context factors, they take place on different levels (international to local). Political processes can be characterized in general as top-down and short-term (only few year cycles), whereas IWRM and its sustainability objective require a long-term vision and commitment. However, crisis events (e.g. large-scale pollution, floods, etc) can cause political processes to become more bottom-up driven as growing awareness and sense of urgency (public opinion) gives political pressure (growing political support base) and drive change.
- Although *climate change and crisis events* are described by many as drivers to change, the knife cuts in two ways: (1) causing increased political pressure through awareness and sense of urgency; (2) leading to increased stress caused by water scarcity which can create increased competition between economic activities for water.
- The *economic situation* has impact on all levels and is a strong driver for the setting of (political) priorities. Priorities and issues can change depending on the prevalent economic situation. So there is a strong link between the economic situation and the political process.

6.4 IWRM - Internal Context

6.4.1 Existing structures

Many of the respondents discussed how existing physical, governance and organizational structures affect the implementation of IWRM. To describe the influence the existing physical system, a respondent from the Murray Darling case study described the basin as follows:

> *'The Murray Darling system covers 21 different systems. The Southern part of the basin has a winter/ spring system where you bank on the predominance of inflows being received, which are stored and allocated for use during the summer and autumn period by both consumptive and environmental use. In contrast the Northern part is very much a summer system, which relies on rinsing flows from tropical rainfall events. This leads to very different biophysical structures and also as time has evolved to very different approaches to water planning and water use' (MD04)*

He described that it has been very difficult to manage the Murray Darling basin as one single entity from a planning perspective and that *'tension between these basins has grown over the last 20 years'* due to the fact that agricultural activities have grown in the Northern basin that handed out a much greater number of (water) entitlements than the natural capacity of the Northern basin. This increased pressure on the Southern basin head works to '*pick up the slacks of what was not coming out of the Northern system and also to compete with growing demands from its own system'* (MD04). One of the big arguments in Australia as a federation is that *'there is a certain amount of autonomy for the states'* (MD06). A respondent described that those states *'have the power to manage in a way that's appropriate for that state*' as each state *'has different strengths in terms of e.g. water resources availability and climates*' (MD06). The difficulty here is, according to the same respondent, that when a problem needs to be addressed, that all these different approaches and processes need to be reconciled.

With regard to governance and organizational structures, a Rhine respondent stated that '*there's an organizational issue because water management is*

organized in different countries in different ways and it is not always possible to have integration in 'one body' (R09). Another respondent described that '*a lot of the countries involved have different structures and levels of bureaucracy'* (R05*)*, and he stated that these differences and the number of institutions involved are a challenge both on an international as well as on a national level '*as roles and responsibilities become largely overlapping and unclear'* and *'decision-making processes very time consuming'* (R05). Another respondent also addressed the differences in bureaucratic and hierarchical organization within different countries that are involved in the management of the Rhine and explained that '*delegations of some countries have less decision making power and need to go through more bureaucratic process before decisions can be made'* (R09)*.* One respondent explained above issues in the context of water management in the Netherlands in his following statement:

> *'The structure of Dutch water management is very complex. There are many institutions involved and many stakeholders and authorities. It's still way more complex that would be necessary and good. This makes it difficult to collaborate and more time consuming…' (R04)*

Most of the respondents agreed that *'an enabling organizational struture'* is important at both international and national levels. For example, the existing International Rhine Commission and the Murray Darling Basin Commission are described as effectively offering forums, through which governments and states can come together to discuss and negotiate issues.

6.4.2 Legal framework

One respondent explained the legal framework as '*the way things are organized and how changes in management of water is legally supported and agreed upon for longer term'* (R03) and he also stated that with integration *'we are usually talking about agreements and decisions that should still be in place in ten years or longer, but it is difficult to organize this in the legal framework and to get all parties to agree on it and to live up to it as well'*. Another respondent stated that the ICPR does not have the legal power to make sure that '*everyone does what [has been] agreed'* (R01)*.* However, some respondents stated this

issue is addressed and counter balanced by the existing Water Framework Directives (WFD) under the European Union, which penalizes countries when they do not implement or reach agreed upon measures or targets.

IWRM demands collaboration and cooperation between a large amount of stakeholders and *'they all have their own interests, mandates and legal arrangements'* (R03). This respondent continued to explain that *'if these different interests and legal arrangements are not in line with each other that will create many difficulties throughout the process (e.g. unclear roles and responsibilities)'* and *'it becomes much harder for these parties to come to an agreement'.* Many respondents agreed that especially on an international level, a more integrated and overall legal framework is required. On a more positive note, one of the respondents stated that with regard to the different member states of the Murray Darling basin *'the legal frameworks are relatively similar'* as these member states all fall under the Common Wealth nation, whereas in the case of the management of the Rhine basin the member states are all different countries with different legal frameworks.

The Murray Darling Basin Committee is set up to coordinate between six governments who all have different interests. The Murray Darling Basin Agreement, which has been approved as legislation in each of the basin states, '*sets out water sharing formulas and other things, such as a land management strategy and trading of water between jurisdictions, etc*' (MD06). One of the respondents from the Murray Darling case study gave the following explanation of the difficulties with regard to creating an effective and integrated legal framework:

> *'We are an agency of six governments and as an agency our aim is to try and get them to agree on common outcomes rather than common actions… It's the nature of these processes that they are very lengthy as getting all governments to agree is difficult; particularly, when in many cases what they will agree to will result in them having to change their legislation to meet that agreement' (MD03)*

This same respondent also described the difficulty due to inflexibility of legal frameworks by stating that *'once a jurisdiction brings in legal regulations, it is*

often very difficult to go back and change it in the short term' even if *'we may find in retrospect, that a big decision should have been made differently, but it is often hard to go back and revisit that in a short period of time'*. He provided the following more detailed explanation of this issue:

> *'We are in a time where water resources are rapidly declining which makes it very difficult to make fixed plans and objectives as plans made now can't be met anymore in three to four years… So there is a lot of uncertainty about the legitimacy of our problems and issues for the near future. Decisions made years ago are now hard to revise because of jurisdiction' (MD03)*

Another Murray Darling case study respondent stated that it is crucial to '*devise an institutional arrangement as well as legal and market arrangements, that you would be confident you do not have to change for a long time'* (MD09). So instead of taking hasty and reactive decisions when it comes to the legal and institutional set-up, it would be very important to '*focus on getting the structural foundations really well designed so that this can cope with whatever happens in the future'* (MD09).

6.4.3 Roles, responsibilities and accountability

The issues mentioned under the 'institutional structure' and 'legal framework' are very closely linked to the issues described with regard to mandates, roles and responsibilities, as they are all to do with how things are organized and who is responsible and accountable for what. With regard to IWRM, a respondent described that *'you need to look at many aspects as well as include many stakeholders and it is crucial that all roles and responsibilities need to be clear'* (R05), however in reality, '*there are still too many questions remaining with regard to who is responsible for which part of the water cycle and management process'* (R08). One respondent described how *'responsibilities are divided over different parts of different organizations'* (R09) and he also highlighted the importance, when dealing with certain problems, *'to involve those parties that have actual mandate and responsibility to deal with those problems'*, which is not easy as '*some organizations do not feel they have anything to do with your problem and are only causing it for instance'* (R09).

A consequence of the lack of clarity on roles, responsibilities and accountability is, according to one respondent, that '*there is much less progress [in the integration process] than we could have made...'* (R08).

Most respondents agreed that there is no 'broad' thinking when it comes to issues. One respondent described that *'within organizations we have our own mandates and responsibilities that go to a certain point and then it goes on to other organizations'* (R05). Another respondent agreed with this by explaining that '*authorities have an internal view and they only look at their own interests and do not have an outward look'* (R04). According to another respondent, there is also an issue with regard to a lack of accountability that is clearly linked to unclarity of roles and responsibilities. For example, one respondent stated that it is very important '*to clearly define who takes the consequences of certain risks'* as in many cases *'people prefer to be vague about who is responsible for certain risks*' (MD09). In other words, it is crucial that everybody understands what the risks are of certain decisions and also accepts these.

With regard to the Murray Darlin regime, one respondent stated that there is '*a fundamental weakness where it relies on the degree of goodwill and good intent by the individual [state] governments to apply what they have agreed'* (MD04). However, this respondent also described that this issue is currently being addressed:

> *'…we are moving towards something like the European Water Framework Directives… from having individual planning regimes that are brought together only when needed and replace it with a much more hierarchical approach where you have an overall basin plan… Accountability is documented quite clearly to work within the confines of the directives if you are either deliberately or otherwise not able to meet with the directives (MD04)*

Unfortunately, this debate has become *'highly politicized where the central government has [taken] a much stronger role in terms of central control'* over a number of aspects that have been '*traditionally managed at state level'* (MD04). This has made coming to an agreement a lot more complicated.

6.4.4 Power, control and representation

One of the respondents from the Murray Darling case study described issues of representation and power and states that *'IWRM is about understanding the consequences of resource sharing within a catchment'* (MD08). He further explained that if you want to recognize the consequences of particular usage patterns within the catchment, that what you find is '*that the development has been at the cost of the environment and what you are really looking at doing is adjusting the shares between e.g. the irrigation industry and the environment.* In his view the irrigation industries are very capable of identifying what e.g. the economic benefits associated with its industry are, whereas there is really nobody actively representing the environment.

Another respondent described that relevant parties should be an integral part of the whole integration process as they *'are linked to and affected by the integration process in every step of the cycle'* (MD01). This respondent explained, however, that often particular stakeholder parties are forgotten to be included in the process, which can also cause resistance by these parties to the process and it's consequences. He, however, provided an example where the community got involved and were given great freedom and power by the government in developing a plan. The respondent concluded that '*this process was very successful as its strength was to have people [with a direct interest] in control of the process instead of engineers and experts with a distant and perhaps more politically driven interest'* (MD01). One of the Rhine respondents raised some questions with regard to stakeholder representation. He stated that '*there are different types of stakeholders, those who can influence the process and those who are affected by it'* (R04). And the question that he raised is '*whom should you focus on and whom should you include?*'

With regard to the Rhine, one of the respondents described this issue in the context of physical planning and scarcity of land by stating that *'the parties that usually have most strength and power in these processes are the parties that are involved in urbanization, the project developers'* (R03). He highlighted that

those parties often have most power to influence what is happening and great plans can be developed, but if e.g. '*these parties are not supporting your plan, then that is a major hindering factor for the implementation'* (R03).

One of the Murray Darling respondents asked the question*: 'how do you plan within an environment where effectively there's not enough water to go round to meet all needs?'* (MD04). This immense issue of water scarcity poses a magnitude of pressure and difficulties to managing relationships, positive conduct and decision making within the Murray Darling basin. Another respondent explained that in this context, *'you have got a strongly competitive environment in which states and individuals are playing off one another'* which *'represents significant barriers in terms of parties and individuals working together to achieve effective IWRM'* (MD08).

One of the respondents also stated that '*there are no mechanisms in place to reward people'* to think outside their own direct interests and in a more broader context. He described the following consequences that come forth from this lack of mechanisms and incentives for integration:

> *'If an irrigation farmer wants to start doing things differently for beneficial justice and sustainability of the river, all that will happen is that they will make less money. So reductionism (thinking only of your own interests) is easier and more rewarding to the individual… People like to be able to control things, we don't like taking on things that might fail… So we set up projects that are fairly narrowly defined and bounded so we can control them' (MD10)*

This same respondent stated that 'there is something hard to budge with integration as it requires sharing responsibilities, control and resources' (MD10) and that there is 'weariness because integration implies some sort of power sharing: not [being] in complete control'.

6.4.5 Resources and skills

A number of respondents highlighted that IWRM demands and requires a lot of input and resources. As one respondent stressed this point by stating that '*you*

can't run an [integration] process and deal with complex problems with a one day meeting... you have got to be prepared to commit a lot of time, effort and money to work through the problems' (MD07). He explained that when the Australian government committed to IWRM 20 years ago, that '*they formed community groups and provided a large amount of technical expertise as well as time and effort'* (MD07).

Respondents of the Murray Darling basin stated that there has been quite an extensive amount of funding available for science and research. For example, one respondent described that *'the Murray Darling Basin Commission sponsored quite large programs and co-operative research centres which provided good links to research and science'* (MD01). Besides the availability of funding and investments to research, one respondent also stated that the existing infrastructure is a resource that is helping them to deal with climate variability and droughts:

> *'…as it provides a degree of certainty that you can apply within your planning approaches and decision making to give you a sound base at least to make your predictions and feature your outcomes. Also you can perfectly manage the water in a way that has a capability of delivering the outcomes you have set… so you have got some degree of physical control to give you a reasonable capable position if you like to achieve what you set out to achieve' (MD04)*

Another respondent also addressed this and states that '*we have got very significant investments in storages in order to mitigate the high variability in rainfall events'* (MD08). This respondent also stressed that it comes down to the people that are involved and their individual capacities to affect change through '*interpersonal skills and the ability to identify opportunities and align these with available information on existing conditions'* (MD08). Another respondent highlighted a decrease in experienced people and explained that *'many people with long experience in the integration process are retiring and there is a big gap between people in their 50's and people in their 20' and 30's'* (MD01). Another barrier that has been described by a respondent (MD06) is the fact that there are not enough skilled people who are prepared to work in regional and more rural areas in getting projects off the ground. So there is money as well as

planning done, but getting actions and plans to be implemented is a big challenge.

In the context of the Rhine, the respondents describe that there is a lot of manpower and effort needed for the implementation of IWRM. For example, one respondent stated that, with regards to the implementation of measures under the WFD, the national water agency and water boards require '*a lot of manpower and money and at times there are just not enough resources to guarentee the implementation of agreed upon actions'* (R05). Another respondent also expressed that sometimes it is very expensive to implement certain measures, which results in '*some parties being reluctant to accept the necessary measures in the first place or to make the investment'* (R01).

Another barrier that is highlighted by respondents is the lack of continuity of people involved in the integration process: e.g. '*at the level of national cooperation, people usually do not stay for a longer period of time'* which can become a challenge *'especially when you meet only once or twice a year [as] it become quite hard to build trust and raport'* (R05).

6.3.6 Time Horizons

One of the Murray Darling respondents describes that '*to change established water division is a political process and can take a very long time to turn around'* (MD01) as you are often dealing with many interests who will not give up and agree easily. Another respondent described that '*negotiations are very time-consuming and IWRM is a very political process involving different types of governments and stakeholder parties'* (R01). One of the Rhine respondents agreed with the above statements and described IWRM as follows:

> *'IWRM demands to design plans and implement actions in an interactive way with stakeholders and that is a very difficult and time consuming process. It usually takes more time than the length of an average project… You basically need much more time [than an average project length] for this process and also in order to test concepts' (R05)*

He also stated that '*intentions to follow a genuine integrated approach are limited as it does not involve short term results and outcomes*' (R05). In politics, it is regarded important to achieve short-term results as usually political terms are only a few years. In other words, there is discrepancy between the necessity of longer time spans for integration processes and the real-life project cycles that are usually much shorter. Another respondent emphasized this in the following statement:

> *'In the western world, we tend to like to take action rather than reflection and so we are not terribly keen on looking back and learning from what we have been doing. We like to keep on going, going and going, so we have a lot of short term projects, a lot of targets to meet but we don't necessarily link them up or learn much from them because we are so busy getting on to the next thing and doing that. There are a lot of costs involved in an integration process and it is harder to get things done. You have to put so much effort into talking to other people and working together with other people' (MD10)*

Another respondent explained that *'we have had to spend a lot of time in order to get the national policy implemented to the regional level and local level*' (R07), because of a '*lack of broader perspectives as well as a lack of forward thinking and longterm planning*' (R07). A Rhine respondent has provided an example of this issue of short-term project horizons: '*we are not entitled to validate results of projects and no measures are being taken after expensive study projects'* (R08). He described that one would think that after a project people would monitor outcomes and progress. However, his experience is that '*nobody is interested because they have already found different and new projects*' (R08).

– Internal Context Factors –

- Countries or states tend to manage a catchment in a way that best suits their particular needs (depending on the biophysical structure: e.g. water resources availability and climate) and depending on those needs, the countries or states also develop different structures, approaches and practices to water planning and use. Because of these differences it can be challenging to manage a basin as one single entity from a planning perspective.
- In reconciling different approaches and processes, historical cooperation should be considered as a factor that can influence the level of willingness for or openness to cooperation, depending on past experiences.
- Integration requires an integrated and overall framework on international or inter-state level. This framework regulates how things are organized and how changes in management of water are legally supported and agreed upon for longer term. It generally is time-consuming to change a legal framework (making it quite inflexible), The dilemma is, however, that with growing climate change and other uncertainties one cannot be sure about the legitimacy of problems or decisions for the future. In other words, legal arrangements need to be created that allow space and flexibility to cope with whatever happens in the future.
- Both the existing structure and legal framework mutually determine the division of roles, responsibilities and accountability (see Figure 6.2).

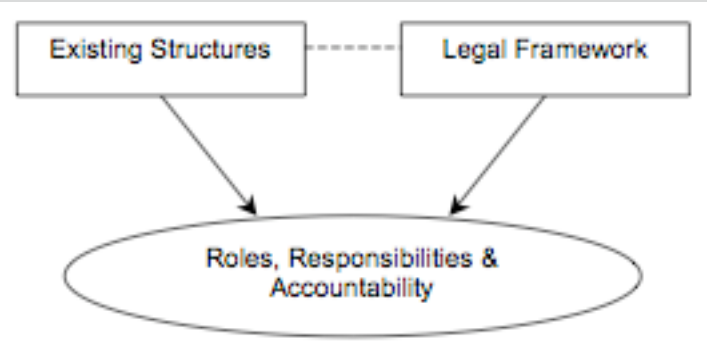

Figure 6.2 Structures, Legal Framework, Roles and Responsibilities

- However, with a complex management structure including many institutions, authorities and stakeholders, roles and responsibilities become unclear or overlapping. Also when legal arrangements are not in line between countries, states or sectors, it becomes unclear who is responsible and can be held accountable for what. Changing current structures, legal frameworks, or roles and responsibilities can become very difficult as it involves shifts in power and control.
- IWRM is about understanding the consequences of resource sharing within a catchment and it requires sharing of responsibilities, control and resources: it is about adjusting shares (power and control) between different water uses. These adjustments require shifts in power and control which are factors usually not given up easily by people. It is important that all relevant stakeholder parties are represented, as excluding certain parties can lead to an eventual resistance to change. Increasing issues with water scarcity can pose major pressure to managing relationships as competition between demands grows.
- An integration process demands a lot of time, effort and other resources to work through the upcoming challenges. It requires a continuity of skilled people, with interpersonal skills and ability to identify opportunities and align those with available information on existing conditions. Funding and investment should be available for science and research.
- To plan and implement IWRM is a process and demands much more time than that of an average project. A genuine integrated approach does not involve short-term results and outcomes, which appears to contradict with usual political cycles. The focus should be shifting from one of action to one of (iterative) reflection and learning.

6.4 IWRM - Change Implementation Process

6.4.1 Competing Interests and Agendas

According to one respondent '*water management has to do with interests, with values, with different perceptions'* and he further described IWRM as '*a human activity that has to do with decision-making and politics, being both a political and also an ethical issue'* (R04). There are a number of different stakeholders that are involved in the integration process and '*it becomes obvious that they are playing out their own interests rather than the collective interests*' (MD08). Another respondent added to this by explaining that IWRM *'demands collaboration and cooperation between a large amount of stakeholders and they all have their own interests and mandates*' (R03). This respondent described that barriers will arise when interests and agendas are in conflict with each other, which results in agreements not being reached. One respondent described IWRM as '*people-work'* and highlights the '*difficulty of changing people's mindsets as people are having their own agendas and interests and are not willing to take into account other interests'* (R07).

In other words, '*a multitude of competing interests can lead to deadlock because nobody wants to give in and everyone is sticking to their own standpoints'* (R08). So '*it is many times too difficult to [come to] a decision because of so many interests involved'* (R04). It is many times also not clear what the different interests are as '*for one issue it might be one party having a certain 'hat' on and for another issue they could be wearing another 'hat'* (MD01). Besides this changing of stakeholder interests according to the issues that are being discussed, respondents also stated that the interests change according to the scale that is focused on in the integration process. As an example, one of the respondents described following:

> *'At the basin scale, you are looking for environmental sustainability, whereas at the local scale it is economic sustainability. So the reality is that there are crunch points: they have to prioritize and it is going to be difficult as there is direct competition between scales' (MD02)*

One of the Murray Darling respondents highlighted that it is important to develop an arrangement that *'enables stakeholders to resolve their differences not by discussing these differences, but by finding common ground and trade-offs'* (MD09). And another respondent explained that *'people need to have accepted and recognize that they have a shared problem to solve'* (MD07).

6.4.2 Stakeholder Involvement and Interaction

A number of respondents emphasized the importance of including relevant stakeholders in the integration and decision-making processes. One respondent stated, for example, that '*if you have to implement measures then you need all relevant players to get acceptance for the decided measures*' (R01). This will otherwise impede the implementation process of those measures. With regard to the relevancy of stakeholders, one respondent described that it is important to include '*stakeholders who have a real interest*' (R02) and then to also make sure that those people have interaction with experts as this will help create more understanding both ways. However, one respondent also addresses the unclarity that still remains with regard to involvement of stakeholders:

> *'There is still a tricky issue: who exactly are the relevant stakeholders and whom of them to involve? It depends on the problem at hand, but also on the geo-graphical area, the issues that you pay attention to, but at the same time the problem also depends on who you involve. So it is a difficult point as in theory there are many stakeholders. And if you involve too many, cooperation can become more difficult' (R04)*

A number of respondents explained that the manner in which the stakeholder process is organized affects the attitude of stakeholders towards the integration process and change. One respondent highlighted the importance of feeling of ownership amongs the stakeholders involved. He explained, that the feeling of ownership was created by giving stakeholders; *'the room to state what they wanted'* (R02). Another respondent addressed the *question 'how do you plan within an environment where effectively there is not enough water to go round to meet all needs*' (MD04). He further stated that this challenge has '*really posed an order of magnitutde and difficulty in managing relationships and positive conduct as well as decision making within the MD agreement'* (MD04).

Yet another respondent explained that in order to deal with these challenges '*you have to keep working away getting people together, facilitating people to understand the objectives of what's going on, encouraging people to sort their issues out*' (MD01). A number of respondents also agreed that the more frequent there are meetings and interactions the better this is for the process. One respondent also highlighted the importance of informal meetings and discussions as they *'bring people closer together breaking gaps between the different stakeholders*' (MD07). Another respondent stated that '*the process itself is quite dependent on the characters that are involved in it'* (MD01) and that there are lessons showing that these processes depend very much *'on elements such as honesty, integrity and respect*' (MD07). It is important to '*let people retain their ownership and to facilitate people to be more creative*' (MD02).

An issue that is brought forward by one of the respondents are those of '*a lack of genuine belief in the value of stakeholder involvement'* by e.g. governments and authorities as well as a '*lack of understanding of how to organize and facilitate those processes*' (MD13). Some respondents, however, highlighted an increasing awareness with water managers who recognize the importance of stakeholder involvement. It is very important to have good people to facilitate the stakeholder discussions, '*people who can carry the change process and motivate this change, people who are aware of the system as well as the interconnectedness of it and the problems that play*' (R07).

6.4.3 Communication and Collaboration

A Rhine respondent, who is particularly interested in the link between physical planning and water management, highlighted that it involved '*two different policy fields, with different cultures and different ways of communication'* (R03). He also states that '*these differences have been hindering the collaboration and integration process*'. '*Sometimes major decisions are being taken and years down the track still finding that there are serious issues around the implementation of those decisions*' (MD04). This same respondent explained

that developing '*effective communication and collaboration between the parties is absolutely capital to move forward*'. A number of respondents stressed the importance of involving relevant stakeholders throughout the integration process. One of the respondents stated that it is important to '*facilitate and coordinate the collaboration between different parties so communication becomes easier'* (R10). A Rhine respondents provided the following statement in which he discussed communication and collaboration:

> *'There are participatory approaches in the Netherlands, but especially at policy levels they don't talk about participation. They talk about communication; about telling people that they are intending to do good things, convincing people to give their support, which is not the same as collaborating and using their experience, taking serious their concerns…' (R04)*

This respondent elaborated further on the topic of communication and stated that there is *'two-way communication'* which can be described as a '*discussion or a dialogue'* but he explained that many politicians are more often using a form of *'one-way communication: that of giving information and persuading people'* (R04). Respondents have emphasized that levels of trust between the different stakeholder parties (with often competing interests and agendas) will impact the effectiveness of communication and collaboration taking place. '*To bring different involved parties with their own interests and agendas together takes sometimes years of talking and communicating'* (R10). One of the respondents stated that '*it is important that people are entitled in larger groups to communicate and express their views, which is often not the case*' (R08).

One respondent stressed that when experts communicate information to stakeholders that it is important to '*speak the language of the people you are talking to*' (R08). To further explain, he gave an example where a hydrologist is giving a presentation using terminology that a majority of the people does not understand and is also ignoring the questions and confused looks of the people in the room to his presentation. Another respondent stated that *'it is important to try and do everything in a way that lay people can understand it'* (MD09) and he

also suggested using methods, such as *'a poem or art to communicate information or an idea*'.

6.4.4 Leadership and Vision

A number of respondents highlighted that good leaders and a clear vision are very important elements and a lack of those elements form barriers to the implementation of IWRM. In the context of integration, a respondent described that '*you are dealing with difficulties to changing people's mindsets and a resistance to change*' (R07). You are at times dealing with people having their own agendas and interests not willing to take into account other interests. In this context, '*it is important that people on political and management levels have a very clear understanding of the process and vision*' (R07). Another respondent stated that '*it is crucial that people involved feel enthusiasm for the ideas vision and that there is strong political support and leadership'* (R10).

Many respondents described occasions where discussions are in a deadlock and leaders are not making decisions. In that context, one of the respondents stated:

> *'The quality of leaders applies all the way from planning through to action and intervention. If you don't have good leaders, the rest of the community and stakeholders might never agree… Leaders are in effect critical to be getting through the planning but they are also critical for getting the action going' (MD07)*

Respondents talked about both vision and experience that are required from leaders in integration processes: '*people with charisma'* (R08) with *'good communication skills and understanding how to facilitate this process'* (R05). One of the Murray Darling respondents (MD01) described that there are many people with extensive experience in IWRM, who are retiring, and that a big gap has been created. *'There are not many people left due to downsizing and restructuring in the 80s with the aim to get rid of middle management in the water sector*' (MD01). This respondent stated that it is also crucial that leaders

have extensive experience in dealing with integration and stakeholder processes.

Leaders are elementary for guiding and developing common vision of where you want to go. One Rhine respondent explained that this happened in the Rhine where a common political vision was developed for the Rhine amongst member states to '*bring the salmon back into the Rhine*' (R01), which was a symbolic goal to bring 'life' back into the Rhine as the salmon is on the top of the foodchain. Not only leaders on political levels are necessary, also leaders in the form of people that guide and facilitate stakeholder processes or representatives of certain local stakeholder groups. These leaders need to have a '*real good concept of what is important and what does society wants'* (R09). As an example of community leaders, a Murray Darling respondent described the following:

> *'Outstanding leaders carried the process through until now… They were community leaders, local leaders with a vision for the catchment, good political connections and good connections back into their communities. These people formed a mediating bridge between the agencies and the community' (MD01)*

This respondent summed up all the benefits of good leadership by stating that '*you need good leadership to develop mutually agreed objectives, to carry the planning process, to bring stakeholders together and keep them in the process*' as well as to *'make sure that you achieve the objectives that you expected to get*' (MD01). Another respondent (MD02) also described elements such as '*inspiration*' and '*motivation*' to be important characteristics of leaders. In another example, a respondent explained that '*leaders have got to be prepared to work through a problem and understand it from other people's point of views and not their own*' (MD07). Respondents agreed that leaders are important to build vision, trust amongst stakeholder groups as well as space for open communication and collaboration.

6.4.5 Data and Information

A number of Rhine respondents highlighted data and information as a mediating factor for the implementation of IWRM. One respondent described the importance of data and information in the following statement:

> *'You need to start by gathering basic data. When you want integration, then you should start with measuring and you need information and data about functioning of the ecosystem. On the basis of this information we develop common objectives. So first: measurements, second: laying down objectives, and third: how you can agree on measures between different countries' (R01)*

He also stated that in the context of the Rhine, '*there is a huge amount of data available*' and *'as soon as you look at this information it becomes clear where the issues lie*' (R01). Another Rhine respondent stated that '*you need data and knowledge about the system in order to make good decisions*' (R05). Respondents also emphasized the importance of accuracy of data and information. One of the ways to ensure accuracy of data this is by e.g. monitoring implementation of plans and actions:

> *'… design a foundation in such a way that if things stop going well, they get very clear signals about the fact that it is no longer working: they have to change [course]. So [it is important that a] very robust monitoring system is designed' (MD09)*

Some of the Murray Darling respondents addressed hindrances caused by decisions that are not backed by good science or sufficient knowledge base. As an example, one respondent stated that *'a common barrier is uncertain knowledge and information'* (MD03) and he also explained that because of that '*people are sometimes unsure of signs which makes it very easy to go into denial*'. Another respondent gave example where decisions in the near past were completely driven by '*social and political interests and not backed up by good scientific information*' (MD01).

Most respondents emphasized the importance of being able to make data and information available to different stakeholder groups and the public. They

discuss different methods and tools to gather and disseminate data and information. Some respondents addressed the existence of modern computer techniques as a major advantage to data collection and dissimenation. One respondent stated that '*modern communication tools, the Internet, etc, these kind of things enhance the possibility to dissiminate and to have access to information*' (R08). Other tools and methods, such as modeling and scenario building have been mentioned and described to be very conducive to the integration process as these tools can '*envision and make visible what the possible results and outcomes can be*' and '*through the use of these tools you can bring together people and inform them*' (R02). This respondent described that:

> *'Scenarios are to be discussed with different stakeholders and parties which is usually done in the form of sessions to talk about the outcomes and results of the scenarios and choices and possibilities that come forth from that' (R03)*

To conclude, another respondent provided an example where existing technology and infrastructure is positively contributing to the gathering of data and information: '*the Dutch 'Deltawerken' pushed the increase in knowledge and understanding about ecological systems tremendously and also increased the focus on ecology and environment'* (R07).

– Process Factors –

- IWRM is a human activity that involves decision-making and politics: dealing with different (competing) interests, values and perceptions. IWRM demands collaboration and cooperation between a large amount of stakeholders (at different levels: international, national, regional, local and individual) all having their own mandates, interests and agendas. Issues highlighted here are: competing interests; difficulty to change mindsets; deadlock because of resistance to change. It is important to develop arrangements that enable stakeholders to resolve their differences, not by discussing them, but by focusing on common grounds and finding trade-offs. In other words, to accept and recognize that there is a shared problem (or vision) that needs solving.
- Stakeholder involvement and interaction is important: if you have to implement measures you need al relevant players to give acceptance for the implementation of measures. Questions remain, such as: who exactly are relevant stakeholders to involve? The dilemma is that stakeholders decide upon (perceived) issues and problems, and these may differ depending on the stakeholders involved. The way a stakeholder process is organized is crucial as this affects the levels of: feeling of ownership, resistance or openness to change, positive or negative conduct amongst stakeholders. Frequent (informal and formal) interaction is important. Creativity, honesty, integrity and respect are important elements of such a process.
- Effective communication and collaboration (based on the above-described elements of creativity, honesty, integrity and respect) between parties is capital to moving forward.
- Leadership and facilitators, people who can carry a change process and motivate change through a clear vision, are also important factors. This leadership takes place on different levels, from a political support base, to facilitators of stakeholder processes, to stakeholder representatives. They need to work together, to guide and develop an inspiring common vision.
- In many cases, decisions are driven by social and political interests and not backed up by good scientific information. Monitoring and evaluation are important elements to ensure accuracy of data. Data and information needs to be made available to all stakeholders through different tools.

6.5 IWRM – Individual Attributes

6.5.1 Attitude to Change

Many respondents highlighted (either explicitly or not) that IWRM is primarily a '*human*' process – shaped and affected by the people that are involved - as well as a process that requires significant changes to occur on different levels – e.g. structural changes, changes of procedures, changes of how different processes are organized (such as communication, coordination, collaboration). As an example of how the people involved can negatively affect the integration process, one respondent provided the following statement:

> *'People who are opposed to change or are fearful of change because they have not worked out how to solve things in an innovative way and tend to put rules into the plan to protect themselves… So if they see that they are going to be losing, they will try to put in place arrangements to stop them from losing as much' (MD09)*

With regard to the implementation of water management concepts (such as IWRM and AM), the level of resistance to change can be viewed as an indicator of the extent or scale to which change is intended to or is taking place (assuming that the higher the extent or scale of change, the more resistance will be met along the way). A number of respondents described and highlighted different factors that can stimulate or hinder the resistance or openness to individual and organizational change. In other words, attitudes to change are a key-mediating factor (either a barrier or enabling factor) in the implementation of IWRM.

The integration process is '*quite dependent on the characters involved'* (MD01). One respondent highlighted that the main problem is that *'it's difficult for people to change as people generally want to keep things as they are at present'* (R10). He provided an example: '*when you are launching an idea for change on a political level, it disturbs the present situation and the present positions: the present hierarchy between speakers and parliame*nt'. Another respondent explained this further by stating that '*politicians follow their agendas of getting*

more constituents' and that resistance to change comes forth from the fact that people have invested in a certain path; '*not only on an individual level, but also on an institutional and societal level we have invested [time, money, intentions and emotions, etc] in certain directions*' (MD02). He explained this further in the following statement:

> *'People invest based on the understanding that policies are secure. So if someone e.g. says: this is the way your water property rights are going to be defined, then the farmers will go out and invest on that basis and on that understanding. So there is a big history in terms of invested time and money and other resources that commits people down a certain path and it's an impediment to change at all scales. It's an impediment to a farmer changing and it's also an impediment to government to change' (MD02)*

One respondent described how people tend to retreat to their own positions when it comes to '*conflicting interests and agendas or when people feel that they are not entitled in larger groups to communicate and express their views'* (R08). '*What is very important is openness to discussion and to share views and come up with ideas and alternatives; it's crucial that people involved feel enthusiasm for the ideas'* (R10). Another respondent stressed that it is crucial to have '*people who can carry the change process and motivate the change'* (R07). These persons can play an important role in *'creating and developing real understanding amongst different players in order to make sure agreements are kept and similarly understood by different parties'* (R09).

6.5.2 Level of Trust

A number of respondents from the Rhine and Murray Darling case studies talked during their interviews about events where trust facilitated the integration process, but also of instances where distrust hindered the implementation of IWRM. One respondent described the reasons why distrust arises in a stakeholder process through '*misperceptions of other parties, labels that people put on other people, (assuming) hidden agendas'* and he further explained that '*in core it's people's selfishness, but can also be caused by a lack of interaction'* (R02). This respondent also provided examples of negative effects of distrust, such as *'exclusion of certain parties, not sharing necessary information, not*

believing information shared, lack of giving support, keeping the cards to yourself' and he also provided an example where certain stakeholder groups are excluded and there is unwillingness to effectively participate in a project.

Other respondents stressed the great importance of including relevant stakeholders in decision-making processes to develop trust and come to mutually agreed decisions. For example, one respondent shared that '*goals are often not perceived as common goals, because not everyone has had a chance to bring in their views and come to agree on decisions*' (R08). Another respondent described that when negotiations have been taking place where all governments and other relevant stakeholders have been involved and have come to an agreement, that those decisions are perceived as '*robust and very well informed decisions because everyone has supplied their scrutiny and everyone has negotiated about what the best approach and outcome would be'* (MD06). This respondent, however, also explained that inclusion of all relevant stakeholders can at times also turn into a barrier, when parties cannot come to an agreement and and get stuck in neverending discussions. Another respondent stated that *'good will, mutual understanding and trust are prerequisites'* and '*major elements to reach common understanding and goals*' (R10).

Some respondents not only highlighted the importance of trust during stakeholder processes, but also described the importance of trust developed through successful implementation of projects and processes and the achievement of desired outcomes. As an example, one respondent described that:

> *'…when an integration process has been successful in the eyes of the stakeholders, people have seen that it can work and that this approach has helped to develop skills and confidence in the people involved. This will stimulate these people to also be involved and commited to other or extension processes' (MD01)*

'*To build up trust costs time'* (R05) explained a respondent. His experience is that there is usually more trust and confidence on a local level as there is less

division between disciplines and interests. However, he also stated that '*you have to work several years on certain issues, as people have to trust you in what you are doing as well as have trust in how much you know about the issues*' (R05). A Murray Darling respondent explained the importance of building trust and continuity and stated that it is crucial to have access to '*a group of (community) leaders who's knowledge base and preparedness to do these sort of things have build up over time' (MD07)*

Some respondents described that IWRM is a concept about sharing as opposed to win or loss, and it does not mean that everyone gets exactly what they want to get. It's about *'getting what is reasonable for us, relative to our circumstances*' (MD07). This same respondent also stated that '*people need to walk out with a feeling that there is a good reason why they have not got quite what they wanted and that it is fair'*. With other words, fairly does not necessarily mean equally, but it means that people have not been dealt harshly with in comparison to others taking into account the broader context. It is very important in this process to be able to explain and provide well-grounded reasons why certain directions would be better to take than other.

6.5.3 Sense of Urgency and Awareness

A number of Murray Darling respondents describe the context of the basin and stated that *'it is subject to a very variable climate, with lots of droughts and also flooding'* (MD02). Many respondents agreed that '*climate change may be a trigger for people's awareness to grow*' and '*to understand the necessity of managing resources in integrated manner*' (e.g. MD05). A number of respondents also emphasized that environmental issues and crisis events can be a strong driver for an integration process. One of the Rhine respondents even stated that '*disasters are gifts from heaven*' and he further explained this by stating that '*we are not undertaking water management, but disaster management'* and *'we are mostly coming into action after something has happened'* (R10). It is important that '*we all have to have the same sense of*

urgency that something has to be done' (R09). One respondent explained this further in his following statement:

> *'In a way the urgency of the matter is a very crucial component to transforming resistance to change. There is an impulse, but it takes time to reach the greatest effect… So it is important to see how you can realize to continue this motion of change… It is like a tanker at sea; when there is a shift in direction, it takes time to see this shift occurring as it takes the tanker time to change direction' (R10)*

A number of respondents also highlighted the necessity of having clear evidence of a problem in order to catalyze change. As an example, some Murray Darling respondents described an event where there was an enormous algae bloom on the Darling River of about 1000 km long and people could not extract water because of the toxic algae. The impact of this event was so obvious and terrible on the environment and it was inhibiting economic and social users of the river system. In this case all parties agreed on the severity of the problem. What usually happens with less evident problems is that '*everyone gets together with the different states and they all have different perspectives of how important a problem is' and 'they all have a different levels of willingness to pursue any management actions for it*' (MD06).

Most of the respondents stated that there is more awareness and there has been a big push towards recognizing the environmental need for water. '*It is a process of evolution in terms of policy and people*' (MD02) that is also very much driven by change in climate, increasing uncertainties and people's desire to survive and grow:

> *'Climate change has prompted some change in people's behavior as well as economic leverage stimulated by the Australian government. For example, water markets and things like that change people's opportunities to make money from water. Whether it changes it for the better or worst is highly debatable. There is a fundamentally limited system, so what creates opportunity for one person is taking away opportunity from another…' (MD02)*

Besides a growing environmental awareness, respondents also talked about an increasing awareness and recognition of the importance of stakeholders and

the realization of water managers that they cannot be in this process by themselves (e.g. R03, R05). As an example one of the respondents stated that '*there is a recognition that the more people you have bringing different perspectives, the more win-win situations you can come up with'* (MD01). The level of awareness and understanding of the issues by people involved in the integration process is an aspect that is highlighted as well. One of the Murray Darling respondents stated, for example, that '*there is still a vast majority of the public that probably do not have a good understanding of the process and issues*' (MD06). He further explained that '*most Australians realize that Australia is a place of very scarce water resources, but there are informed people and uninformed people and informed people tend to be much more mature and constructive for the integration process*'.

– Individual Attributes –

- IWRM is primarily a 'human' process, shaped and affected by the people involved. It is also a process that requires significant changes on different levels (structural, procedural, etc). The level of resistance to change can be viewed as an indicator of the extent or scale of the intended change: assuming that the higher the extent or scale of change, the more resistance will be met. It is linked to control as many people want to keep things as they are (as they have invested in a certain path). Resistance to change can be caused by many different factors: peoples' characters; competing or conflicting interests; lack of respect and openness in stakeholder process, etc.
- Distrust arises in a stakeholder process through misperceptions of other parties, labels that people put on other people, and (assuming) hidden agendas. This can have the following effects: exclusion of parties, not sharing of necessary information, not believing information that is shared, lack of giving support, keeping cards to yourself. Mutual trust is developed through inclusion of stakeholders, open and transparent communication & leadership, as well as successful implementation experiences in the past.

- Good will, mutual understanding and trust are prerequisites for reaching common understanding and goals, but to build up trust costs time and it can easily be broken down again.
- IWRM is a process of evolution in terms of policy and people. Climate change and crisis events can trigger growing awareness and a sense of urgency. Clear evidence of the urgency of an issue or situation is a crucial component to transforming resistance to change. There are informed and uninformed people and the informed ones tend to be much more mature and constructive for the integration process.

6.6 Barriers and Enabling Factors for AM

The next sections present the results of the interview survey, exploring in more detail the barriers and enabling factors that have been described by the AM case study respondents. Table 6.2 below provides an oversight of the categories of mediating factor categories that have come from the data analysis indicating the number of respondents per case study (total number of respondents for GCDAMP is 14, and for KRRP is 11) that have highlighted and identified factors as a barrier or enabling factor.

	GCDAMP		KRRP	
Category	Barrier	Enabling	Barrier	Enabling
CONTEXT FACTORS - External				
Government and policies	0	0	0	0
Political processes	8	1	8	2
Economic situation	3	0	2	0
Climate change and uncertainties	2	0	0	3
CONTEXT FACTORS - External				
Existing structures	5	1	3	4
Legal Framework	3	4	2	4
Roles, responsibilities and accountability	8	0	3	1
Power, control and representation	3	1	2	0
Resources and skills	8	6	8	1
Time horizons	8	2	7	5
PROCESS FACTORS				
Competing interests and agendas	8	0	8	1
Stakeholder involvement and interaction	10	9	7	11
Communication and collaboration	10	8	5	6
Leadership and vision	8	0	3	9
Data and Information	6	6	5	8
INDIVIDUAL ATTRIBUTES				
Attitude to change	12	1	8	6
Level of trust	6	2	6	2
Sense of urgency and awareness	0	4	3	6

Table 6.2 Barriers and enabling factors for AM planning & implementation

6.7 AM - External Context

6.7.1 Political process

A number of respondents indicated that political processes highly affect the implementation of AM. One of the Glen Canyon respondents joked about this issue, by describing that '*there is more politics in the river than there is water*' (GC11). Another respondent provided the following statement:

> *'This process is so political you can't believe it. My guess is that any AM you will ever find is full of politics and you just have to dig in. It absolutely does not matter whether it's state, local or whether it is multi state, they all have some level of politics in them. People get into them because they are politically motivated and the problems are political because they have substantial impact on what happens today and on what the future might look like. Politics gets in the way of the future. If people knew politics was important then they would identify the rules of politics when they set up their AM programs and then they at least have a means of dealing with it' (GC06)*

Some respondents from the GCDAMP case study described how most of the stakeholder representatives have become friendly with each other through working together in the different workgroups. However, the process of making recommendations to the Secretary of Interior has become a '*very politically charged process*' (GC02) where '*decision-making is more driven by politics than by science*' (GC10). For example, one respondent described that the Secretary of Interior will not take a strong position because he '*does not want to take on the rap of those people who don't want something*' (GC06). Some of the respondents stated that although in their view in theory AM should be driven by science, that in reality '*what's making you adapt are different things, whether it's driven by stakeholders or by something else*' (GC10).

Changing governments affect the positions taken and priorities that are set. There is a lack of consistency with regard to directions taken and decisions followed through. One respondent emphasized this by describing that '*depending who is in charge in the political realm and who they view their stakeholders are, you get more pressure to do one thing or the other*' (GC02).

Some of the respondents referred to political processes where decision makers decide to e.g. introduce a study just because they do not want to have to make a decision. A respondent described that this is '*an easy way of putting off a decision because it's too controversial and you are not going to please all of your stakeholders*' (KR05). This respondent also explained that authorization of e.g. environmental studies is often seen as a '*recognition of it's [environmental] value and so the environmental community will take that as a positive step eventhough actual restoration is not taking place*' (KR05).

One of the Kissimme respondents (KR09) stated that compared to some of the other case studies, the stakeholder interest in the Kissimmee has been simpler as most of the land is owned by farmers and used for cattle. When decisions would affect more urbanized areas, political issues start becoming more complex, as politicians '*are not going to force people to relocate for nature, you can argue about whether or not it's good policy'* (KR09). However, one respondent stated that to apply (active) AM, '*you have got to put ideas and approaches at risk in decision-making, you can't just practice safe science, swimming to the shore that you know is there*' (KR11). He described that if the political decision-making environment is adverse of this more risk taking approach, that this is in fact a major barrier for the application of AM. He also stated that also '*scientists feel that immediately, there are very few scientists who will take a stance regardless of the consequences'* (KR11).

6.7.2 Economic situation

With regards to the GCDAMP case study, many of the respondents highlighted the economic importance of the dam. For example, one respondent explained that '*as the Environmental Impact Statement was created, the option of removing the dam was briefly entertained*' however, *'the dam is an important moneymaking part of the economic framework'* (GC11). This respondent also stated that the dilemma here is that '*the department agrees to participate, but is managing for pristine conditions that can't exist with the dam in place'*. In other words, '*there is an inherent kind of duality there that is one of the stumbling blocks of this program'* (GC11). Another respondent described how the operation is driven by the '*economic and social impact of operating the dam in a certain way'* and that scientific findings in this process *'do not carry much weight'* (GC04).

Another respondent addressed the issue of calculating economic impact on different stakeholder parties. He described that within the GCDAMP case study there is this *'concept that a minority of the stakeholder group gets to bear all the costs economically',* however, they do not seem to acknowledge that '*other*

stakeholders feel like they're also bearing costs although those have not been defined economically' (GC12). This same respondent provided the following example:

> *'if there is a proposal to change the way they operate the power plant at Grand Canyon dam, the power community can assess relatively easily what the cost implications of that are by the financial impacts… But of the environmental group says: well you're building the dam, of course it's not the operation of the dam but by the dam's existence there's been a cost. And the way you operate the dam in a way that actually hasm't promoted downstream resources. Can we agree on how to value that loss? But there's still no agreement on how to value that loss' (GC12).*

One of the Kissimmee respondents explained how in the past, '*the Federal Government was looking at ways of making Florida more economically prosperous*' and how development in the South of Florida has led to the '*building of thousands of miles of canals, substations, levies and other big infrastructure'* (KR01). A number of respondents described how this existing infrastructure initially formed a major barrier to the restoration of the Kissimmee River.

6.7.3 Climate change and uncertainties

One respondent stressed that *a 'recognition of uncertainties is an enabler to the implementation of AM'* (KR03). He also stated that through this recognition of uncertainties, '*people acknowledge that they don't have the answers'*. Another respondent addressed substantial rainfall and flooding events as well as a number of hurricanes crossing Florida State during 2004. He described that through these events '*large amounts of precipitation fell into the basin and we experienced very large flows moving down the Kissimmee system'* (KR10). However, these crisis events *'allowed us to observe the performance of the restored project under very high flows'* and '*gave some very good information about how the system responded under these very large flows'* (KR10). Yet another Kissimmee respondent agreed *that 'in certain cases, crisis events can certainly be an enabling factor*' (KR02) and he provided another explample in his following statement:

> *'I can point to a couple of events where that's been true, e.g. Lake Okeechobee became covered in green algae and everyone felt that all the living organisms in the lake were going to die and that the algae had been attributed to the fact that Kissimmee had been channelized. This did push the study pace of the Kissimmee restoration' (KR02)*

However, one of the Glen Canyon respondents is of the view that climate change is something '*you cannot anticipate in the first place, so you could do everything in the world right together, but still not have a positive outcome'* (GC02). Another respondent stated that *'learning can lead to a period of inaction because it's clear that what you're doing is more uncertain than you thought and more risky than you imagined*' (GC12). According to this respondent, managers might therefore '*resolve to not doing anything, not because they don't know enough, but because they've learned more*' and they might not be willing to take a risk.

– External Context Factors –

- Political processes highly affect planning and implementation of AM. 'There is more politics in the river than there is water'. These political processes take place at different levels: inter-state, state, local. Most of the water related issues become political because they have substantial impact on what happens today and on what the future might look like.
- In many cases decision-making is more driven by politics than by scientific findings. In theory AM should be driven by science with a learning objective, in practice it is often driven by social and political factors. 'Depending on who is in charge in the political realm and who their stakeholders are, you get more pressure to do one thing or the other'. To apply active AM, however, you have to put ideas and approaches to the test, you can't just practice safe science. Risks need to be taken, but there is the difficulty as the (political) decision-making environment is often advers to risk taking.

- Existing infrastructure and physical structures can form a economical barrier to restoration of a river as the existence of this structure is often driven by economi and social factors. In other words, economics and the environment are often viewed as opposites.
- Recognition of uncertainties is an enabling factor to the implementation of AM as people acknowledge that they don't have all the answers. In a sense, climate change and crisis events can be viewed and used to increase understanding and knowledge of the system through observation. Learning can lead to a period of inaction, not because 'we don't know enough, but because we have learned more'. In other words, action is not more important than learning and reflection.

6.8 AM - Internal Context

6.8.1 Existing Structures

With regards to the implementation of AM, a number of respondents highlighted that there are institutional barriers that are the result of different agencies involved and in control of restoration projects of extensive scope and scale. One respondent described the Kissimmee '*in the big picture of things as a modest watershed*' (KR04). Another respondent compared the Kissimmee restoration project to the one for the Florida Everglades and stated that in '*scale, complexity, types of issues and stakeholder involvement, the Kissimmee was much more straightforward'* KR09). Although the scope and scale of the KRRP is not considered complex (as it runs e.g. only through one state), it has still taken almost twenty years to perpetuate this restoration program. One Kissimmee respondent highlighted that one of the challenges has been that different agencies involved in the implementation of the project have *'different management practices at odds with one another*' (KR07). Another respondent described a lack of continuity in the institutional setting:

> *'It's very hard to keep the governance working smoothly, because political settings change, priorities change and over a long term project, how do you keep the continuity going when key people leave, take other jobs, so how do you keep all of this moving in a good direction?' (KR01)*

The lack of continuity in management is also stressed by another respondent, as he stated that this coincides '*with political and institutional systems changing with four, six or eight year increments'* (KR04). He emphasized that a continuous generation of commitment is of major importance to the program. Another respondent stressed the need for a more adaptive form of governance, but that *'we have not build agency infrastructure in many agencies that allow that'* (KR01). However important an enabling organizational structure, implementation of the program also stands or falls with the people in it. As one respondent stated it is very dependent on the dynamics of personal interactions: '*the right people will overcome a bad organizational structure but not the other way around'* (KR09).

With regards to the GCDAMP case study, respondents highlighted a misfit between the working of the institutional structure and that of the natural physical system. For example, one respondent from the Glen Canyon case study stated that in his view a major barrier to the implementation of the AM program is '*the complexity and time frame of existing networks charged with management*' (GC10). He explained that there is a *'gap between how the ecosystem works - the timescale that it operates on – and the complexities and realities of how scientists and managers operate*' (GC10).

Another respondent elaborated on this by explaining that the Glen Canyon is a huge erosional feature. He stated that *'it is man's ego to believe that we have somehow changed things indefinitely*' and that '*what we are looking at right now is only a very narrow snapshot in time and we have to be aware of that'* (GC02). So *'for a a period of time, this big cement feature has been placed in it, this big dam and we now have to learn to make that ecosystem whatever we want it to be'* (GC02). He further explained that AM is a *'value in trying to answer the questions we are dealing with'*, but the reality is that *'because of the very fact*

that we have put the dam in place, it's going to take a long time before we will really know and understand what the final outcome is going to be' (GC02).

6.8.2 Legal Framework

'What's happened is the environmental community keeps going to court and the courts are not equipped to deal with managing conflicts or projects, so they appointed a Secretary of Interior as a special master' (KR04). One of the Glen Canyon respondents explained that '*it has to do with culture and where we are in the US with regard to litigation and legislation: that if you can't fix a problem, someone else will fix it for you'* (GC01).

According to another respondent, however, the executive and political branches are not equipped to deal with the challenges and conflicts that come up as they change every four to eight years. However, he stressed that '*maybe in our legislative branche we can create a fix in the process and have a legislative commitment that can stand the test of time, that is where I see a potential way of addressing these issues*' (KR04). One respondent stated that *'maybe our rules and regulations and perhaps even our laws need to be adjusted to accommodate a different [more adaptive] approach'* (KR08). With regard to the current legislative framework, a Kissimmee respondent described that it is not possible to follow a genuine AM approach when you *'have rules and regulations that inhibit you from doing things differently, doing things innovatively or attacking a problem from a different perspective or even engaging stakeholders in a certain way'* (KR01).

One of the ways to reach consensus amongst the stakeholders in the GCDAMP has been a voting mechanism. Some respondents acknowledged a problem with this kind of method to reach consensus. One respondent stated for example that:

> *'In this country there are people on the 49% side who quite likely have the ways and means and motive to take up in court. So you may complete the most perfect plan, you may get it funded… but they will be able to find*

> *some court that's sympathetic to their issues and file an injunction to stop you…' (KR01)*

Another respondent described the problem where stakeholders have *'different interpretations of the law'* (GC02) which is the main reason why certain stakeholders start lawsuits. One of the respondents also explained that it is very important to have a legal basis for AM in the projects and that this has been established for the KRRP. He stressed that it is '*important in the project planning to really lay out AM'* (KR09). He described that when this is not the case and AM is not mandated by law, that situations can occur where interests wanes. In other words, it is crucial to establish AM principles and procedures in the regulatory framework as *'that prevents it from being an ad hoc kind of thing*' (KR09).

With regards to the GCDAMP, the Glen Canyon Protection Act that was passed by Congress in 1992 specifies the roles and responsibilities. However, a respondent explained that:

> 'It's a very complex law that suggests that we operate the Gen Canyon dam to preserve and protect the values of the Glen Canyon National park and the Glen Canyon National Recreation Area and do all that in accordance with current protocol law, historic law, the way water was divided, as states deal with each other on the Colorado River' (GC01)

Some of the other GCDAMP respondents highlighted that the US Congress has also passed a law that establishes committees (such as the AMWG and the TWG) to advise government agencies and that this law sets out the rules by which these committees operate. One of the respondents stressed though that *'these are presidential committees: the only way they can be established is by the President, so they are political from the start'* (GC06). Another respondent stressed that that is one of the flaws of the Glen Canyon Program structure and the way it was established, because '*the people did not really sign up for it, it was not a voluntary program that they all said let's come together and figure out this problem'* (GC09). He also stated that these members were never clearly explained they '*have to support the concepts of collaboration and AM: so there was not any requirement of commitment to be part of the process'* (GC09).

6.8.3 Roles, Responsibilities and Accountability

With regard to the GCDAMP and its workgroups, a respondent (GC04) described how the division of roles and responsibilities between the AM workgroup (AMWG) and the Technical workgroup (TWG) are not clear. The communication and conversations that take place between these two different work groupsare also '*often filled with discord… as they have different views with regard to how to proceed'* (GC11). This respondent also explained that it is therefore very difficult to reach consensus and agreement between those work groups in formulating recommendations for the Secretary of Interior. Another Glen Canyon respondent also stated that '*there is a recognized need to better define the roles and responsibilities of program members'* particularly '*between sub groups and between the scientists and managers'* (GC08).

A number of respondent explained that the AMWG does not meet enough to be able to develop common goals and objectives and that the TWG takes over that role at times. As a result of this the TWG sometimes *'gets more involved in policy discussions then it needs to or should'* (GC10). Part of this problem could also be caused by the fact that some of the AMWG members are also members of the TWG, which *'can be an issue because you are really playing two different roles'* (GC10). The same respondent also stated that at times the TWG takes over the role of a science body and that '*finding a balance [between these three groups] is difficult'*.

In the Kissimmee case study, one respondent described that one of the problems they had was that '*agencies were not respecting each other's territory which should be clearly by mandate and responsibility'* (KR07). He further explained that resource providers and all other different agencies involved should have mandates that are clearly described up front. Another respondent, however, explained that '*there is a Project Co-operative Agreement called the PCA, between the District and the Corps of Engineers'* (KR06). This Agreement describes the roles and responsibilities of both the District and the Corps. He explained that it is just a matter of *'re-educating, because upper management*

changes a lot, more often than the scientists and the lower management, so it's making sure when you do have changes in the upper management that they understand the process, what's involved, what our portion of the agreement is and making sure that they are behind us' (KR06)

One Kissimmee respondent described the existing roles and responsibilities and '*how those affect the flexibility and openness of stakeholders positions in the stakeholder process as those people are held accountable by their organizations for specific things'* and they might not *'agree to waiver from those goals and compromise'* (KR01). Another respondent addressed a discrepancy in risk perception and accountability between scientists and managers. He described that *'scientists can't evaluate and determine what level of risk is acceptable to the managers'* (GC12) and that scientists are in general more comfortable with an uncertain environment than managers. He further explained that this is the case because *'scientists are of the hook because if the outcome of an experiment is negative, they may have learned a lot, but it is the manager who is held accountable for the outcome on the resource'* (GC12) .

6.8.4 Power, control and representation

One of the Kissimmee respondents (KR07) provided quite an extensive explanation of the kind of power plays that have been going on within the project. He described that big barriers to the project implementation were personal or agency agendas that are independent of the project agenda. *'When you get those personal or agency agenda's in a room you can easily tell the difference between the project agenda and the personal or agency agenda, because things just stop and run to a halt* (KR07). He explained that it often is to do with '*power, influence and about who is more important'* however, he is of the opinion that '*it shouldn't matter what position you have as an organization when you pull together as a project team to address an issue and you have in mind a single goal or vision'* (KR07). However, according to another respondent, '*the politics have always been complicated and that's true for any ecosystem restoration effort'* (KR02).

One respondent (GC08) described that e.g. an organization like the Western Power Administration receives a large amount of funding from their agency. A number of respondents explained that this availability of financial resources allows such an agency to have a larger number of people participating in the AMWG, TWG and other ad hoc committees: '*those committees take up a lot of time and they take power and human resources*' (GC08). What the respondent stressed is that for stakeholder groups with less (political) power and resources it will be much harder to contribute in the committees and represent their particular interests.

Another respondent is of the view that challenges are caused because some parties without much involvement in the program still have the same voting power as other stakeholders:

> *'This program has nothing to do with water allocation or delivery and that is what the basin states are principally concerned about. So they tend to not be very active members of the committee. So when they vote, if they are convinced by the hydro power people for instance what they need to vote, they scratch each others' backs and they make a block. They can have a very strong sway on any outcome and they can also influence other members on the committee because they have more time to put into lobbying other members' (GC08)*

An enabling factor for the restoration project has been that the '*grass roots restoration movement gained more political strength over the years'* as without that movement '*restoration would never have occurred and would not have been initiated within the Government'* (KR05). One of the Glen Canyon respondents highlights that the AM Program has e.g. provided '*a really strong basis for tribes to be in the forefront'* and it also '*allowed for all the stakeholders (whether we agree or disagree) to continue this dialogue and have involvement on issues'* (GC07).

6.8.5 Resources and skills

With regard to availability of funding, one respondent stated that '*funding associated with the monitoring process is a huge issue'* (KR02) and he

continued stating that the reason for this is because of the fact that *'politicians want to see a response while they are in office, so anything that takes longer than three to four years means that they won't get the credit for it'.* Another respondent described that '*it has been a struggle for funding for science and research activities'* (KR07). '*The majority of the funding that comes from the district are tax dollars'* (KR06) and due to a change of Governor, the entire budget is going to be reduced by 20% in the course of 2008. In other words, available funding is very much depending on the political setting. One respondent shared that in his experience '*it is very hard to negotiate time or get resources because politics changes, priorities change and over a long term project how do you keep the continuity going when key people leave, take other jobs, so how do you keep all of this moving in the right direction?*' (KR01).

With regards to the Glen Canyone case study, a respondent highlighted that '*there is a huge science base for the operation of the Glen Canyon'* (GC01). One respondent claimed, however, that '*research is very adequately designed and carried out but there is not enough time to take advantage of it as we are not meeting enough to discuss*' (GC13). The funds are coming from power revenues and *'as long as we are producing power we have got this money to do research*' (GC13). The dilemma here is, however, that '*if decisions are made to reduce power to a certain level*', that they can then turn around and say *'that they can't do anymore research*' (GC13). Most of the Glen Canyon respondents described the issue of the funding for their program coming only from one source. As an example, one respondent described that '*the funding mechanism creates obstacles as it's funded only by the power customer*' (GC01). Another respondent explained that power *'pays for everything, all of the experiments… plus they have to pay for replacement of the power'* (GC02). According to some of the respondents it would be better to have more payers at the table to make sure that the playing field gets leveller.

A number of respondents highlighted an imbalance of resources between different stakeholder groups. For example, some organizations have '*a tremendous amount of internal funding from their agency'* and they can devote

that *'to supporting two, three, sometimes four members to go to all the meetings and serve on the work groups'* (GC08). This imbalance is not only with regard to funding and financial resources, but also with regards to availability of skilled people. As an example, one respondent stated that:

> *'State agencies have biologists and hydrologists that they can bring to the table whereas another group have very limited resources. So you get one person that is [at the meetings] on a voluntary basis and it's hard for them to feel as much a part of the process as others…' (GC09)*

Another respondent (GC11) described that for the last four years he has worked at least one or two days a week of my time for free on this program. He explained that his travels and lodging are covered, but not the times spend on meetings, conference calls, debriefings, etc. He complained that '*some stakeholders are making lots and lots of money out of the process and that it's pretty unequal in that way*' (GC11).

6.8.6 Time Horizons

One of the respondents described that with regards to AM, *'you've got to be in it for the long haul*' (KR11). He called AM '*the path of the last resort'* and explained that often '*we know better but we keep making the same mistakes over and over again because we refuse to learn'* (KR11). When the Kissimmee restoration (and measuring of response) was initially introduced to the Corps of Engineers, for example, the reaction was *'we build projects that succeed, there's no reason to measure or monitor*' (KR02). Another respondent stressed that baseline monitoring '… *is critical in order to monitor the performance of the project'* (KR10). He further explained that a lesson that is learned is that '*we need to start monitoring early to address potential impacts of our project on e.g. the hydrology or drainage*'. As an example, he described that landowners have accused the project of causing flooding. '*If we had more baseline data, we would have been able to demonstrate to landowners whether or not we are actually causing an impasse*' (KR10).

One respondent explained how '*funding associated with the monitoring process is a huge issue as government agencies are not very interested in putting money into evaluation of response'* (KR02). One respondent stated that *'the time it takes to learn things is sometimes decades and the decision makers are looking for answers in a much shorter time frame*' (GC09). The political process is a real barrier: *'they are willing to try to do things short term, they really don't have long term solutions for this'* (GC02).

In other words, there is a discrepancy between time horizons between policy makers, decision makers and scientists. *'Scientists would love to have a robust program that they can accumulate data for a number of years'* (KR09) but on the other hand there are '*management and policy levels who have a disdain for that believing that when they pay to do a study for three years, that ought to be enough data*' (KR01). One respondent provided following statement:

> *'Scientists and managers are on very different horizons and the challenge here is that the science community be involved but they may not be able to involve themselves consistently for a long time needed for the managers to resolve some of the legal or political things. And then you lose continuity. And by the time managers are ready to resolve to move forward, the scientific community may have disbanded or moved on too…' (GC12)*

One GCDAMP respondent stated that '*evaluation needs to be in the context of what your goals are and these goals may in fact change again as a result of what you learn*' (GC09). Another respondent explained that *'when the scientists started evaluating what was going on in the Canyon that was on a very short term basis*' and '*we recognize now that it has to be on a longer term basis'* (GC07). However, one respondent explained that it's perceived there is *'no incentive when you're done with the process to go back and look whether the result will impact on your resources'* (GC10).

– Internal Context Factors –

- There are usually different agencies involved and in control of restoration projects of extensive scope and scale. However, even in smaller scale restoration projects, with less diversity in stakeholders and issues, implementation of AM takes considerable amount of time. Different agencies and stakeholders involved in these change processes often have different management practices at odds with each other.
- A lack of continuity in management is often caused by incremental changes in the political system. To implement AM effectively, however, a continuous generation of commitment is crucial: a more adaptive form of governance is required. Foremost, AM is depending on the people involved and the dynamic interaction between those people.
- A challenge is the complexity and time frame of existing networks charged with management and implementation of AM. There is a gap or misfit between how the ecosystem works (the time-scale it operates on) and the complexities and realities of how scientists and managers operate. They all go through different time cycles. 'It is man's ego to believe that we can control nature and what we are looking at right now is only a very narrow snapshot in time'. Perhaps our perception of time is required to change.
- Culture is linked to existing legal and institutional frameworks. The executive and political branches are not equipped to deal with upcoming conflicts as these institutions change every four to eight years. The legislative branche is more able to stand the test of time and that is where those issues and conflicts need to be addressed. Law, rules and regulations need to be adjusted to accommodate a more adaptive approach. Often existing rules and regulations are inhibiting to 'doing things differently'. It is crucial to establish AM principles and procedures in the regulatory framework as it prevents the AM intervention from being an ad hoc kind of thing.
- Using voting mechanisms is not considered an ideal method to reach agreement or decisions as only 51% of all stakeholders need to reach agreement, leaving a a large group unsatisfied.

- It is important for the implementation of AM, to have well defined roles and responsibilities for all parties involved, otherwise roles and responsibilities might be unclear or overlapping leaving space for conflict and confusion. Eventually, the different stakeholder parties also have to respect each others territory once defined clearly. It is the role of management to remind or, if necessary, re-educate stakeholders about their particular roles and responsibilities.
- When it comes to the stakeholder process, however, existing institutional mandates, roles and responsibilities can affect the flexibility and openness of stakeholder positions, as those people are held accountable by their individual organizations for specific things. So they are stuck between the roles they are demanded to play for an effective AM process and the requirements placed upon them by the institution or organization they are representing. In other words, they have personal or agency agendas independent of the project agenda. It should also be noted that there is often discrepancy with regard to risk perception and accountability between scientists and managers (two different worlds).
- In the AM processes it still often has to do with: who has the most power, influence and importance? Stakeholder parties with less resources and power (imbalance) it can be much harder to contribute to the process equally. Ideally, it should not matter what position you have as an organization when you pull together as a project team to address an issue; you should have in mind a single goal or vision.
- To get funding for monitoring and evaluation is also often difficult as politicians want to see results while in office, which usually is not longer than four years. In other words, funding is very much depending on the political setting that changes (as well as its priorities). There is often a lack of continuity because of this. An issue can also be if funding comes from one of the stakeholder parties, e.g. power revenues from dam, which then creates obstacles.
- With regards to AM: ‘you’ve got to be in it for the long haul’. Monitoring has to start early in order to develop baseline data and in oreder to learn. It should be noted that scientists and managers have very different time horizons, which often raises conflict.

6.9 AM – Process Factors

6.9.1 Competing Interests and Agendas

A number of respondents have explained that the stakeholder processes aimed for consensus buiding. However, '*consensus implies that all the stakeholders have a detail and you have to optimize everybody's perspective'* (KR04). This respondent also explained that '*there are so many conflicting demands on any big watershed system'* and to imply that you can *'get all stakeholders in one room and satisfy them all is unrealistic'.* He also stressed that to state that your aim is '*restoration of environmental values of the system'* is very dangerous as this '*means different things to different people'* (KR04). In the case of the KRRP, the project was based on a concept of ecological integrity, which meant that '*we're not going to maximize benefits for individual components of this system, but rather restore the system such that all of these components will once again be sustainable'* (KR05).

The difficulty with the Kissimmee restoration project was according to one of the respondents (KR05) the contradiction that was created by initially canalizing the river while subjecting the headwater lakes to flood control regulation schedules and operation rules. When restoration was initiated at a later stage, a dillema was created that '*if you would maintain flood protection in the upper basin water shed, you could not achieve restoration'* and the biggest challenge was that '*you still needed to maintain flood protection on private lands',* therefore having to *'find a balance between flood protection as well as ecological restoration'* (KR05). A similar kind of dilemma has also been described for the GCDAMP case study with its dam.

In the case of the GCDAM, one respondent stated that the way the program was structured and the workgroups set up it was obvious that there would be conflict in interests, as '*these people were selected to represent a significant array of different positions by their very nature'* (GC04). The AMWG and TWG comprise of 26 members who all represent different stakeholder groups. *'The*

diverse nature of these stakeholders makes getting a decision out of this body very difficult' and '*not an easy short process'* (GC01). Another stakeholder stressed the importance of '*clearly identifying and clarifying the goals that [the program] attempts to achieve*' (GC06) as it became clear throughout the planning process that stakeholders had different goals or interpretations of the goals that were set out.

The above issues are clearly described in the following statement:

> *'With the fairly divergent groups and stakeholders that have often very specific concerns for one or more resources, there's almost no way to reach consensus. They're going in opposite ways and this brings decision-making based on politics rather than science. Different stakeholder come in with fairly well defined turf what they want to protect and you can reach consensus on some things but if it goes too far into their area of interest, that's where politics starts coming in' (GC10)*

Although the challenge of a large amount of stakeholders involved was much less great for the KRRP, also in this project hindrances were encountered with regards to conflicting interests and agendas. One of the Kissimmee respondents claimed that '*the reason we are forced to do what's called passive AM, is because you can't just take an ecosystem and experiment with it*' (KR09). He explained that the main reason for this is that are people living in those areas.

6.9.2 Stakeholder Involvement and Interaction

Despite above described barriers with regards to stakeholders and their competing interests, one Glen Canyon respondent stated that: *'you might achieve a lot more in the short term without the variety of stakeholders involved, but in the long term an AM program wouldn't be sustainable'* (GC10). He explained that there '*won't be buy-in unless all the people who think they have a role in it have been involved'*. Also by bringing in more perspectives, one respondent stated, '*you have a better chance of making the right decisions'* (GC01). According to another respondent, '*the polarized perspectives are not a surprise*', however, there is a lack of concepts such as '*mediation or binding*

arbitration: that can bring the spirit of viewpoints into some commonality' (GC12). He further explained that *'AM in itself is intended to promote learning and benefit the resources but it doesn't have built into it a mechanism for binding arbitration and mediation (which are more things that come out of a legal arena)*'.

The AMWG, which is the policy group, does have a facilitator for the meetings 'who helps to manage the meeting, focuses the discussions and tries to get consensus' (GC04). However, there is no facilitator available to the discussions in the TWG and between the two groups*. 'A lot of their meetings are sometimes not as productive as a result'* (GC09). A number of respondents also highlighted that with regards to the GCDAMP not enough meetings are organized to meet and discuss matters. One respondent stated that '*we only meet two or three times a year and you cannot respond to changing environmental needs and public needs meeting that rarely'* GC13). A number of respondents highlighted the fact that there is a large amount of information to be digested prior to these meetings and that some stakeholder groups have significantly less time, resources and skills to go through and understand this information.

On a positive note, one respondent described that *'generally people tend to stay for quite a while'* (GC08). According to this respondent, continuity helps to form the collective mindset of the group, to understand each other's concerns and to build relationships and trust. With regard to the KRRP, one respondent stated, that '*the idea is to get different stakeholders to work together and find commonalities and build on those rather than focusing on the differences'* (KR01). However, the stakeholder process in the KRRP was organized differently than that for the GCDAMP. Instead of placing all stakeholders together on one table, the project leaders *'went out and negotiated with each of the interests independently and then figured out what the composite solution was'* (KR11). This approach was described in more detail in the following statement:

> *'you practice appreciative enquiry which says I respect and value your points of view… I reserve the right to bring all of these points of views in*

> *and to make [a decision] what I think is in the best interest of society… and I am going to do this and I will have transparency, let this be an open process. I am going to be honest, you're going to see the data but understand the final outcome might not optimize your objective or your point of view…' (KR04).*

In other words, it is very important to build *'an open forum, a free exchange of information, creating an environment that is conducive to develop and reach common goals and understanding'* (KR08). It should be noted that the amount of stakeholders involved was significantly less than for the GCDAMP.

The KRRP program did not make use of a voting mechanism (as used for the GCDAMP) as *'you don't want to implement and take action based on votes*' (KR01). This respondent further described that '*if you have a narrow majority, you are immediately deepening the divide between the minority and majority*'. '*The political process in this country allows for [taking votes], but that's a legislative process, not a adaptive planning process'* (KR01). One respondent explained that AM really is not about planning but about design. He described that '*when you're not sure you can frame the problem correctly, you're really in a design mode and what you do is you go through different frames and reframing of the problem'* (KR11).

6.9.3 Communication and Collaboration

To start this sub-section on communication and collaboration, the following statement is provided by one of the respondents who highlighted the importance of communication and collaboration:

> *'The success of any AM effort is going to be whether it is embraced by multiple agencies, multiple groups and how well does a team work together. I hesitate to say that that is not unique to AM, I think that's true on any endeavour: how well a team functions, do you have the right process and communication in place… The dynamics of how well a team works together is going to dictate how successful a team is going to be whatever the task' (KR09)*

One of the Glen Canyon respondents stated that '*there is a lack of collaboration amongs all stakeholders including the science group'* (GC09). He further

explained that part of that '*relates to a lack of trust and to different people having different agendas'*. These people don't perceive it to be in their interest to collaborate and there is '*no incentives to collaborate, there is no agreement on a common mission, there is no agreement on what the desired future conditions for resources should be'* (GC09).

Another respondent (KR01) explained that in order to build collaboration and communication between stakeholder groups, you have to understand how the dynamics work. He provided a drawing visualizing different stakeholder groups on an axis (present to future state). He described for example, that '*a lot of the times the scientific community may be out in the front pioneering their way from a present state to a future state'* (KR01). However, he also explained that there are groups that are lagging behind, this can be e.g. the public. This approach visualizes the distance between the different groups on the time axis toward a future state: *'if the people who are in front learning and experimenting and doing things to fast, the other groups behind feel that the front group is not engaging them'* (KR01). In other words, if the gap between the groups becomes to big, people may feel that plans are developed without their knowledge or consent. Another respondent added that '*if you don't try to integrate science and the stakeholder process then you are going to have an inherent conflict'* (KR09).

One of the Glen Canyon respondents addressed this above described dynamic also. He stated that the scientists are in the front of the line and they have to avoid '*getting so far out in front of the managers that these don't have a clue anymore of what's going on because they've been left behind'* (GC12). You constantly have to stop and make sure to inform the managers and other stakeholders and give them time to learn and understand the information and knowledge coming from experiments. This regular contact between scientists and stakeholders is also important in order to understand from a policy perspective *'what you can do politically, realistically and whether or not you might have to modify some of the desired conditions*' (GC10). One of the respondents explained that:

> '… *the scientists can't evaluate and determine what level of risk is acceptable to the managers, they have to be told by the managers and they have to simply try to define how much is unknown and what the risks are in doing it*' GC12).

Another respondent stated that '*maintaining a healthy distance between the technical and political elements of the program without sacrificing communication is a real challenge'* (GC08). And in the case of the GCDAMP, this distance has been negated in part by the fact that some stakeholder groups have the same members serving on both the AMWG as well as the TWG.

6.9.4 Leadership and Vision

Some of the respondents from the Glen Canyon case study stated that there is a vision statement developed for the program. However, one respondent explained that:

> *'… The vision statement developed by the AM workgroup is quite impressive, it took us eight days to write five sentences, every word was battled over. It's always difficult, but in this case to get everybody to agree to it was extraordinary. The problem with it is though that this was an AMWG process that the TWG never really bought into… Many of the TWG members are middle level managers that are calling the shots on what actually goes on, so I don't feel confident that the TWG actually follow through and commit to this program…' (GC10)*

Another respondent stated that the GCDAMP *'does not have a clear vision of where it wants to go'* (GC11). This respondent explained further that not having a clear or accepted vision is '*a symptom of a deep division [between the stakeholder groups]'.* At times, he explained, the program not working could actually provide benefits to some of the stakeholder groups, as *'the slower it goes and the less efficient it is, the more water and power interests benefit'* (GC11). Another GCDAMP respondent expressed that in truth it is impossible to *'line up 26 needles and string a thread through all of them at once*' (GC04). He described that you have to get '*strong leadership at the top and create a vision: offering transparency and inviting people in to the process to trust'* (GC04).

A number of respondents highlighted that leadership on all levels is a very important element to implementing AM. One respondent (KR09) described how there is always a lot of human dynamics going on and another respondent highlighted that there is therefore a strong need for *'longterm continuity and leadership'* (KR05) in order to build trust and understanding. You need a leader who *'is more like a facilitator, strong in vision and enthusiasm and intuitive and sensitive to how agencies are responding'* (KR07).

In the case of the GCDAMP case study, the AMWG and the TWG are advisory, not decision-making bodies. One respondent (GC04) stated that the decision maker and key leader for this program should be the Secretary of Interior. According to this respondent, however, the Secretary of Interior has been more concerned to come to consensus instead of making decisions based on recommendations from the AMWG and the TWG. Depending on the political context, another respondent explained, 'some secretaries are more bold than others' (GC08). He further stated that '*in the previous administration we had a much more proactive Secretary who was in the process with us to do it'*. The biggest problem, according to another respondent, has been the fact that 'we do not have well defined desired future conditions and goals: and this kind of drives everything' (GC10).

With regard to the KRRP, a respondent described how the project leader 'did a really good job of keeping the planned development out of the political arena, so that when he was ready to this is hpw it needs to be done, he had strong documentation and science behind it'. In other words, he tried to keep the politics out of it until he felt that it was time for politics to come in. The difference between the GCDAMP and KRRP cases and their leadership challenges is very likely caused by the differences in set-up of the program structures and stakeholder processes.

6.9.5 Data and Information

One of the respondents from the GCDAMP case study expressed that '*research is very adequately designed and carried out, but there is not enough time to*

take advantage of it' (GC13). According to another respondent, the different organizations involved with conducting research for the GCDAMP are all doing a great job at *'non bias scientific production of data and information'* (GC08). However, another respondent stated that these organizations have not been able at all to provide 'coherent information on the overall ecosystem' (GC11). A number of respondents stated that more interaction is required between scientists and stakeholder groups as:

> '*most of the stakeholder representatives are policy makers who are very good at making policy, what they're not so good at is understanding the information that is coming out of the science process to integrate that into a plan*' (GC08).

This same respondent also declared that '*there is so much scientific information and to stay abreast of that requires a significant amount of dedication, effort and time'* (GC08). And as discussed before, some stakeholder groups have more time than other to do this. The question one respondent asked is *'how do you effectively educate people about what scientific findings are showing and to have them embrace that information?*' GC09). He also explained that he thinks that they have developed no effective way of doing that. '*It's clear that just having scientists stand before decision makers and describe the results of their studies is usually not good enough'* (GC09). Neither is producing a *'300 page report on different alternatives for the operation of the dam'* (GC09).

Another big challenge with regard to information is that in general in the US, *'there is simply no pre-dam information or other baseline information and this is the case for many of our rivers and springs'* (GC11). And without that information to provide a clear goal for the management of resources *'we can't really get a clear picture of what we are managing for'* (GC11). With regard to the KRRP, this lack of baseline data was tackled by building a large model containing the actual systems of the Kissimmee River. *'This model was build to understand the restoration and how it would function'* (KR03). Initially, *'research institutions and scientists were seen as of doing their own thing'*, but our managers have worked very hard to define this role of scientists within the

agencies – '*science being applied science for the purpose of informing management'* (KR07).

Both the GCDAMP and the KRRP have their science coming predominantly from one agency or organization. One respondent stated that *'it's ok to have research done mainly by one agency, as long as that organization is trusted and viewed as a reliable source by stakeholder groups'* (KR08). This organization should not *'get into biasing the objectivity of their data and information as they might lose confidence of the stakeholders'* (KR08). Although some respondents are positive about the science branche of the GCDAM program, some respondents also expressed their lack of confidence in the ability of the involved research organization to integrate different aspects of the information about the ecosystem. One respondent, for example, described how this organization in his view has sometimes provided '*incorrect information that totally took the stakeholder groups off in a wrong direction'* (GC11). One of the KRRP respondents also provided and example where biased data was given. Scientists should provide objective data '*whether they like the result or not'* KR08). From a scientific perspective, *'it's just a matter of providing the needed data in order to be able to give information*', in other words: *'if you do this, that is what you can expect as a result'* (KR08).

– Process Factors –

- Consensus implies that all stakeholders have a part and that everyone's perspectives are optimized. The question is, however, whether it is realistic to imply that you can get all stakeholders (with so many conflicting demands) in one place and satisfies them all? Maximizing benefits for individual components is not possible, the aim is to restore the system and subsequently all different components will benefit from that. It is also noted that aiming for somethings abstract as 'restoration of environmental values of the system' can be dangerous as this can mean different things to different people. So the vision needs to be clear and comprehensive.

- However, usually restoration goes hand in hand with an already existing physical structure that cannot be taken down and therefore requiring (by law) a balance between e.g. flood protection and ecological restoration.
- With regard to AM, it is important to include relevant stakeholders as their buy-in is needed and bringing in more perspectives also increases the chance of making more informed decisions. AM in itself is intended to promote learning and benefit resources, but it does not have built into it a mechanism for binding arbitration and mediation. Having leaders in the form of facilitators that guide the process is crucial. Frequent (formal and informal) interaction between the different stakeholders is necessary in order to respond to changing environmental and public needs. Continuity helps to form the collective mindset of the group, understanding each others' concerns and building relationships and trust.
- Another approach that has been followed by one of the case studies (instead of bringing stakeholders together) is one of 'appreciative inquiry' where you go out and meet the different stakeholder parties to find out their needs and interests. While respecting and valuing each point of view, the right is being reserved to eventually make a decision about a 'composite solution'. It is important to keep this process very open and transparent explaining every step of the way what is happening: building an open forum with a free exchange of information, conducive to develop and reach common goals. It might be difficult to follow this approach when there is a large amount of stakeholder parties.
- One respondent noted that AM is not about planning, but about designing: 'when you are not sure you can frame a problem correctly you are really in a design mode going through different frames and reframing of the problem'.
- The success of an AM effort depends on whether it is embraced by the multitude of agencies and groups involved and how well the team work is among them; having the right collaboration and communication process in place. A lack of trust and competing interests can, however, jeapordize this process. In order to build collaboration and communication, you have to understand *how the dynamics work* and create a common vision and incentives for collaboration.

- Developing a clear and common vision that everyone agrees to is crucial and is the pointer that keeps 'all eyes facing the same direction'. Not having a clear and common vision is a symptom of a deep division between the stakeholder groups and also indicates that the leadership is not successful in bringing the parties together. There is a need for strong leadership (on all levels) in order to build trust and relationships. It is quite important to keep the planned development as much as possible out of the political arena until you have sufficient documentation and scientific data to support it.
- However, it should be noted that for some parties it could provide benefits (usually related to power and control) for the process not to work as this will stop the change that they might not wish. In other words, they resist the intended change and will not cooperate no matter what.
- With regard to data and information, it should be noted that it is important to provide coherent information on the overall ecosystem that is disseminated in a way that is understandable for parties involved. How to effectively educate people about what scientific findings are indicating and to have them embrace that information? Just preparing reports and giving presentations is generally not effective.
- Baseline information of the project context is important as this provides a clear picture of what 'we are managing for'. If this information is not available beforehand, tools such as largescale models can help develop baseline data.
- It is ok to have science predominantly done by one organization as long as it is trusted and viewed a reliable objective source.

6.10 AM – Individual Attributes

6.10.21 Attitudes to Change

Most of the respondents addressed resistance to change as an important barrier to the implementation of AM principles and described that the level of resistance depends on and is affected by different factors and circumstances. A number of respondents referred to power and egos of the people involved having a great impact on the overall stakeholder process and attitudes to

change of the people involved. One respondent described that the process is '*mostly personality driven, big egos and people with a very expansive appreciation of themselves*' and that these '*big egos don't really move for consensus*es' (GC11). Another respondent stated that '*you can definitely see the influence of characters, personalities and interaction in the personal skills of the people involved*' (KR08). AM '*depends on having all the various users at the table… but I don't want to tell you that everybody is happy with it, I doubt that they are…*' (GC08). According to one respondent it is often necessary to bring external facilitation into the process in order to '*get the egos out of the room and get the project back into the room*' (KR07). Most respondents agree that it is crucial that the members of a team place value in all of the different resources and perspectives. Otherwise, '*discussions become labored and long and it becomes very hard to make decisions, to find consensus; the process becomes very frustrating*' (GC04). One respondent described the spirit of AM as follows:

> *'it's really a whole mindset about how flexible and open minded you are on the project versus how set you are in your way of thinking… It allows you to be flexible and to change throughout the project based on a number of factors' (KR10)*

Most of the mediating factors that are described in the sub-sections above have an impact on the level of openness or resistance to change. For example, one of the respondents described the stakeholder process to that of the US Congress, where people '*become so entranced with their own political party that they don't compromise for the benefit of all other people, they just want their party to win'* (GC04). One respondent explained that '*if you want to influence the future you have to have ideas about the future and the only thing harder than implementing new ideas is by getting rid of the ones that don't work anymore, so whether that's a structure, an old idea or something else*' (KR11).

One of the respondents (KR01) provided a method for stakeholder interaction that can help to create more openness to change:

> *'…In a team you have to continually challenge people that every time an issue or question comes up, instead of what is a traditional response – we would never be allowed to do that, that's impossible or that will never get*

> *funded etc – they need to turn the question 90 degrees and ask a different question, such as what would it take to get this approved, what would we have to do… you can develop real holistic solutions that are going to be powerful and fitting for the answer' (KR01)*

Another respondent referred to '*just-in-time learning*' (KR11). He described that just-in-time learning is '*when you're in a situation and somebody asks you a question, it's usually based on the way they think the world works'* and their questioning '*how what you're saying fits into their view of the world'*. When you become aware of this, he explained, *'helps people to become more open to change, connectively*'. He explained this is important, but also getting training. He stated that *'right now there isn't enough training so a lot of people are just going by the seat of their pants'*.

6.10.2 Level of Trust

With regard to levels of trust between the different stakeholders and individuals involved in an AM process, one of the respondents stated the following:

> *'There is a certain level of trust and respect and professionalism that should be demonstrated across agencies, between scientists and managers, between managers and policy makers… If the entire team regardless of the structure or hierarchy understands the goal then collectively you are all working towards the same thing…' (KR07)*

He also described that '*differences of opinion can erode trust between the agencies in dialogue'* (KR07). One of the Glen Canyon respondents highlighted that very often scientists and managers are using different terminology that can create misunderstandings. Such misunderstanding *'can erode trust and slow down the progress, so careful attention to ensuring that the intended meaning is conveyed is a constant necessity*' (GC08). Another respondent explained that there is at times a lack of trust by some stakeholders that *'the science arm of the program is credible and objective'* (GC06). He further described that some stakeholders are of the view that *'as an organization, the science branche began to develop their own ideas'* and in that way would not be able to guide the AM process objectively. Another respondent explained that through time *'the science provider is more or less seen by other stakeholders as just another*

stakeholder with its' own interests, agenda and desired outcome' (GC12). The reason that the science branche is no longer seen as truly independent, according to this respondent, is because they interact with other stakeholders on such a collegial basis, so rather than trusting more, the outcome is that the level of trust has decreased.

A respondent highlighted that there is 'supposed to be an equal distribution of decision making where people's issues and concerns are adequately addressed' (GC07). He also stated that '*as far as AM right now with regard to the management of natural resources, it is scientifically driven, and I feel that the indigenous perspectives are not being considered enough'* (GC07). In his view, '*AM is really management of the Western scientific perspectives, not considering a holistic scale or basis of how to incorporate all other resources concerned'*.

One of the Kissimmee respondents (KR05) stressed how many times during the beginning of his involvement with the restoration project the public would express that *'we believe you but we did not want this channelization to begin with*'. He further described that the public would say that '*now we have lived with it for 20 or 30 odd years, you told us it was good back then, just leave us alone'*. He concluded that there is a basic mistrust of the government, which was a major barrier that had to be overcome.

6.10.3 Sense of Urgency and Awareness

In the case of the Kissimmee case study, one of the respondents explained that the environmental community has always been a strong driver for the restoration of the Kissimmee River. Currently, however, with regards to the restoration of the Kissimmee, *'the environmental community have moved on to other issues and there is no longer a strong push and sense of urgency'* (KR05). One GCDAMP respondent explained that what holds all the different stakeholders together is *'their concern about their individual resources'* (GC02). He also stated that '*it is difficult to get to where everybody agrees, there is a lot of give and take, but it has to go on and the stakeholders are aware of that*'.

Another respondent explained how his involvement in the GCDAMP program has helped him to '*become more aware of the different resources and the different types of disciplines in managing resources'* (GC07). What has also facilitated AM have been '*public meetings that facilitate more involvement, more awareness*' as well as tools such as '*the Internet, the fact that we have digital libraries, periodical literature is more availableto more people than ever before'* (GC12).

Like for IWRM, crisis events have driven the implementation of AM. For example, one respondent described that *'when water levels get high, the general public begins to speak up'* (KR10). Throughout the project:

> *'We realised that we needed to expand the scope and provide a more integrated basin wide solution for water management because there were other issues in addition to the river restoration project that needed to be addressed in a comprehensive and compatible way' (KR07)*

'*The public climate to be more environmentally sensitive was a large enabler for the AM process'* (KR02). This public climate had a huge effect on the standpoint of the Corps of Engineers and '*without that having effect we would not be doing ecosystem restoration in this country'* (KR02). Also the recognition of uncertainties is *'an enabler to AM as people recognize that they don't have all the answers'* (KR03).

– Individual Attributes –

- The level of resistance or openness to change is an important factor in the implementation of AM and depends on and is affected by different factors and circumstances. Characteris and personalities of those involved play a major role as well as personal skills. It is important to have strong leadership and facilitation of stakeholder processes in order to get 'egos out of the room and the project back into the room'. In other words, it is also about the mindset of those involved and how flexible and open minded they are in the process.

- Trust between stakeholder groups is very important and can be eroded by differences of opinion or misunderstanding. Trust can be build e.g. through an equal distribution of decision-making where people's issues and concerns are adequately addressed. In general, there is a basic mistrust of the government and political system.
- A strong sense of urgency and concern for individual resources are important drivers to the AM process. Awareness of what is required in a stakeholder process (by stakeholder parties as well as leaders) is an important enabler. Awareness about issues can be raised through e.g. public meetings and digital libraries, facilitating more involvement. Also crisis events change public opinion (because of increased awareness and understanding that we don't have all the answers) and are strong drivers to an AM process.

6.11 Comparing of IWRM and AM Results

In this section, the Tables 6.1 and 6.2 will be compared. These tables both provide a list of barriers and enabling factors that have been identified and highlighted by the case study respondents and indicate the number of interview respondents of each case study that have highlighted a factor as a barrier or enabling factor. The numbers provide insight into the emphasis and intensity with which respondents have experienced factors as either hindering or facilitating the implementation or IWRM or AM in the selected case studies.

Table 6.3 below compares these findings by indicating the percentages of the total number of respondents per case study that have highlighted a factor as either a barrier or an enabling factor. This table can help provide more insight into the influence of the mediating factors on the planning and implementation processes of IWRM or AM in the case study contexts. This section will compare findings on a case-by-case basis, comparing IWRM case studies an AM case studies separately in order to see if there are similarities between the case studies for one concept. However, findings between the IWRM and AM case studies will also be compared.

		IWRM (in %)				AM (in %)			
		Rhine		Murray Darling		GCDAMP		KRRP	
		Barriers	Enabling	Barriers	Enabling	Barriers	Enabling	Barriers	Enabling
1	**External Context Factors**								
1a	government and policies	40	0	38	0	0	0	0	0
1b	political processes	50	10	38	15	57	7	73	18
1c	economic situation	50	10	23	23	21	0	18	0
1d	climate change and crisis events	20	50	46	31	14	0	0	27
2	**Internal Context Factors**								
2a	existing structures	90	10	62	38	36	7	27	36
2b	legal framework	50	40	15	38	21	29	18	36
2c	roles, responsibilities and accountability	60	20	38	15	57	0	27	9
2d	power, control and representation	40	0	62	38	21	7	18	0
2e	resources and skills	30	0	46	38	57	43	73	9
2f	time horizons	40	0	31	8	57	14	64	45
3	**Process Factors**								
3a	competing interests and agendas	70	0	69	23	57	0	73	9
3b	stakeholder involvement and interaction	90	80	85	54	71	64	64	100
3c	communication and collaboration	30	60	38	31	71	57	45	55
3d	leadership and vision	40	40	62	62	57	0	27	82
3e	data and Information	20	40	46	38	43	43	45	73
4	**Individual Attributes**								
4a	attitude to change	90	50	77	46	86	7	73	55
4b	level of trust	50	10	31	8	43	14	55	18
4c	sense of urgency and awareness	0	90	38	38	0	29	27	55

Table 6.3 Comparing Results of four Selected Case Studies

While analyzing Table 6.3, circles have been placed around those percentages per key factor categories (external context; internal context; process; and individual attributes) that are either significantly the highest percentages compared to other factors (selecting two or three factors) in their category or – in the cases were there were no percentages above 50%, factors have been circled that are between 40 and 50%. Factors with scores under 40% have not been highlighted. These are further discussed below by comparing:

1. IWRM case study results;
2. AM case study results;
3. overall IWRM and AM results.

1. IWRM: comparing Rhine and Murray Darling

First of all, it should be noted that for both IWRM case studies, the percentages given to barriers are significantly higher overall than for the enabling factors. Since the respondents were asked to provide at least three barriers and three enabling factors during their interviews, this result is most likely not related to the data collection method. This result indicates that respondents have (in their perception) more negative experiences in their involvement in planning and implementation of IWRM than positive ones. Since it concerns perceptions and memory, it is not clear whether in fact there have been more barriers than enabling factors during the implementation of IWRM in the case study contexts or whether this is more a psychological factors were individuals tend to remember more vividly challenges and barriers that they have encountered than the positive and facilitating experiences. During the interviews in the Rhine and Murray Darling case studies, respondents overall did show signs of frustration about the difficulties encountered and the slow speed with which effective changes have taken place.

External Context Factors – The emphasis in the Rhine case study is more on the 'political process' and 'economic situation', whereas for the Murray Darling 'clinate change and crisis events' are considered important barriers. This can be explained as climate change and variability have a strong effect on the Murray

Darling basins water availaibility. For the Rhine but to an extent also for the Murray Darling case study, crisis events have been considered enabling factors as they have generated a change in awareness on both public as well as political levels.

Internal Context Factors – For the Rhine the two highest scoring barriers are 'existing structures' and 'roles, responsibilities and accountability'. Many of the Dutch respondents have referred to high complexity in the existing national institutional structures for water management as well as unclarity in roles and responsibilities due to these complex structures. In the case of the Murray Darling, emphasis is also on existing structures, but more in relation to power and control struggles in the light of increasing water scarcity and competition.

An important enabling factor in the Rhine has been the legal framework, more specifically the European Water Framework Directive, that is based on IWRM principles and supports the implementation of IWRM in the Rhine.

Process Factors – The two most emphasized barriers for the Rhine in this category have been 'competing interests' and 'stakeholder involvement and interaction'. However, the enabling factors in this category for the Rhine are also 'stakeholder involvement and interaction' as well as 'communication and collaboration'. This indicates that barriers in this area have been overcome by the way the planning and implementation process have been organized and facilitated through efficient communication and collaboration between different parties. This has been similarly the case for the Murray Darling, however, the emphasis there lies more in 'leadership and vision' than in 'communication and collaboration'.

Individual Attributes – Both case studies indicate that 'attitudes to change' are important mediating factors to the implementation of IWRM. In the case of the Rhine, 'levels of trust' between stakeholders involved are also indicated as barrier and a strong emphasis lies on 'sense of urgency and awareness' as being an enabling factor.

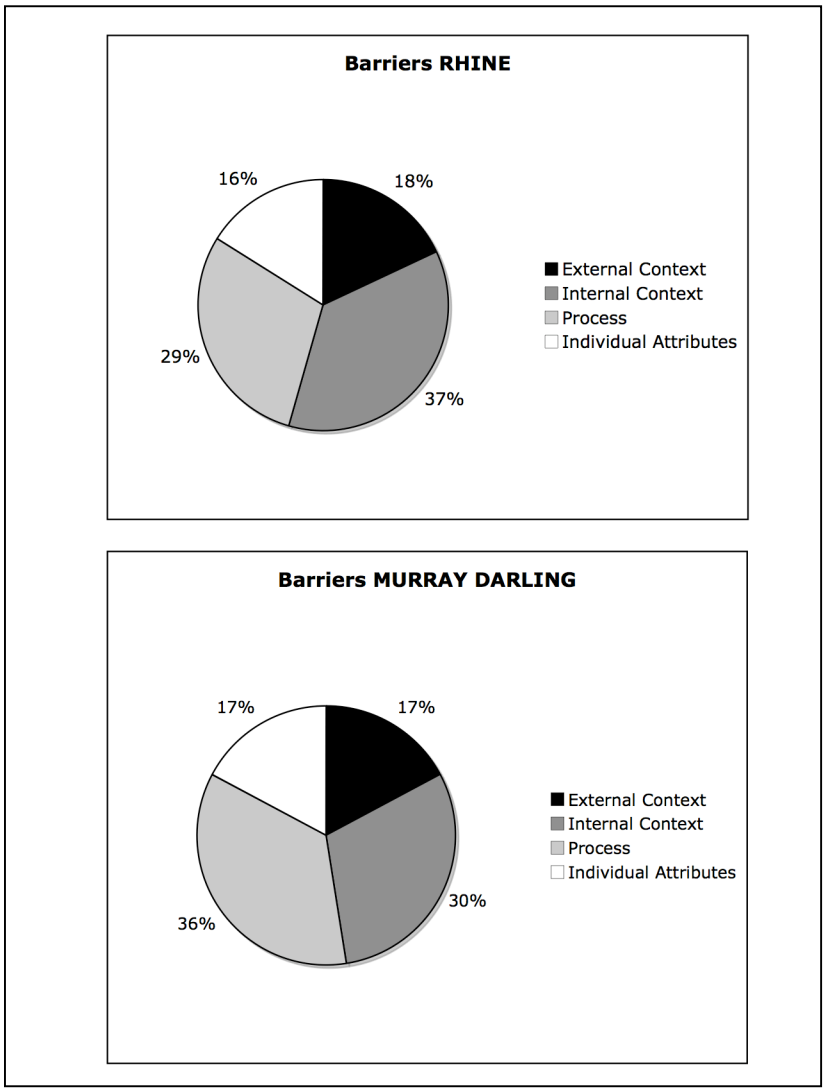

Figure 6.3 Comparing Barriers Rhine and Murray Darling

Figure 6.3 above provides an oversight of the intensity with which respondents have highlighted and identified barriers mentioned in the four key categories. When comparing the results for the Rhine and the Murray Darling, it can be concluded that the emphasis is very similar. The intensity of process factors is slightly higher than the internal context factors for the Murray Darling, which is the other way around for the Rhine. The overall emphasis lies with internal context and process factors.

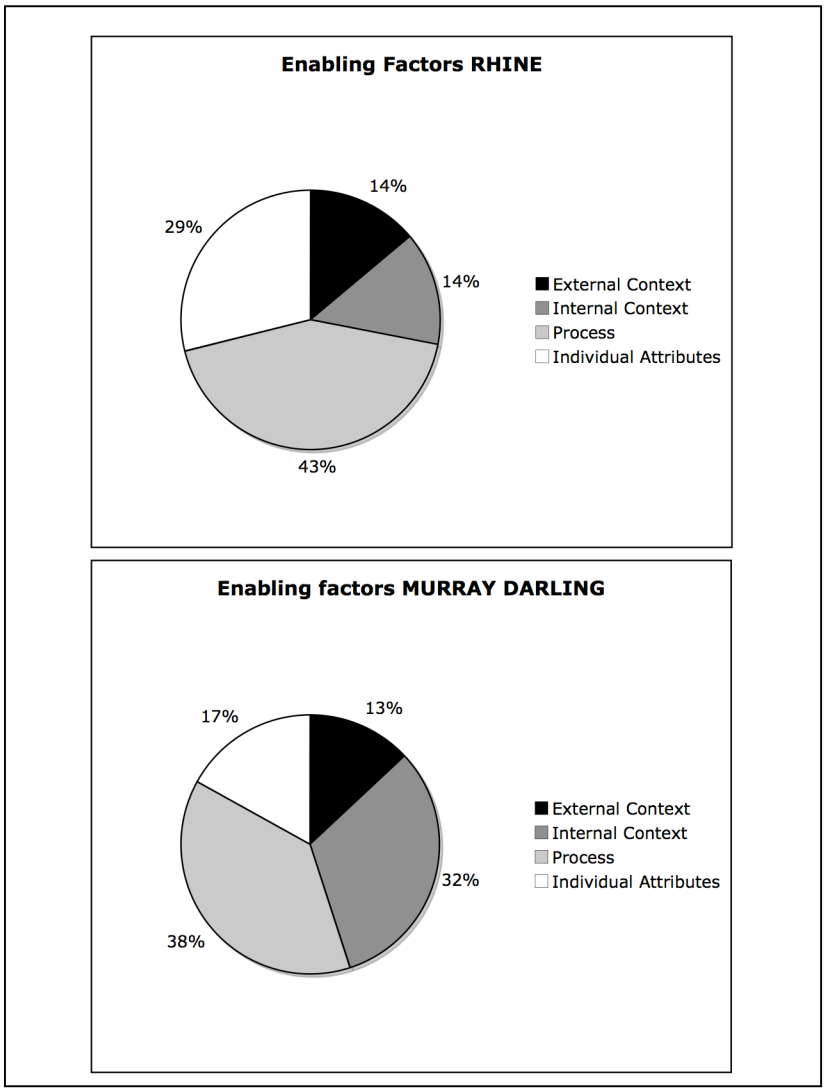

Figure 6.4 Comparing Enabling Factors Rhine and Murray Darling

Figure 6.4 provides an oversight of the intensity with which respondents have highlighted and identified enabling factors for the key categories. When comparing the results for the Rhine and the Murray Darling, it can be concluded that the emphasis is varying across the two case studies. The emphasis for the Rhine case study lies clearly in the process factors and individual attributes, whereas in the case of the Murray Darling this lies with the internal context factors and process factors. An explanation for this difference might be the fact that the Murray Darling flows through different states, but one country, whereas the Rhine flows through a number of different countries.

2. AM: comparing GCDAMP and KRRP

Similarly to the IWRM case studies, percentages given to barriers are significantly higher than for the enabling factors. Although in the case of the KRRP, with regard to the process factors, this is the other way around. This indicates that respondents were overall positive about the way the overall process of planning and implementation has been organized with the KRRP case study. When it comes to the other key categories, however, respondents were generally more negative than positive in describing their experiences. Also here, it is not clear whether there have in fact been more barriers than enabling factors during the implementation of AM in the case study contexts or whether it is more related to psychological factors, i.e. frustration and impatience. During the interviews, especially in the case of the GCDAMP case study, respondents showed signs of frustration about the difficulties encountered and the slow speed with which effective changes have taken place.

External Context Factors – For both GCDAMP and KRRP fareout the highest percentage for barriers is with the 'political process'. The other factors in this category have not been highlighted much. An explanation for this could be that AM is less concerned in nature with changing structures than IWRM. Since political processes take place and influence different levels, this also influences the way the planning and implementation processes for AM are organized. This also clearly comes forth from the interview data discussed earlier.

Internal Context Factors – For this category, the highest percentages of identified barriers (and in some instances also enabling factors) are in both case studies 'resources and skills' and 'time horizons'. As discussed above, AM involves more a change in processes than in structures, it makes sense that the emphasis here lies more on thos factors that are directly influencing the process.

Process Factors – This category received the highest scores compared to the other categories for both AM case studies with most emphasis on 'stakeholder involvement and interaction' and 'communication and collaboration' for the

GCDAMP, and 'competing interests' and 'stakeholder involvement and interaction' for the KRRP. Especially the KRRP respondents share a relatively large number of positive experiences and enabling factors, highlighting 'stakeholder involvement and interaction', 'leadership and vision' and 'data and information' as important enabling factors.

Individual Attributes – Both GCDAMP and KRRP respondents indicate that 'attitudes to change' and 'levels of trust' are important barriers to planning and implementation of AM in the case studies. Especially in the case of the KRRP, 'sense of urgency and awareness' has been mentioned as an important enabling factor to change attitudes of those involved in the implementation.

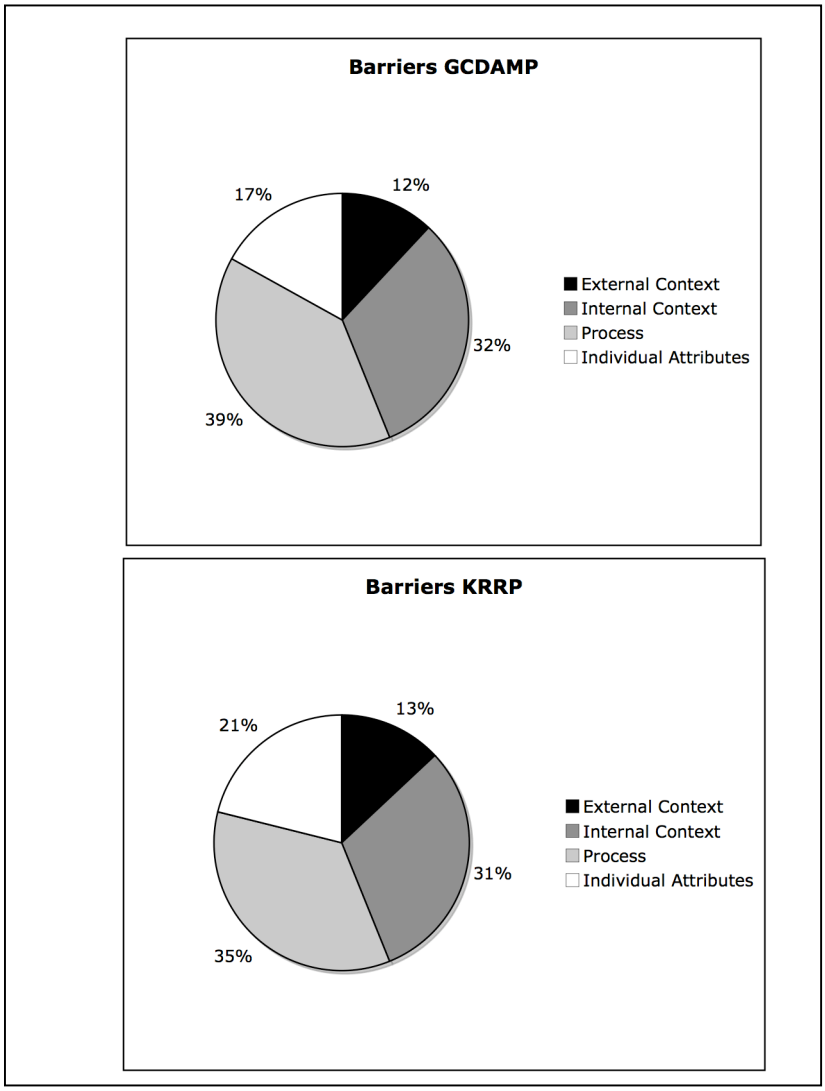

Figure 6.5 Comparing Barriers GCDAMP and KRRP

Figure 6.5 provides an oversight of the intensity with which respondents have highlighted and identified barriers for the key categories. When comparing the results for the GCDAMP and the KRRP, it appears that the emphasis is similar across the two case studies: internal context and process factors.

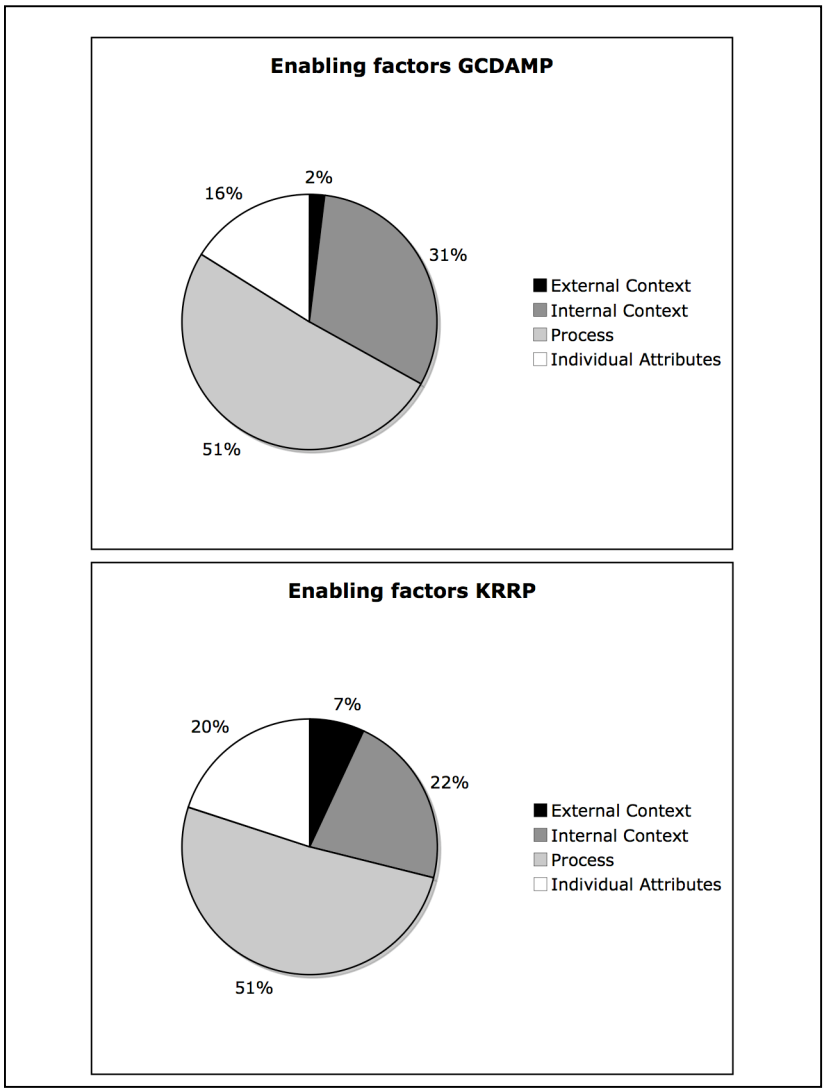

Figure 6.6 Comparing Enabling Factors GCDAMP and KRRP

However, Figure 6.6 indicates that this emphasis is different for the enabling factors of the GCDAMP and KRRP case studies. The trend is quite similar between both case studies, but the highest percentages for enabling factors lies significantly with process factors. External context factors are hardly considered here.

3. IWRM and AM: Comparing overall results from case studies

For both the IWRM and AM case studies overall, the emphasis of experiences was given to barriers and challenges that respondents have faced during the planning and implementation processes. As explained earlier, this could point to an actually experiencing of more difficulties than enabling factors during IWRM and AM planning and implementation processes, but it might also be caused by psychological factors related to those that are involved in these processes.

When comparing the IWRM and AM case studies and the percentages assigned to the factors in the key categories, the following key points can be concluded:

- There is less emphasis on the external context for AM than for IWRM. This could be related to the fact that IWRM in nature involves changing structures, whereas AM focuses more on the process of change itself. In other words, this might be related to the change content of IWRM and AM;
- Similarly, for AM there is less focus on 'existing structures' and related factors such as 'roles and responsibilities' and power and control' than for IWRM. The emphasis for AM is more on availability of 'resources and skills' and 'time horizons' (or project horizons). This makes sense as those factors are more directly affecting the actual change process;
- In all four case studies, process factors are considered the most important mediating factors for both IWRM and AM;
- From the individual attributes category, the key barriers for all four case studies lie with 'attitudes to change' first and 'levels of trust' second. And an increasing 'sense of urgency and awareness' is indicated at a key enabling factor or driver for change in attitudes of those involved in the planning and implementation of IWRM and AM.

6.12 Conclusion

The four cases researched and the respondents of these case studies have provided a set of different mediating factors that have hindered and enabled the planning and implementation process of IWRM and AM. For each section in this chapter, short pieces of key points and findings were provided. The next chapter will discuss in greater depth the dynamics between the content, context, process and individual factors based on the findings from Chapter 5 and this chapter.

7 Discussion

7.1 Introduction

Due to the extent and detail of data presented in Chapter 5 and 6, this chapter provides a summary of the key empirical findings and principle insights derived, and forms Reflection II in the overall research structure (Figure 1.2).

This chapter starts with a distilled summary of the key empirical findings and insights from data analysis action 1 (similarity analysis – Chapter 5) and data analysis action 2 (mediating factors – Chapter 6). Subsequently the researcher will provide a personal presentation of what the two concepts of IWRM and AM are about. The findings and insights are carried forward and discussed in the light of relevant literature in order to create a deeper understanding of the mediating factors that influence IWRM and AM implementation. In addition to discussing the key findings from the similarity analysis and the analysis of mediating factors, the dynamics and interactions between these factors will be investigated. This will be done with the support of relevant literature, findings from Chapter 5 and 6, as well as with the feedback and insights from the stakeholder discussions held after the analysis of the case study data.[14]

Thus the overall aim of this chapter is to discuss the overall findings of the research and revisit relevant literature as a context for discussing these findings as well as provide a revision of the conceptual framework. The interaction models for theory and practice that have been discussed in Chapter 2 are further elaborated upon with the objective of providing more insight and basis for refining the conceptual framework after Reflection I (Figure 2.11). Time and space (levels of interaction) aspects are taken into account for the development

[14] For an explanation of how these stakeholder discussions were conducted, refer to Section 4.5.4

of the final proposed conceptual framework for translating water management concepts from theory into practice.

Figure 7.1 provides an oversight from the above aspects that are discussed in this chapter.

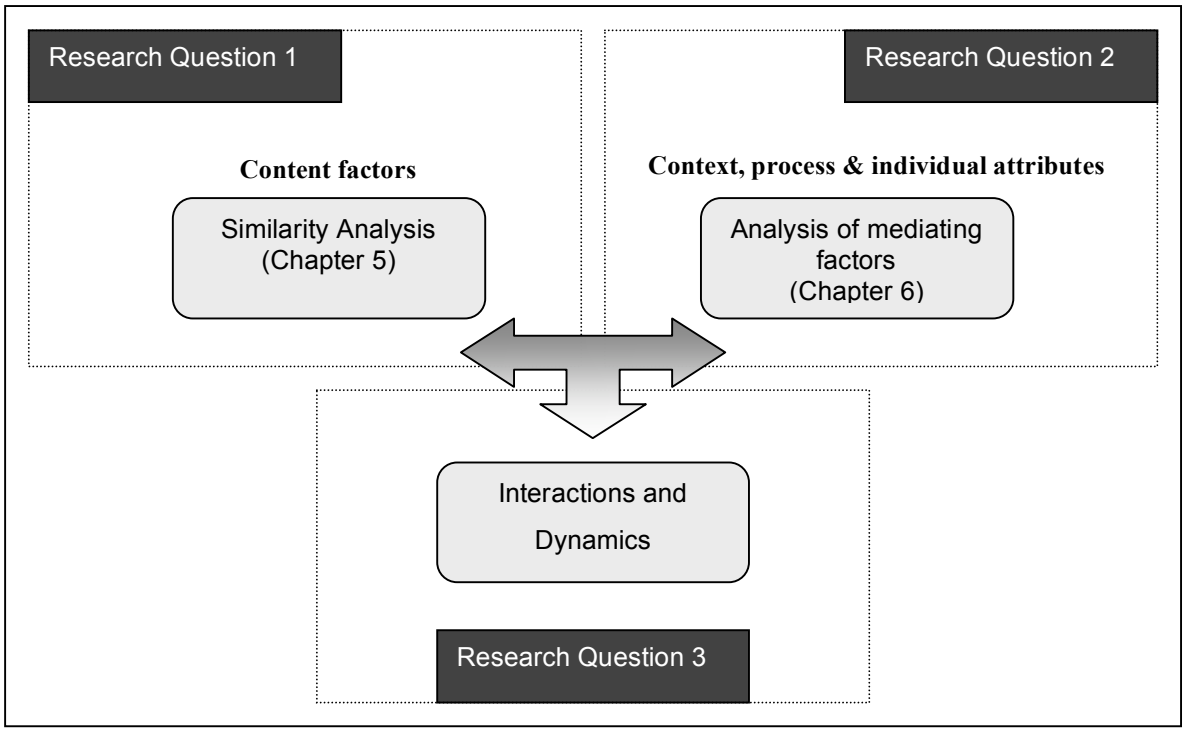

Figure 7.1 Oversight of Discussion Elements

By means of this approach contributions to knowledge and paths of potential further research are derived, which are presented and elaborated on in the concluding chapter. Also presented in Chapter 8 are the implications of the findings of this study.

7.2 Key Empirical Findings

As mentioned above, this paragraph provides a distilled summary of the key empirical findings coming from the similarity analysis and the analysis of mediating factors and forms the basis for the further discussion. From Section

7.3 onwards these insights and findings are linked back to the relevant literature.

7.2.1 Similarity Analysis

The similarity analysis used for this research is quite a novel approach and the findings of this approach indicate that a majority of the respondents from all four case studies provided definitions and objectives of IWRM and AM that show some understanding of the main spirit of the IWRM and AM concepts. However, a majority of their descriptions provided uncertain structures and did not include all key aspects of the IWRM or AM concepts. There is also a significant amount of respondents that provided definitions that were poorly structured, contradictory and ambiguous.

An important question is what this really tells us? Does it mean that practitioners don't understand the two concepts or is it evidence of adaptive implementation? As is explained in more detail in Section 7.3, both IWRM and AM concepts have evolved over time and it is therefore important to note that there isn't a single correct definition or interpretation of either. However, since all respondents have a significant amount of experience in working with either of the concepts as well as their implementation, one would assume that they have at least a solid practical understanding of the concepts and their implications. When asked about the barriers and enabling factors that they experienced during the implementation of IWRM or AM in their respective case studies, most of the respondents were very capable and articulate in providing a significant number of relevant examples.

The issue here is more likely related to the fact that only a small amount of respondents described that reading and reflecting on IWRM and AM through academic and grey literature have supported the development of their understanding of the IWRM and AM concepts. Most of the respondents claim to have developed their knowledge with regard to IWRM and AM concepts and theory mainly through interaction with other people and their involvement in

projects and not through time of reflection and reading of relevant literature on the concepts.

During the interviews, a large number of respondents also indicated that they do not see a clear difference between IWRM and AM, especially when it comes to implementing them in practice. For example, with regard to the IWRM process, many of the respondents described an adaptive cycle similar to the AM process. Another example is the aspect that has been highlighted by a majority of respondents that both IWRM and AM approaches seem to have in common, which is the strong emphasis on stakeholder participation processes in line with the necessity to negotiate and balance different interests and perspectives. These difficulties concerning clear distinctions between IWRM and AM and their theory and practice are discussed in more detail in Section 7.3.

When looking with greater detail at the results of the similarity analysis for the IWRM and AM case studies, it is found that for IWRM, respondents score higher for their objective of IWRM than with their definition, whereas for the AM case studies it is mostly the other way around. In other words, respondents are better capable to describe the purpose of IWRM than to describe the integration process and definition of IWRM and this is the opposite in the case of the AM respondents. In this light, correlation between the amount of 'years of experience' of the respondents in applying IWRM or AM and the similarity ratings they received for the statements on IWRM and AM definition and objective has been investigated and explains partly the differences in ratings for IWRM and AM definitions and objectives.

For IWRM, the respondents with least experience were given higher ratings for their definitions of IWRM than the respondents with eleven or more years of experience. The reason for this could be that most of the respondents in the group with least experience have indicated to spend more time reading academic and grey literature on the IWRM topic than the more experienced groups, whose knowledge has developed mainly through experience and long-term involvement in projects. This provides a possible explanation as to why the

longer experienced groups have received relatively higher ratings when it comes to their statements of the IWRM objective. It is very likely that their practical experience has made it easier for them to express the purpose of IWRM than to give a comprehensive definition. Thus this could be related to maturity of the field (and changing definitions) and the fact that longer serving practitioners are not exposed as much to or aware of more contemporary explicit formalisms with regard to IWRM definition and description.

For AM, it appeared that the majority of least experienced respondents received ratings from 'limited' to 'moderate similarity' for their AM definition and objective. Similarity ratings are slightly higher for those respondents in the two longer experience groups. As mentioned the IWRM and AM concepts and their implications are described in more detail in Section 7.3.

7.2.2 Analysis of Mediating Factors

While collecting and analysing data from the interviews of the four case studies it became evident that the categories of key mediating factors are similar across the different IWRM and AM case studies. It is also indicated that most of the factors have been described as both barriers and enabling factors by the respondents, depending on the situations or events the respondents eluded to. However, the emphasis and intensity with which respondents have experienced these factors as either barriers or enabling factors differentiates per case study and depend very much on the local situation and key issues that are playing.

For example, when looking at the oversights of intensity with which respondents have highlighted and identified barriers and enabling factors (see Figures 6.3, 6.4, 6.5 and 6.6) the overall emphasis of the experienced barriers for IWRM and AM implementation lies in the categories of 'internal context' factors and 'process' factors, whereas the overall emphasis of enabling factors is with 'process' factors for all four case studies. In other words, according to the interview respondents the most crucial ways to improve the effective implementation of IWRM and AM in their respective case studies has been through altering the way in which change related to IWRM and AM has been

introduced and communicated as well as the way the change processes have been guided, facilitated and enabled.

When comparing the results of the IWRM and AM case studies, it can be concluded that there is less emphasis on the external context for AM than for IWRM. This could be related to the fact that IWRM in nature involves changing structures, whereas AM focuses more on the process of change itself. In other words, this might be related to the change content of IWRM and AM. In all four case studies, process factors are considered the most important category of mediating factors.

Context factors

Political processes have been described in all four case studies as an important mediating factor. Political processes are indicated to take place at different levels (international to local) and are characterized as top-down and short-term cycles, whereas IWRM and AM require long-term visions and commitment as well as a considerable amount of resources and skills. Also economic situations are highlighted as potential drivers, impacting the way priorities are set, and thus affecting political directions and processes.

Crisis events, on the other hand, are described by many respondents as drivers to change and can cause political processes to become more bottom-up as growing awareness and a sense of urgency creates political pressure and drive change. Climate change and crisis events, however, may also lead to increased stress caused by e.g. water scarcity which can create increased competition between different water uses.

An integrated approach implies interaction between different governments, states, ministries, departments and policies depending on scale and issue. The aim of integration is to somehow integrate or unite these elements through increased cooperation and the main challenge is that these different elements have a diversity of competing interests and practices that need to be reconciled. Many respondents have indicated e.g. that countries or states tend to manage a

system in a way that best suits their particular needs, explaining that many countries and states have developed different structures, approaches and practices to water planning and use. Because of these differences it can be challenging to manage a basin as one single entity from a planning perspective.

In reconciling different approaches and processes, historical cooperation and the historical context should be considered as a factor that can influence the level of willingness and openness to cooperation, depending on past experiences. In other words, attitudes and behaviour depend on past experiences. Although culture was not explicitly mentioned during the interviews, the discussions that were conducted with experts after analysis of the case study data revealed that culture is certainly a factor that should be taken into account while implementing change.

A combination of existing management structures and legal frameworks determine the division of roles and responsibilities of those involved in implementing IWRM or AM. When management structures and legal frameworks are too complex or not in line between different countries or states, it becomes unclear who is responsible for what. However, changing existing structures or legal frameworks can become very challenging as it involves shifts in power and control and very few people are willing to let go of those.

Process factors

The success of IWRM and AM depends on whether these concepts are embraced by the multitude of agencies and groups involved and how well the teamwork and rapport is between these groups. The case study respondents describe the process of implementing IWRM and AM as a human activity that involves plenty of decision-making and politics: having to deal with competing interests, values and perceptions. Both concepts demand collaboration and communication between (a potentially large) amount of stakeholders that each has their own mandates, interests and agendas. It is crucial to develop arrangements that enable stakeholders to resolve their differences by finding common grounds and trade-offs. Thus, the way participation and cooperation

between different stakeholders is crucial as this affects the stakeholders' feeling of ownership, resistance or openness to change as well as positive or negative conduct amongst stakeholders.

A large number of respondents stress that effective communication is an important factor to creating a more transparent and open process of collaboration between the different stakeholders. Leadership has been highlighted as a crucial factor for this as effective visionary leaders and facilitators can carry a change process and motivate change. Leadership is described to take place on different levels, from a political support base, to facilitators of stakeholder processes, to stakeholder and community representatives. These people need to work together in order to guide the change process and work towards an inspiring common vision.

It is noted, however, by some of the respondents that aiming for something abstract (as 'restoration of environmental values of the system') can be dangerous as this can mean different things to different people. In other words, a common vision needs to be clear and comprehensive. According to some of the respondents, not having a clear and common vision is a symptom of a deep division between the stakeholder groups and indicates that leadership is not successful in bringing the parties together.

IWRM and AM are intended to promote sustainable ways of managing resources through an integrated and learning approach. However, both concepts do not have a mechanism built in to deal with binding arbitration and mediation. Having leaders that guide the process is crucial with frequent interaction (informal and formal) between the different stakeholders in order to respond to changing environmental and public needs. Continuity helps to form the collective mindset of the group, understanding each other's concerns and building relationships and trust.

Data and information needs to be made available to all relevant people through different methods and tools. It is important to provide coherent information in a way that is understandable for different parties involved. Just preparing reports

and giving presentations has generally not been considered effective. It is important to build an open forum with a free exchange of information, conducive to develop and reach common goals and vision.

Individual attributes

As mentioned before, IWRM and AM are primarily human processes, shaped and affected by the people involved. These concepts also involve processes that require significant changes on different levels. Some of the key challenges that are highlighted by the case study respondents are to do with the level of 'resistance to change' by those involved in change processes. The level of resistance to change could be viewed as an indicator of the extent or scale of the intended change: assuming that the higher the extent or scale of change, the more resistance will be met. Resistance to change can be caused by many different factors: e.g. not wanting to let go of power and control, people's characters, competing or conflicting interests, lack of openness in communication during stakeholder processes, etc.

One of the respondents stressed that it is important to have strong leadership and facilitation of stakeholder processes in order to get 'egos out of the room and the project back into the room'. In other words, it is about the mindset of those involved and how flexible and open minded they are in the process. Trust between stakeholders is very important and can be eroded by e.g. differences of opinion or misunderstanding. Good will, mutual understanding and trust are prerequisites for reaching common understanding and goals, but to build up trust, good will and mutual understanding costs time and can easily be broken down. Trust can be build through an equal distribution of decision-making where people's issues and concerns are adequately addressed. In other words, mutual trust is developed through inclusion of stakeholders, open and transparent communication & leadership, as well as successful implementation experiences in the past.

Distrust, however, arises in a stakeholder process through misperceptions of other parties, labels that people put on other people, and (assuming) hidden

agendas. This distrust can lead for example to exclusion of parties, not sharing of necessary information, not believing information that is shared, lack of giving support, keeping cards to yourself. In general, respondents shared that there is a basic mistrust of governments and the political system.

Individual attributes, such as increasing levels of awareness and sense of urgency, are factors that can drive a decrease in the resistance to change as people understand the urgency of the matter and realize that it is in their benefit to cooperate. A strong sense of urgency and awareness about issues is an important enabler in a stakeholder process and can be raised through e.g. public meetings, digital libraries, and facilitating more involvement and collaboration. Also crisis events can change public opinion and are strong drivers to change.

7.3 Discussing IWRM and AM

The empirical findings discussed in Section 7.2 clearly indicate that there is a multitude of factors that influence the implementation of IWRM and AM, and that these factors are not stand-alone or disconnected from each other. The dynamics and interactions between the mediating factors and the way they relate to the change process are described in Section 7.4 and subsequently visualized in the final proposed conceptual framework.

This section will discuss the researcher's understanding of IWRM and AM concepts and what they are about, developed through insights gained from relevant literature as well as through the case study interviews and interaction with key stakeholders.

7.3.1 The Context of IWRM and AM…

Numerous arguments have been put forward regarding the need for a major change in water resources management. For example, increasing awareness of the impacts of climate change has lead to the insight that water management must become more flexible in order to deal with uncertainties and surprises.

Implementation of integrated and adaptive water management approaches require a structural change in water management regimes.

As mentioned, IWRM is primarily concerned with reform of water governance arrangements, whereas AM with the reform of responsible authorities, although this also often involves stakeholder participation or co-ordination with other agencies. IWRM is concerned with changing the way in which water is managed by, in one sense, reformulating the problem or re-bounding the 'system' of concern. AM, on the other hand, is concerned with changing the way in which responsible authorities view and undertake management action to focus on learning as a key way of combating uncertainty and promoting adaptability. IWRM and AM are both focused on and require institutional reform – from changing management processes to potentially establishing entirely new organizations – and in many cases require change not only at the individual and organizational levels, but also at national and international level.

The aim of this section is to describe in further detail the researcher's understanding of IWRM and AM and what they are about. Several discussions with one of the key respondents for this research, Steve Light, have helped the researcher to gain deeper understanding of the concepts and their relation to managing dynamic and complex systems in general. According to Steve Light (and to the researcher), Ashby's 'law of requisite variety'[15] is an important cornerstone that brings social and ecological systems under one roof while creating better understanding of their interactions. Ashby describes the 'law of requisite variety' in his book 'Design for a Brain' (1952). This book explains very clearly the different ways in which organisms and their environments interact and what affect this has on their adaptation potential and time spans needed for adaptation. It also shows that there are different ways of learning and adapting depending on the types of connections between systems and subsystems.

[15] This law says that ' the larger the variety of actions available to a control system, the larger the variety of perturbations it is able to compensate' (Ashby, 1952)

According to Ashby, organisms and their environment are to be treated as a single system and thus the dividing line between 'organism' and 'environment' becomes partly conceptual, and to an extent arbitrary. Ashby further provides the following principles with regard to the interaction between 'organisms' and their 'environments':

- Organisms are mechanistic in nature, composed of parts; and the behaviour of the whole is the outcome of the compounded actions of the parts (1952: 26);
- Organisms change their behaviour by learning, and they change it so that the later behaviour is better adapted to their environment than the earlier (1952: 26);
- Given an organism, its environment is defined as 'those variables whose changes affect the organism, and those variables which are changed by the organism's behaviour' (1952: 48);
- The organism affects the environment, and the environment affects the organism: such a system is said to have 'feedback' (1952: 49).

These principles described above touch the core of what integrated and adaptive approaches are about. IWRM as a water management paradigm evolved from the realization that the different sectors and stakeholders involved cannot continue to manage water independently of each other and of the environment (Stikker, 1998; Dziegielewaki and Baumann, 1992; Gleick, 2000; Duda and El-Ashry, 2000; White, 1998). Whereas, the AM approach stems from the recognition that natural systems and the interactions between people and ecosystems are unpredictable (Gunderson *et al.*, 1995) and that management actions are taken not only to manage but also to explicitly learn about the processes governing the system (Shea *et al.*, 1998).

Two aspects that are clearly related to IWRM and AM are *co-ordination* and *learning*. Ashby discusses these aspects thoroughly as well as their relation to each other. According to Ashby, 'adaptation' to an organism means that, in spite of the world 'doing its worst', the organism responds in such a way that it

survives for the duration necessary for reproduction. An organism does not reach its full adult adaptation by making trial after trial, all of which count for nothing until suddenly everything comes right. On the contrary, the organism achieves partial successes and retains them while improving what is still unsatisfactory (Ashby, 1952: 48).

He also refers to the concept of 'in-coordinated activity', which means that 'if a dynamic system is allowed to proceed to vigorous action without special precautions, the activity will usually lead to the destruction of the system itself' (1952: 20). The question that is raised in the book is how you can specify the 'correct' properties or functions for each part of the system, if the correctness depends not on the behaviour of each part, but on its relation to the other parts? The challenge that is referred to here is to get these parts properly co-ordinated. Ashby's experiments also showed that if a system is too well integrated and co-ordinated, that this system cannot accumulate adaptations and learn as effectively as possible: as connections become richer or the system becomes larger, so will the system's time required for adaptation increase. Thus, in adapting systems an increase in the amount of co-ordination and communication channels can be harmful as it decreases a system's chance of getting adapted in a reasonably short time. Effective learning and adaptation, therefore, require a combination of independence as well as interaction.

Ashby also suggests that co-ordination between parts does not always have to take place through direct communication channels; it can also take place indirectly through the environment. Indirect communication between parts through their environment has a fundamental advantage. The reason is that if the information (to learn and adapt) has to come through other parts directly, it is much more limited than when it comes through the environment. As an analogy, Ashby uses an example of a mouse that teaches a kitten how to hunt for mice: in other words, the environment becomes the teacher.

Linking Ashby's theory back to the context of IWRM and AM, the most crucial point is that organizations are heavily dependent on their environment and that

their learning to survive and adapt is not by controlling the environment but by learning to get what it needs to take effective action. It is important to note that over stimulus, by the use of too many channels of communication, is as bad as no channels for communication. During the discussions, Steve Light clearly highlighted that too many channels of communication just create noise, but that a requisite diversity of perspectives is necessary to address complex problem solving. Steve further stressed that according to the Law of Requisite Variety, the 'speed, scale and complexity of a system's response has to be equal to that of its challenge'.

7.3.2 … their Implementation…

It has been mentioned that although both IWRM and AM offer attractive ambitions for improving water resources management, they have yet to be adequately realized. The fact that both approaches share a very common set of barriers to their implementation, perhaps points to a wider, underlying problem – that of translating generic, science-based management concepts and theories developed by academics into practice.

Although in their core, both IWRM and AM denote broad and pragmatic approaches, the way IWRM and AM concepts are generally implemented in a top-down manner. Lankford *et al.* (2007: 1), for example, describe how 'IWRM in an idealized form denote a set of principles, usually accompanied by a package of tools and practices, designed to match and accommodate the complex and *mosaic* nature of the problem'. These authors further point out how the IWRM concept (acknowledged as a defining feature of contemporary river basin management) trickles down from the Dublin principles and a formal definition by the GWP, to a Statement of National Water Policy, leading to a National Water Strategy and subsequently to the translation into more operational programs.

Somach (1993) highlights this issue and describes how in water resources management policy makers give considerably more attention to policy development than to policy implementation. He further emphasizes (1993: 19)

that 'policies by themselves have very little value without the development of implementation strategies and the will to carry those policies into actual practice'. An important point that Somach makes is that policies create expectations that must be met as a failure to meet those expectations creates: significant credibility gaps that hampers further action as well as the possibility to address significant problems in a meaningful way.

It is also often assumed that a good policy will produce satisfactory outcomes. In reality, however, policy outcomes are determined by government action, not by what governments state they intent to do. In other words, implementation is the key ingredient of good effective policy. Pressman and Wildavsky (1984) were some of the first in a generation of implementation analysts who showed that implementation dominates outcomes and that consequences of even the best planned, best supported and most promising policy initiatives depend eventually on what happens as individuals throughout the policy system interpret and act on these policies (Bardach, 1977; Berman and McLaughlin, 1978). In other words, policy can at best enable outcomes, but it cannot mandate what matters. Elmore and McLaughlin (1982) indicate that external policy features have limited influence on outcome, particularly at lower levels of the policy process, and that the emphasis is on e.g. individual motivation and attitudes as well as internal institutional conditions.

Lankford *et al.* (2007: 8) describe and give examples of how operational programs in many cases differ from the comprehensive template (as provided in principles and policies) due to different factors and constraints related to e.g. scale, funding, data availability, policing, knowledge, logistics, variability and systemic interfaces. These authors therefore propose that 'the comprehensive framework of IWRM should not be the starting point for drawing up water operations and that instead the main frame of reference should be the problems identified on the ground, and the ongoing iterative relationships with stakeholders'. In other words, Lankford *et al.* (2007) propose a more adaptive and bottom-up approach for policy development and implementation (see

Figure 2.2) shifting away from the adoption of accepted norms towards problem identification and solution.

Mitchell (1990) realized that implementation is a balancing act, on the one hand reflecting the ideal and on the other hand reflecting the problems found, stating that: 'at the strategic level, a comprehensive approach should be used to ensure that the widest possible perspective is maintained. In contrast, at the operational level a more focused approach is needed. At the operational level, attention should, therefore, be directed to a smaller number of issues that account for most of the problem' (1990: 4). It appears that the key argument made here, with respect to water resources management, is very similar to that made by Ashby (1952) that points towards: individuals, organizations and governments learning from their environment instead of trying to simply control it.

7.3.3 … and proposed Definitions

A variety of definitions have been developed and contested for IWRM and AM over time. The fact that IWRM and AM have been given multiple definitions and descriptions cannot be a surprise as both concepts have been around for several decades and have not stopped evolving as concepts. Consequently many people and disciplines tend to have differing descriptions for and understandings of the IWRM and AM concepts. This ambiguity of definitions can be a source of confusion and result in a lack of clarity about purpose and process of the concepts. It also further compounds difficulties in demonstrating the success of both concepts.

For IWRM, the GWP definition has been considered the most authoritative (e.g. Snellen and Schrevel, 2004; Jonker, 2007; Lankford *et al.*, 2007), although it gives very limited practical guidance to present and future water management practices (e.g. Allan, 2003; Jonker, 2004; Biswas, 2004; Jeffrey and Geary, 2004). Besides the GWP definition for IWRM, there have been a number of other definitions that all differ from each other in one or more aspects or facets that are included or not (Allan, 2003; Rahaman and Varis, 2005; Merrey *et al.*,

2005; Van der Zaag, 2005). Most of these definitions (at least to an extent) captured the essence of IWRM – a broadening of the bounds of the management system to include multiple sectors, stakeholders, disciplines and scales, and to balance the goals and views of interdependent players (Grigg, 1999).

A possible reason for failure to achieve widespread adoptation, and rather modest success when adopted, is the failure to define what exactly is meant by AM, and how it should be implemented. The AM concept has also been given a multitude of meanings and descriptions by a wide range of authors (some of the key authors being e.g. Bormann *et al.*, 1999; Holling, 1978; Lee, 1993; Nyberg and Taylor, 1995 and Walters, 1997). In its core, the AM approach has been designed to test hypotheses about system response to human interventions (Lee, 1993) where management actions are not only taken to manage, but to explicitly learn about processes governing the system.

Placing the IWRM and AM concepts in their historical contexts, it should be noted that both concepts have evolved over time and that there is, therefore, no single correct definition or interpretation of either. Indeed, this ties with one of the central themes in this thesis – the critical importance of contextual factors in shaping the extent and nature of the implementation process and challenges. Literature concerning IWRM and AM contains incomplete, ambiguous and sometimes even contradictory definitions, partly because of the thrust for genericity behind both approaches. An key question is whether such diversity of understanding is a strength, a weakness or a necessity given the wide range of social, economic and environmental contexts that IWRM and AM are supposed to benefit?

Based on the findings of this research and what has been discussed in this section, it would probably be right to say that such a diversity of understanding is unavoidable. People from different backgrounds seldom have the same idea about what water resources management implies. For example, to those living in arid countries it has a very different meaning than to those living in humid

areas. Also people from different professional background tend to view water resources management differently (e.g. ecologists, water engineers, lawyers, economists, etc). In fact, water resources management includes all of these points of view: it is physical, economic, political, sociological, environmental and technical. In other words, water resources management, in all its components is multi-disciplinary.

However, when it comes to assessing the success of implementing IWRM and AM concepts, it is important to have 'noses pointing in the same direction' with regards to the overall meaning of the concepts. It is very difficult to provide and record clear empirical evidence if there is no clear understanding of what the IWRM and AM concepts are about and what exactly they are supposed to achieve.

To conclude this section, the researcher provides a personal definition of the IWRM and AM concepts based on insights gained through this research. As the roles and benefits of the IWRM and AM concepts will vary depending on the context of the implementing country (different countries will have different ways of implementing these concepts), it does not seem to make sense to develop definitions that include in detail all relevant aspects and factors. The aim is, therefore, not to provide comprehensive definitions of IWRM and AM, but to provide definitions that are pointers to get all 'noses in the right direction', that are inclusive in their simplicity and that are 'bottom-up' informed.

IWRM

Jonker (2007) discussed attempts from contemporary authors to improve the clarity of the IWRM concept by adding certain aspects and elements to the GWP definition. Adding elements, however, seems to make the definition more unwieldy and wordy, and therefore more unlikely to be able to assist in its implementation. Perhaps the responsibility of determining the most appropriate issues to focus on, and elements to include, should be determined for each implementation case separately. It seems impossible for IWRM-promoting agencies and institutions (such as the GWP) to determine exactly what *matters*

in many different locations at the same time. Biswas (2004) addressed this point while stating that despite the popularity of the IWRM concept, it remains to be seen whether it is indeed possible for a single paradigm to encompass all countries and regions, each with very different political, physical, economic, social, cultural and legal conditions.

The researcher proposes, therefore, to provide a definition for IWRM that gives a clear picture of what IWRM is about, without giving it too much detail. These details are left to fill in, by those who have committed to and are in charge of developing integrative policies, strategies and management actions. It should be noted that it is the responsibility of those individuals, institutions (as well as relevant stakeholders and the public) to accommodate a democratic policy process: developing and implementing policies in a transparent and participatory manner. The formulation and implementation of policy should also operate on the basis of the principle of shared responsibility, which dictates that diversity must be reflected in the ethos, strategy and process of the management of policy. The core objective of the IWRM concept is to ensure sustainable development and management of water and related resources. For clarity purposes, sustainable development and management is defined here as: 'improving of people's livelihoods without disrupting the natural cycles' (Brundtland, 1987).

Based on the above, the researcher proposes the following definition for IWRM:

IWRM is a democratic process for developing and managing water and related resources in a coordinated and sustainable manner

AM

Before proposing a definition for AM, it should be noted that AM in general is being referred to as a scientific process. However, the use of the word 'science'

can create issues in multidisciplinary conversations, where the use of language will always be a barrier. The use of the term 'science' suggests the practice of creating knowledge for sustainability as an academic endeavour. Making new knowledge available and useful to society in facing sustainability, however, is a question of wider social processes that must include non-academic groups at all levels as in its core AM is all about social learning. Thus, inclusive language is important and instead of using the term 'scientific', the researcher prefers to use the term 'inquiry'.

Another important point made with regard to the AM concept during the discussion with Steve Light is that AM is not about planning, but about designing: when one is not sure how to frame a problem correctly, one is really in a design mode going through different frames and reframing of the problem.

Based on the above, the researcher proposes the following definition for AM:

AM is a process of inquiry that incorporates new knowledge with the aim to continually improve management policies and practices

7.4 Mediating Factors and Change Process

The aim of this section is to describe in more detail the dynamics between the mediating factors (as identified through the case study interviews) and the change processes that reflect the implementation of the IWRM and AM concepts. The mediating factors that have come forth from the data analysis of case study interview transcripts have been discussed in great detail in Chapters 5 and 6 and are divided into four key categories: content factors; context factors; process factors; and individual attributes. The following questions are being answered by the discussion of the different factors:

- *What* is being changed?
- *Why* is the change successful or not?
- *How* is change implemented?
- *Who* is involved in and affects the change process?

7.4.1 Content Factors – What is being changed?

As described in Chapter 2, content factors refer to *what* is being changed or the type of changes being implemented. In the case of this research, the proposed changes in the case studies are driven by either the IWRM or the AM concept and principles. As mentioned, IWRM is primarily concerned with reform of water governance arrangements, whereas AM focuses on the reform of responsible authorities, which often also involves stakeholder participation or co-ordination with other agencies. In other words, the change that is to be manifested through IWRM is change in the way in which water is managed, and through AM in the way responsible authorities view and undertake management action, focusing on learning as the key objective. Both IWRM and AM are approaches that require an enormous change in the way things are currently organized in the water sector in most countries in the world.

According to the change management literature, change can be categorized into several ways (e.g. Watzlawick, 1978; Hinings and Greenwood, 1988; Ackerman, 1997). Both IWRM and AM require change of a *transformational* order, which requires a shift in assumptions made by organizations and their members. This kind of change is radical in nature, although in reality IWRM and AM are often implemented in an incremental way: through a step-by-step movement toward a system ideal.

The extensive literature review on IWRM and AM presented in Chapter 2 and discussed further in Section 7.3 revealed that both concepts are struggling with ambiguities and difficulties with regard to their definitions. Although both concepts were raised with the overall aim of developing more sustainable water management systems, they have been developed in the academic ‘world’ and both literature and empirical evidence from the selected case studies (Chapter

5) point to a gap between concept (theory) and reality (practice). Through the conceptual framework for this research (Figure 1.1), an attempt is made to visualize and investigate the links between theory and practice.

At the core of the transfer are the stakeholder organizations and people that are involved in the project definition and execution stages of IWRM and AM interventions. The first step in the framework characterizes the translation of formal theory to perceptions of these concepts. In other words, how the formalized concepts of IWRM and AM are perceived and conceptualized by the different users of these concepts. In line with this first step, the first research question aims at finding out whether the perceptions of practitioners are congruent with the formal concepts of IWRM and AM, and what factors are affecting this step.

As mentioned in Section 7.2.1, the conducted similarity analysis (reported in Chapter 5) reveals that a large number of key actors with extensive experience and involvement in the planning and implementation of IWRM and AM in the case studies, have difficulties when it comes to defining the concepts as well as describing what the concepts are designed to achieve. With regard to their knowledge development on IWRM and AM, all respondents point out that they have learned about the concepts primarily through project involvement and interaction with others. Only a minority of all case study respondents stated that reading and reflecting on information in academic literature and grey documentation have formed the basis for their knowledge development on IWRM and AM. And most of those few that do take or have time to read and reflect, state that they focus more on national policy documents and project reports than on international academic literature.

It is useful here to link back and elaborate further on the explicit and tacit knowledge discussion addressed shortly in Section 2.3.3. Nonaka and Takeuchi (1995: 63-69) discuss four modes of knowledge creation or conversion that are derived from explicit (theory) and tacit knowledge (practice - Table 7.1).

	To tacit knowledge	To explicit knowledge
From explicit knowledge	**Internalization** reading about it, then doing it	**Combination** reading about it, then describing it
From tacit knowledge	**Socialization** watching somebody, then doing it	**Externalization** doing it, then describing it

Table 7.1 Modes of knowledge conversion (Nonaka & Takeuchi, 1995: 63-69)

- *Internalization*: is the process by which explicit knowledge is absorbed and becomes part of tacit knowledge. This process regards the activities of applying knowledge in practice and reflects the concept of 'learning by doing', i.e. internalizing the new or shared explicit knowledge through hands-on practices;
- *Socialization*: Sharing experiences to create tacit knowledge, such as shared mental models and technical skills. This also includes observation, initiation, and practice. However, experience is the key, which is why the mere 'transfer of information' often makes little sense to the receiver;
- *Combination*: A process of systemizing concepts into a knowledge system. Individuals exchange and combine knowledge through media, such as documents, meetings, and conversations. Information is reconfigured by such means as sorting, combining, and categorizing;
- *Externalization*: is the process of converting tacit knowledge to explicit knowledge in the form of metaphors, analogies, hypotheses, and models, i.e. articulating tacit knowledge, such as experience, insight, judgment, problem-solving skills, obtained through observation, imitation, and practice into a format that can be used for future purposes by those who need it.

When linking this back to the findings from Chapter 5, it becomes clear that most of the respondents have developed their tacit knowledge through the tacit knowledge of others, but in most cases not through internalization of explicit knowledge of IWRM and AM concepts. In other words, there is a gap between the theory of IWRM and AM and the practical experience of its users, which

implies the importance of considering more thoroughly effective ways of bringing explicit knowledge on IWRM and AM to the practitioners. The benefit of this would also be that the explicit knowledge domain of IWRM and AM could improve and refine through a more frequent and continuous interaction with the tacit knowledge domain (i.e., practice).

7.4.2 Context Factors – Why is the change successful or not?

Context factors are described as pre-existing forces and conditions in the external and internal environment of a management system that impact the effectiveness of the system (Mowday and Sutton, 1993; Walker *et al.*, 2007). In other words, these factors indicate *why* change is implemented. External context factors are described as those factors over which the system has little control, and examples of such factors evidenced from this research are: e.g. types of government and policies, the economic situation, as well as climate change and crisis events. Internal context factors are conditions that give an indication of the general readiness towards change. The case study investigations have found internal context factors such as: e.g. existing physical and management structures, power and control issues, legal framework, etc. Both the existing structures and the legal framework determine the way roles and responsibilities are divided. In reconciling different approaches and processes, historical cooperation should be considered as a factor that can influence the level of willingness and openness to cooperation in the change process; in other words, attitudes and behaviour depend on past experiences. Overall, the context factors can explain why a change initiative is or is not successful.

Although this is more extensively the case for IWRM, both concepts and their processes imply interaction at different levels and challenges and issues described in all four case studies are regarding differences in practices and interests (or mandates), as well as power and control. Although culture was not explicitly mentioned during the interviews, the discussions that were conducted with experts after analysis of the case study data (stakeholder checks – Section

4.5.4) revealed that culture is a factor they found missing in the described context factors. An explanation for this could be that people generally cannot make a clear distinction of the culture they are embedded in. A reason that people can never fully extricate themselves from culture is that it is all pervasive, affecting either directly or indirectly all that exists in the dynamic of change processes (Webster, 2006: 54). Webster (2006) compares and contrasts a number of concepts and definitions of culture and describes how these relate to and include notions of people's values, beliefs and knowledge, linking them to interpretations of their surroundings, and their social behaviour. He also asserts that social structure is determined by culture and that therefore culture both determines and is influenced by social interaction and thought. In other words, there is a causal relationship between personality, behaviour and culture.

Although political processes are categorized under external context factors for both IWRM and AM, they take place at the different levels and are generally characterized as top-down with short-term focus (in line with the usual political cycles of four to eight years). This is in contrast with IWRM and AM that both require long-term (bottom-up) visions and commitment. In many cases, decision-making processes appear to be more strongly driven by political processes and individual interests rather than by accurate data and information. This is in stark contrast in particular with AM's emphasis on learning that, in theory, should be driven by data and information coming from actual implementation, monitoring and evaluation.

In the light of the discussion in Section 7.3.1, it can be concluded that policy is generally developed and implemented in two different types of context: during (1) periods of significant change (e.g. in economic and political systems or in relevant institutions); or (2) periods where systems are essentially stable. These different contexts in which integrated or adaptive approaches can be introduced very likely have different bearings on the possible outcomes of their policy development and implementation processes. For example, it could be that decisions to undertake major policy changes are more easily made during

periods of significant change as changes tend to be slower and more incremental in periods of relative system stability.

7.4.3 Process Factors – How is the change implemented?

Process factors give an indication of *how* change is implemented and refer to actions and directions taken during the planning and implementation of change. It refers to the way leaders introduce change as well as guide the change process. Planning and implementation of change – or the change process – go through different phases (from the present phase, through a transition phase, to the desired phase). Stakeholder organizations, representatives and individuals form the basis of this change process and the way their participation and involvement is arranged and organized forms a central variable to the level of acceptance and openness to change by those people.

Besides participation, there are other factors discussed in the change management literature as well as during the case study interviews that need to be addressed in the change process. Examples of such factors are: timely, open and honest communication and collaboration; clear explanation of the gap between the current state and the desired state as well as how the proposed change will bridge this gap; support from both external and internal leaders with vision to the change process; etc. Any effort to enhance a policy process must be based on the following aspects: accountability to the people involved; participation, facilitated by an accessible process an a culture of inclusivity; legitimacy; transparancy; efficiency; and ownership.

During the interviews, most respondents indicated that with regard to the stakeholder processes there is not enough time spent on knowledge dissemination with regard to IWRM and AM, and the roles and responsibilities that these concepts entail for those involved. Most respondents (except to an extent for the KRRP case study) explained that their meetings usually revolve around discussing current and past issues and trying to come to some form of agreement or compromise. However, these discussions do not appear to involve reflection on the proposed change concepts and what those exactly

mean for the process as well as frequent reflection on past actions or experiments. This indicates that there is limited time spent on the process of transferring and disseminating knowledge with regard to IWRM and AM (and e.g. past experiences in outside projects), but also that there is not much time spent on attempting to investigate and record the tacit knowledge that is available in the minds of those people that are involved in the process. If there is no form of 're-education' taking place, then knowledge is only changed through experience (tacit to tacit) which might make the already existing divide between theory and practice even greater.

7.4.4 Individual Attributes – Who is involved and affects the process?

Each change process involves a variety of individuals with specific characteristics and mindsets that determine their attitudes and behaviour towards change. In other words, individual attributes refer to *who* is involved in the change and their dispositional and personal characteristics. To elaborate a bit further on the link between culture and personality traits (as discussed in Section 7.4.2), Hofstede claims that human nature is inherited with ones genes and interplays with culture to produce personality traits: 'a unique set of mental programs', some of which is learned and some inherited (Hofstede, 1994 as quoted by Webster, 2006: 54).

In line with the phases in a change process, as described above, the attitudes and behaviours of individuals towards intended change ideally goes from an initial readiness, to adoption and finally institutionalization (Lewin, 1947; Armenakis *et al*., 1999). It is stated that readiness occurs when the external and internal context (the environment and structure) as well as the stakeholders' attitudes are non-resistant and open to the proposed change. Subsequently, these stakeholders alter their attitudes and behaviour conforming requirements for change to occur. And finally, the change becomes institutionalized: an integral part of behaviour and attitudes.

Most of the issues that are highlighted by the case study respondents are to do with the level of resistance to change by those involved in the change process. Schön (1973) explains that resistance to change is often caused by a loss of a stable state. He suggests that belief in a stable state equals belief in 'the unchangeability, the constancy of central aspects of our lives, or belief that we can attain such constancy' (Schon, 1973: 9). This kind of belief rests strongly and deeply in human beings and provides a defensive wall against uncertainties. Schön (1973: 30) describes this tendency as 'dynamic conservatism – a tendency to fight to remain the same'. The loss of the stable state means that our society and all of its institutions are in continuous process of transformation and new states will not endure a lifetime. Therefore, Schön (1973) emphasizes that people must learn to understand, guide, influence and manage these transformations, and become adept at reflecting and learning and systems must become 'learning systems' capable of bringing out their own continuing transformation. In this process it is important to understand and communicate what demands are made on a person who engages in this kind of change and learning (Schön, 1973: 28-29). He further claims that systems must be able to maintain their identity and ability to support the self-identity of those who belong to them, while at the same time allowing transformation on different levels (Schön, 1973: 57).

Other individual attributes such as increasing levels of awareness and sense of urgency, are factors that can drive a decrease in the resistance to change as people understand the necessity of it and realize that it is in their benefit to go along.

7.5 Interactions and Dynamics

With regard to this research, there are different types of interactions and dynamics that are considered relevant and that affect the design, planning and implementation of IWRM and AM concepts in different ways (see Figure 1.1 and 2.11):

1. The theory-practice process itself and the interaction between the elements in this process;
2. The mediating factors that influence the change process either hindering it or facilitating it (barriers and enabling factors);
3. The interaction and dynamics between the different mediating factors.

Insights and understanding about these different dynamics and interactions have been developed through different routes. Understanding about the theory and practice process in general and the links and interactions between them have mostly come from reviewing contemporary literature. This has been described in Chapter 2, and a further review of literature is conducted and described below to develop more thorough understanding. Concerning the mediating factors that influence the process of transfer from IWRM and AM theory into practice, findings and insights have been developed through the similarity analysis (Chapter 5) and the analysis of mediating factors (Chapter 6) and have been described in the above sections. And finally, understanding of the interaction and dynamics between these mediating factors have been developed through the review of literature, findings from case studies and feedback from stakeholder discussions and are described in Section 7.4.

The literature review presented in Chapter 2 provides several useful ways of further investigating and describing the interaction between theory and practice as it infers a common set of dynamics concerning this interaction. From an action science perspective, for example, the construction of theory is perceived as an evolving process that is continuously changing as new understanding (invoked by experiences in practice) emerges (Whitehead, 1988). In other words, theory and practice are considered as integrated parts of a whole: neither one viewed independently from the other.

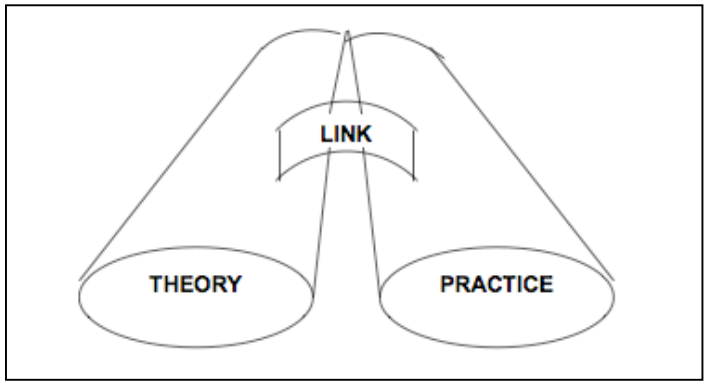

Figure 7.2 Binoculars as a metaphor for theory-practice interaction

Mullen *et al*. (2004) propose that the interaction between theory and practice be metaphorically represented as binoculars, where two lenses are linked to each other (see Figure 7.2). Our eyes need to look through both lenses simultaneously in order to be able to see the overall, 'bigger' picture: without doing that, vision becomes a blur. Nonaka and Takeuchi (1995) further elaborate on this link between theory and practice by defining and describing theory and practice as two different types of knowledge: explicit and tacit knowledge that interact with each other in a cycle of knowledge conversion and creation.

As described in Section 7.2.1, there are four modes of knowledge creation or conversion that are derived from explicit and tacit knowledge. Figure 7.3 visualizes the process that connects these modes of knowledge creation and conversion:

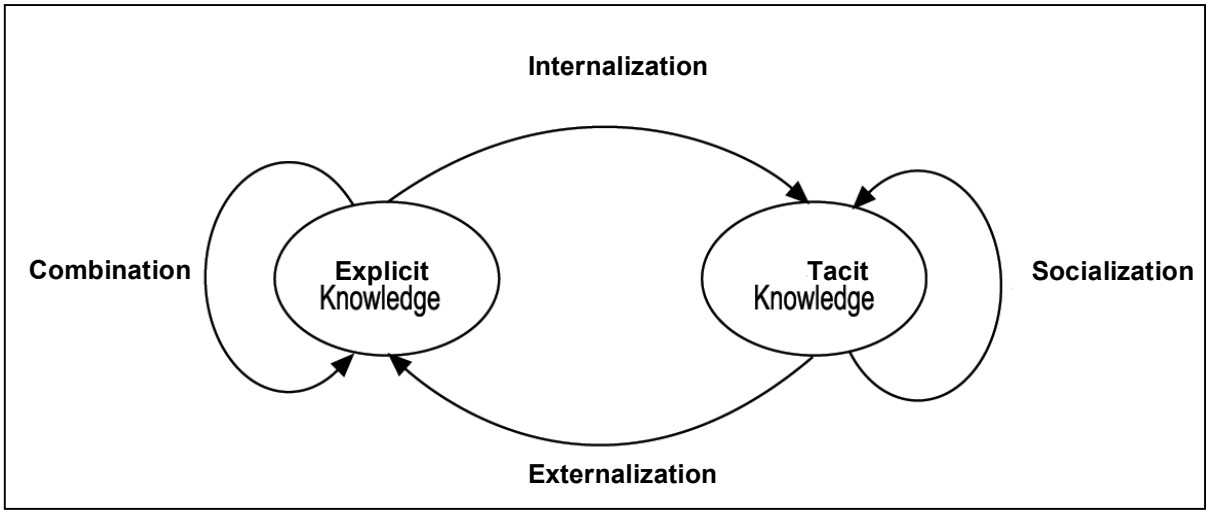

Figure 7.3 Cycle of knowledge creation and conversion (Huberman, 1993 and Nonaka and Takeuchi, 1995: 63-69)

With regard to the theory-practice process described and investigated for this research, the focus is on the conversion from *explicit knowledge into tacit knowledge* (internalization), whereby the process from *tacit knowledge into explicit knowledge* (externalization) is also taken into account for the construction of the final conceptual framework. This model implies two dynamics and interactions that are relevant to this research:

1. The *knowledge transfer* from explicit knowledge to the knowledge user (internalization): it is important to note that the link from theory to practice is 'owned' by the individuals who adopt the theory (knowledge users). This suggests that, like technology (e.g. Williams et al., 2000), the purpose of theory is not fixed but depends on the way users appropriate it (Oliver, 2001).
2. The communication of tacit knowledge through *feedback and reflection* on action (externalization): people gain (tacit) knowledge through context (experiences) and understanding Cleveland (1982), weaving past experiences into new knowledge (theory) by absorbing, doing, interacting, and reflecting.

A more detailed representation of these two interactions and dynamics between theory and practice is provided by Nonaka and Konno (1998) and visualizes the

two streams of knowledge conversion from explicit to tacit knowledge and vice versa (Figure 7.4).

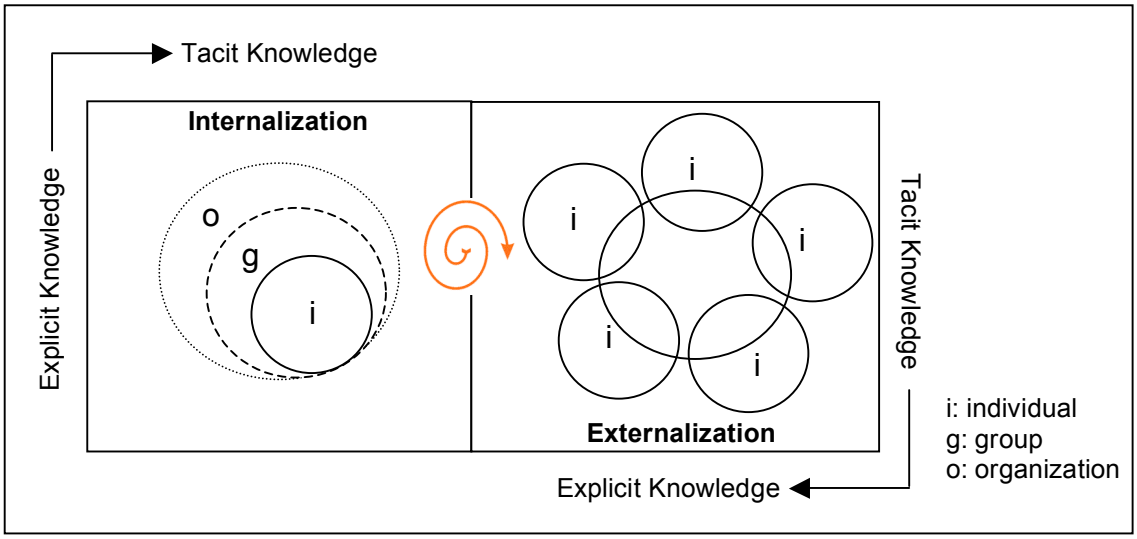

Figure 7.4 Spiral of knowledge conversion (Source: Nonaka and Konno, 1998)

To conclude the discussion on theory-practice interaction and dynamics, the model of 'mediated action' developed by Tensaki and Hay (2004) is discussed in more depth. In the view of the researcher, this model is useful as it focuses in more detail on the linkages between theory and practice in the context of project implementation. 'Mediated action' as a concept is developed by Vygotsky (1979), and is based on a principle of unity of consciousness (i.e., theory) and activity (i.e., practice), which implies in the case of this research that 'theory comes to exist, develops and can only be understood within the context of meaningful, goal-oriented, and socially determined interaction between human beings and their (material) environment' (Tensaki and Hay, 2004: 180). Ryder (2003) describes how human beings ideally mediate their activities through artifacts, which implies that people, before undertaking activities, should appropriate some form of mediation through prior knowledge, theory, guidance, education, expert advice, etc. concerning the intended activity (Luria, 1981; Ryder, 2003).

The model of 'mediated action' developed by Tensaki and Hay (2004) aims to increase understanding with regard to the linkages and dynamics between

theory and practice in the context of a project and also describes the different functions these linkages perform. Tensaki and Hay (2004: 186-189)[16] divide the components of theory and practice over three discernible and sequential stages: project definition, project execution and project realization.

In the case of the four selected case studies, the triggers for the start of a project generally came from practice (e.g., a crisis situation, future vision of leadership or new mandates) and required a form of explicit knowledge (IWRM or AM) that then forms the basis of newly defined projects aiming to deal with the practical issues and needs. At the start and throughout these projects, explicit knowledge is transformed to tacit knowledge by those involved in the project definition and execution stages (framing). Those individuals have access to the explicit theory through different media: contemporary literature, expert advice, personal knowledge and experience, etc. When projects are defined, they are translated into plans and action, which are implemented and monitored in the specific contexts. After project execution, project realization is characterized by dual outcomes, theoretical and practical outcomes.

Based on the discussion, a refined framework for theory-practice process and its linkages is proposed in this section (Figure 7.5), which is quite similar to the initial conceptual framework, but includes a feedback loop representing the interaction between theory (explicit knowledge) and practice (tacit knowledge).

[16] This model is depicted in Chapter 2, Figure 2.6, page 56

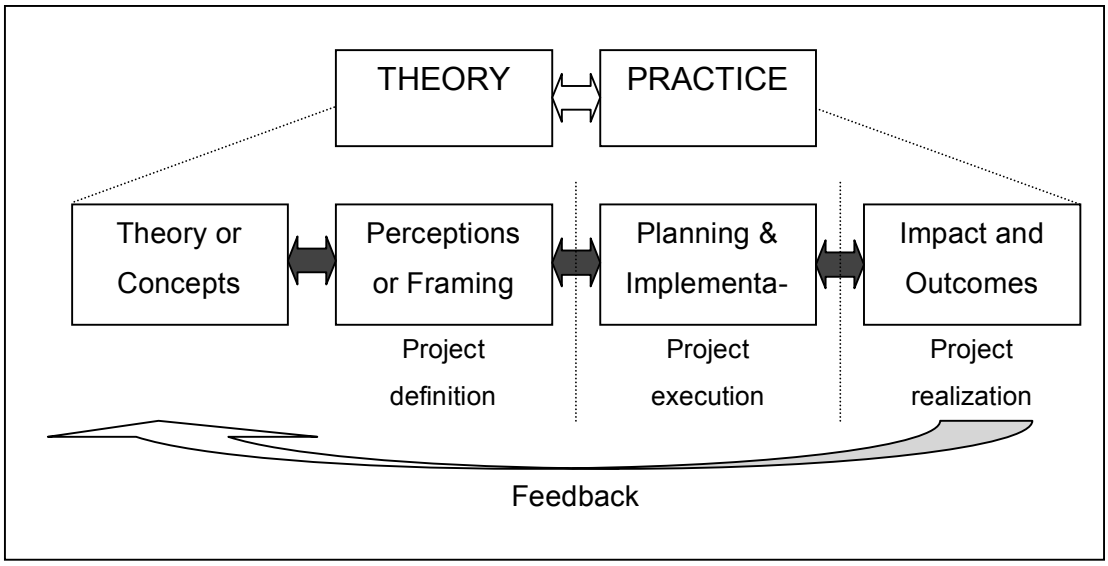

Figure 7.5 Conceptual Framework for theory-practice

7.6 Proposed Conceptual Framework

The discussion in Section 7.5 aimed at developing a greater understanding of the dynamics and interactions between theory and practice, whereas Section 7.4 highlighted the mediating factors that influence the change processes that are involved with the implementation of IWRM and AM concepts. This section investigates and describes the dynamics between the mediating factors that influence the planning and implementation of IWRM and AM.

There are emergent change programs as well as carefully planned ones, although even those generally have some emergent impacts. This implies that there is a link between change content and change context, but also between context, the process, and individual attributes. The case study investigations as well as feedback from the stakeholder discussions indicate that the different mediating factors that have been identified interact with each other in different ways. For example, the context and content of change (what is being changed) influence reactions of those involved in the proposed change process. Apart from the context conditions and the specifics of change (content), the way in which change is planned and implemented also affects the attitudes of people

involved in the intended change. The way change is introduced and facilitated and the way people are prepared for the change, affect their attitudes and behaviours during the process. In other words, there is some sort of hierarchy in the interaction and dynamics between the different factors. This hierarchy between different types of mediating factor interacting at different levels is visualized in Figure 7.6 below.

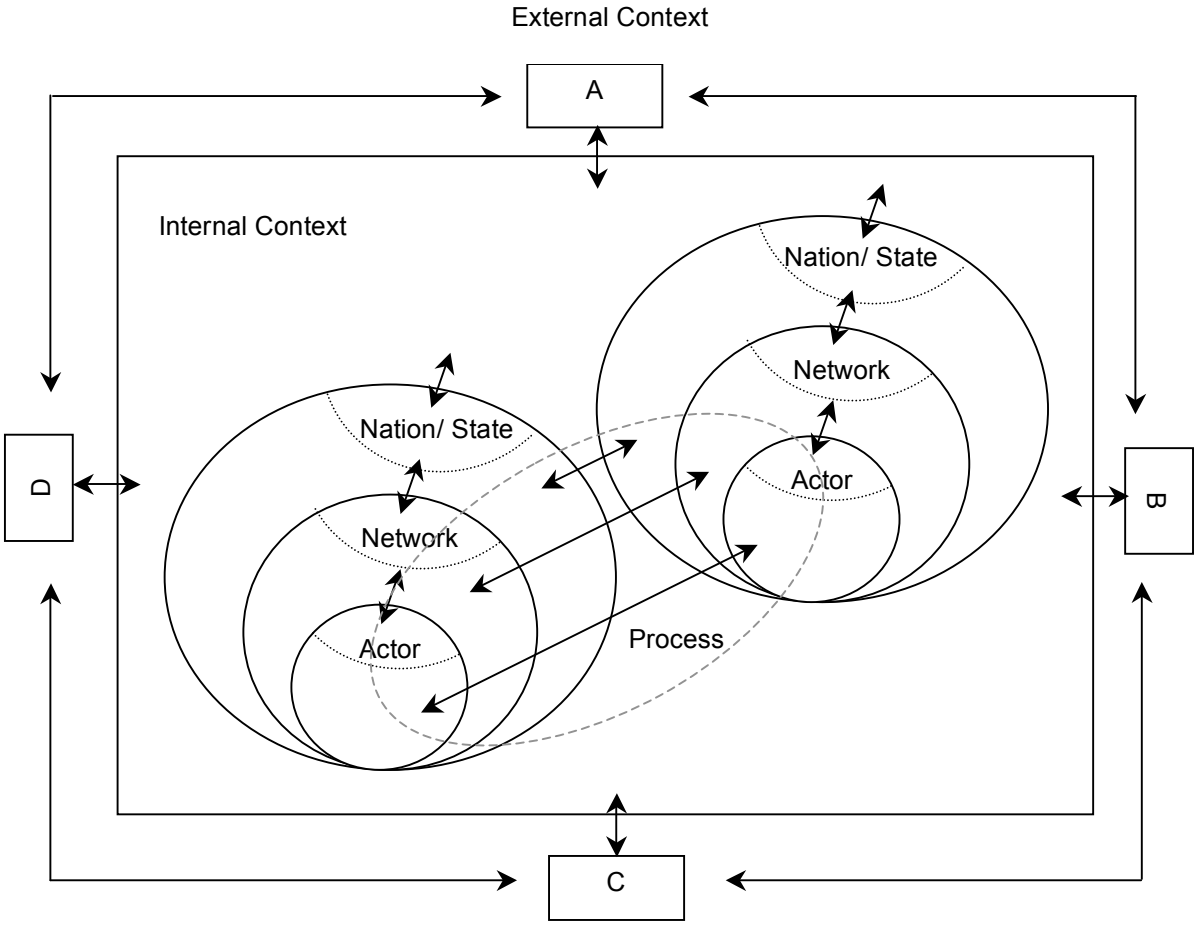

Figure 7.6 Interaction between context, process and individual attributes factors

As mentioned, a system's prior change history of successful or unsuccessful change attempts should also be taken into account as a factor that can impact the process as well as the levels of openness or resistance to change. Feelings and attitudes towards change can either negatively or positively affect the success of present and future change processes.

At the core of the different mediating factors and their dynamics are the individuals (and their attributes) that form the basis through which the change planning and implementation is manifested. Many change agents might make a mistake when writing off this phenomenon as simple 'resistance to change', which can be overcome either by ignoring it and by just ploughing ahead, or by trying to pacify it through e.g. motivational speeches or a quick hitting series of team meetings. Instead more thorough attention must be paid to the cognitive and psychological conditions underlying the resistance to change. Generally, few guidelines exist for defining how work is to be done, or performance is to be measured, and how people's positions and careers will fit and grow in the desired system state.

Damonpour (1991) suggests that change success ultimately be determined by a fit between the different content, context, process and individual factors (see Figure 7.7). In other words, they are interconnected and embedded and all these factors need to work towards the change. It should be noted, however, that some factors are easier to change in the short term and can trigger a change also in other factors. This interaction between these factors and the way they affect change in each other requires further research.

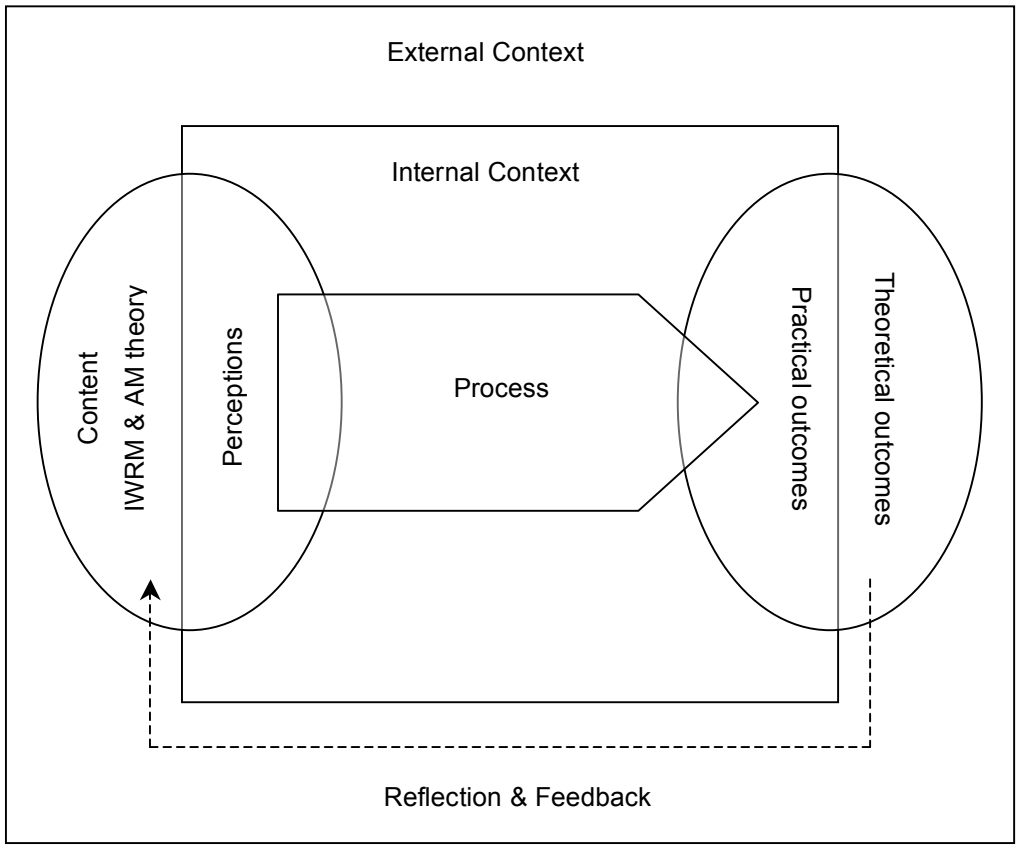

Figure 7.7 Theory-practice process and mediating factors

7.7 Conclusions

This chapter discusses in detail the theory-practice links and interactions and proposes a framework of the implementation process of IWRM and AM theory into practice. This chapter also provides an outline of important mediating factors (i.e., content, context, process and individual attributes and their interplay) that this thesis suggests should be considered when it comes to the implementation of water management theories and concepts, IWRM and AM in particular.

The case studies indicate that the types of mediating factors and their dynamics are very similar when it comes to IWRM or AM, but that the specific details and intensity of the factors and their dynamics are context dependent. The conceptual framework and the evaluation of mediating factors are not prescriptive models that should be applied as a blue print, however, they are

tools that can be used by scientists, managers and practitioners to ask questions about what is going on in specific change contexts and processes and experiment with possible ways to change and improve the implementation process and outcomes.

8 Conclusions

This concluding chapter briefly summarizes the main points and findings derived from the discussion chapter as well as carrying forward the 'key contributions' established. It considers how the research aim and questions were met and how the research questions were answered by means of this study.

The contributions to knowledge this study has provided are further outlined and described as well as the limitations of this study, and finally, suggestions for further research are made.

8.1 Reflection on Research Findings

The aim of this section is to provide a reflection on the general findings from this research (as discussed in detail in Chapter 7) and to find out to what extent the research findings provide answers to the research questions and the overall research aim (as presented in Chapter 1). The research questions have been developed to find out why there is a divide between theory and practice as well as the underlying reasons for this divide. Based on the research findings it is also important to discuss how this gap can be closed.

The IWRM and AM concepts both offer attractive ambitions for improving water resources management, both also facing similar barriers and challenges to their implementation. This points to a wider underlying problem of translating generic (science-based) management concepts and theories developed by academics into practice. Theory and practice are interdependent and should not be considered separate from each other. The construction of theory (explicit knowledge) is an evolving process that is continuously changing as new understanding and knowledge emerges through experience from practice (tacit knowledge). In other words, theory comes to exist, develops and can only be understood within the context of meaningful, goal-oriented and socially determined interaction between human beings and their environment. The

process from theory to practice is owned by the individuals who adopt the theory (knowledge users). Thus, the purpose of theory is not fixed and depends on the ways the explicit knowledge users appropriate it. People develop and gain tacit knowledge by weaving past experiences into new knowledge and theory (feedback and reflection).

As described, components of theory and practice can be divided over three discernible and sequential stages: project definition, execution and realization. Theory is transformed to practice by those involved in the project definition and execution stages (through framing). These individuals have access to explicit theory through different kinds of media (e.g. contemporary academic and grey literature, expert advice). However, when linking this back to the findings of the similarity analysis, it becomes clear that there is a gap between explicit and tacit knowledge domains with regard to IWRM and AM. The findings indicate that a majority of the case study respondents (despite extensive experience in the implementation of IWRM and AM) were not able to comprehensively define and describe the concepts and their purposes.

Empirical evidence from the interviews suggests that most respondents do not have or take time to inform themselves regarding the theory of IWRM and AM concepts. The respondents have learned and developed understanding through experience and involvement in projects and interaction with others, but development of knowledge about IWRM and AM through reflection on contemporary academic and grey literature is taking place only in a very few cases. In other words, most respondents have developed tacit knowledge with regard to IWRM and AM through their own experiences and those of others, but they have not ‘internalized’ or absorbed explicit knowledge. This process of internalizing explicit knowledge involves the activities of applying theory in practice through ‘learning by doing’.

To summarize the above shortly, it should be noted that continuous interaction between explicit knowledge and tacit knowledge is crucial in closing the divide between theory and practice. Both relevant literature and empirical evidence

from case studies highlight a divide between the theory of IWRM and AM and the practical experience of its users. In order to divide this gap between explicit and tacit knowledge domains, effective ways are to be employed to bring explicit knowledge to the practitioners, while at the same time the explicit knowledge domain of the concepts can be improved and refined through a more frequent and continuous interaction with the tacit knowledge domain.

It is also described that implementation of integrated and adaptive water management approaches requires a structural change and institutional reform in water management regimes. In other words, IWRM and AM involve change processes: that of translating IWRM and AM theory and principles into practice and the changes that are required for management systems to transform from current regimes to adaptive and intergrated regimes. These change processes are influenced and affected by different factors and the empirical findings from this research indicate four key categories: content factors, context factors, process factors and individual attributes.

The success or lack of success of a change process is determined by a fit between the content, context, process and individual factors. In other words, they are all interconnected and embedded (see Figure 7.6) and ideally should be working together towards intended change. It should be noted though that some of these factors categories may be easier to change in short term than others, and possibly function as a stronger trigger for change in that sense. The way these factors affect change processes and interact with each other has been researched through the case studies. Findings indicated that the context and process factors, identified by interview respondents, have been the strongest barriers for the implementation of IWRM and AM in the four case studies. At the same time, however, process factors have also been highlighted as the strongest enabling factors for IWRM and AM implementation. This implies that the way in which change has been introduced and communicated, as well as guided and facilitated, has significantly made implementation of integrated and adaptive approaches easier in the selected case studies.

The four identified factor categories all affect the change processes for IWRM and AM in different ways:

- *Content factors* refer to the types of changes for IWRM and AM that are being implemented;
- *Context factors* indicate why integrated and adaptive approaches need to be implemented and also why their implementation is eventually succesful or not;
- *Process factors* provide insight into how change with regard to IWRM and AM is implemented;
- *Individual attributes* describe those who are involved in and affect the implementation process of IWRM and AM.

With regard to the *content factors*, it can be stated that the key barrier to implementation of IWRM and AM concepts is related to the fact that it is not clear exactly what these concepts mean and how they should be implemented. Placing IWRM and AM in their historical contexts, it should be noted that both concepts have evolved over time and therefore have no single correct definition or interpretation. This ties with the critical importance of contextual factors in shaping the extent and nature of the implementation process and challenges. This thus implies that no blue-print of IWRM and AM and their implementation processes is possible. However, ambiguity of definitions can result in a lack of clarity about the purpose and process of the concepts and compunds difficulties in demonstrating the success of the concepts.

Another important content factor is with regard to the type of change that is required for IWRM and AM. This type of change can be described as being of transformational and radial order, which requires a shift in assumptions made by organizations and their members. However, in reality both concepts are implemented incrementally, through a step-by-step movement toward a system ideal. In other words, the way IWRM and AM are being implemented is possibly not effective for the type of change that is required.

In the context of IWRM and AM, individuals and organizations are heavily dependent on their environment and their learning to adapt is not by controlling their environment, but by learning to get what it needs to take effective action. In other words, it is important to understand the different contexts and *context factors* that determine and affect the implementation of IWRM and AM. Context factors are described as pre-existing forces and conditions in the external and internal environment of a management system that impact the effectiveness of the system. External factors are those over which the system has little to no control. And internal context factors are conditions that provide indication of the general readiness towards change.

External context factors, emphasized by the case study respondents, that influence IWRM and AM implementation are e.g. economic situations, crisis events, but also historical context and culture. Economic situations impact the way priorities are set and affect political directions and processes. Crisis events can drive political processes and increase sense of urgency and awareness. They can, however, also lead to increased stress and competition. Political processes are characterized as top-down and short-term, whereas IWRM and AM require longterm visions and commitment as well as a considerable amount of resources and skills. In reconciling different approaches and processes, historical cooperation and the historical context can influence the level of willingness or openness to cooperation, as attitudes and behaviour depend on past experiences. Culture is also a factor to be taken into account while implementing change as there is a causal relationship between personality, behaviour and culture. In other words, culture determines in part the way people behave in change processes.

Internal context factors are aspects such as the existing physical and management structures, approaches and practices to water planning and use. Differences vetween structures make it challenging to manage a basin as one single entity from a planning perspective. Management structures and legal frameworks determine division of roles and responsibilities and when these are overlapping between structures or too complex, it becomes unclear who is

responsible for what. Changing existing structures or legal frameworks is very difficult as it involves shifts in power and cntrol.

With regard to context, it should be stated that IWRM and AM are generally implemented through policies. Policy can be developed and implemented in different types of contexts ranging between periods of significant change and periods where systems are essentially stable. These contexts and their change status likely have bearings on possible outcome of policy development and implementation. For example, decisions to undertake major policy changes are more easily made during periods of significant change as changes tend to be slower and more incremental in periods of relative system stability. It was mentioned earlier that IWRM and AM are of radical and transformational nature, although they are generally implemented incrementally. Respondents in the four case studies affirmed during interviews that e.g. crisis events (periods of significant change) were strong drivers to the implementation of IWRM and AM.

Process factors refer to actions and directions taken during the planning and implementation of change. It refers to the way leaders itroduce change as well as guide change processes. Stakeholder groups and individual representatives form the basis of these change processes and the way their participation and involvement is arranged forms a key aspect to the attitude of these individuals in the change processes. Success of IWRM and AM depends on whether these concepts are embraced by the multitude of agencies and stakeholders involved.

Generally, IWRM and AM demand collaboration and cooperation between a large amount of stakeholder groups, each with their own mandates and interests and often competing agendas. On the one hand, a diversity of perspectives is necessary in order to address complex problem solving, however, the challenge is to get these parts properly coordinated. In this light, it is important to note that increased cooperation also means more diversity of (competing) interests and practices that need to be reconciled. In other words, an appropriate combination should be found between independence as well as interaction. IWRM and AM both have no mechanism built into the concepts and

methods to deal with binding arbitration and mediation and further research areas should studied to solve these issues.

Effective communication creates more transparent and open process of collaboration. Leadership is also a crucial aspect to facilitating change processes as effective visionary leaders and facilitators are indispensable in creating a clear and common vision that brings different parties together. Leadership is important at different levels, from a political support base to effective process facilitators and stakeholder representatives. If there is no common vision that drives these different groups, it is implied that leadership has not been succesful in bringing the parties together. Frequent interaction is needed between different parties in order to respond to changing environmental and public needs. Continuity of interaction supports building trust and understanding between the variety of individuals.

IWRM and AM are mainly human processes that are shaped and affected by the *individual attributes* of the people that are involved in these processes. Each change process involves a variety of individuals with specific characteristics and mindsets that determine their attitudes and behaviours towards change. As mentioned, human nature is inherited with ones genes and interplays with culture to produce personality traits. In line with phases in a change process, attitudes and behaviours of individuals towards change ideally goes from an initial readiness, to adoption and finally institutionalization. Readiness occurs when external and internal context as well as stakeholder's attitudes are non-resistant and open to the proposed change.

It has been stated that policy makers pay more attention to policy development (in this case based on IWRM and AM principles) than to policy implementation. However, without implementation strategies and commitment to carry them through, policies have little value. Policies create expectations and if those are not met, credibility is lost and further action is hampered as well as the possibility to address significant problems in a meaningful way. This is mostly, because feelings and attitudes towards change are affected by the success of

present and past change processes. Even best planned, supported and promising policy initiatives eventually depend on what happens as individuals interpret and act on these policies. The emphasis here lies on individual motivation and attitudes as policy can enable outcomes, but it cannot mandate what really matters.

Levels of openness or resistance to change could be viewed as an indicators of the extent or scale of the intended change, assuming that the higher the scale of change, the more resistance will be there. In the case of IWRM and AM, this resistance to change identified through the case study respondents could then be explained by the transformational nature of the concepts. Resistance to change can also be caused by a loss of a stable state and by factors such as: the need to keep power and control; personality traits, competition between interests; low levels of trust; etc. More attention should be paid to the cognitive conditions underlying resistance to change. People must learn to understand, guide, influence and manage the transformations that are related to IWRM and AM. Generally few guidelines exist for defining how work is to be done, or performance is to be measured and how people's positions and careers will fit and grow in the desired state.

8.2 Implications of Research Findings

Subsequently to the above reflection on how the research findings answer the research questions, this section will discuss succinctly how this research has contributed to knowledge in general and what the research findings mean and imply for future development and application of IWRM and AM. Some specific policy recommendations to addess the various implementation barriers and obstacles identified through the study are put forward.

8.2.1 Contribution to Knowledge

This thesis significantly contributes to our understanding of the process by which theory is turned into practice in general and for the case of IWRM and AM concepts in particular. The study has also made three more general and distinct

contributions to knowledge. The first, by means of the research process developed and utilized, is methodological. The second, in terms of the conceptual framework derived, is theoretical. And the third, with reference to the content and findings of the thesis itself, is substantive – i.e. the potential practical application of the knowledge generated by this study. These are summarized below:

Methodological Contribution: The research process developed and utilized for this study has provided the demonstrable means by which to facilitate certain kinds of exploratory research where the co-creation of findings between researcher and research participant is relevant. The utility and robustness of the research process, that was developed and utilized for this research, has been demonstrated in this thesis. Through this approach we have not only investigated the theory-practice process and its linkages, but have constantly gone back and forth between theoretical knowledge and information (explicit domain) and experiences and insight grounded in practice (tacit domain).

Theoretical Contribution: The conceptualization of the data collection and the findings that were derived from this data has provided further understanding and knowledge in the way that theory and practice are linked as well as the mediating factors that influence this process. In addition, the dynamics and interactions between the different factors have been investigated. Of novelty are the conceptual frameworks developed that propose representation of the theory-practice process and its links in the light of an explicit-tacit knowledge cycle as well as the revised frameworks that show the mediating factors that affect this process and their interactions and dynamics.

Substantive Contribution: The conceptual framework developed through this study and the findings from it provide a framework of exploration, which can be used by scientists, managers and practitioners during the planning and implementation of IWRM or AM interventions. They provide a platform for discussion and aim to increase the understanding of these processes and through that the effectiveness of their implementation.

8.2.2 Recommendations to Policy Makers and Practitioners

Chapter 7 and Section 8.1 have discussed and reflected on the findings coming from this research. This section aims to provide specific recommendations to address the various implementation barriers and obstacles (at the level of content factors, external and internal context, process factors and individual attributes) identified through the study.

As mentioned, most respondents have developed tacit knowledge through practical experience, but not by internalizing explicit knowledge. Continuous interaction between explicit and tacit knowledge is important to close the divide between theory and practice. Effective ways need to be developed to bring explicit knowledge with regard to IWRM and AM to practitioners and at the same time improve explicit knowledge through more frequent interaction with the tacit knowledge domain. In other word, explicit knowledge has to be embodied in action and practice in more depth than just inclusion of its principles at the policy development level: it has to be carried through the entire process from theory to its practical implementation and back again. Thus the process of internalizing explicit knowledge actualizes the concepts through e.g. training programs that help individuals understand the concepts and what they imply for them and the process. Explicit knowledge can also be embodied through simulations and experiments to trigger learning by doing.

Nonaka and Nishiguchi (2001) describe how the interaction between tacit knowledge and explicit knowledge – i.e. knowledge creation – is taking place at different levels: individual, group, organizational and interorganizational levels. They further describe (2001: 18) that knowledge creation is a 'spiral process, starting at the individual level and moving up through expanding communities of interaction that crosses sectional, departmental, divisional and organizational boundaries'. This implies that knowledge creation is a *bottom-up* process that starts with the individuals using and applying specific explicit knowledge (in this case IWRM and AM).

Since knowledge is intangible, boundaryless and dynamic, and cannot be stocked, it has to be exploited where and when it is needed to create values (Nonaka and Nishiguchi, 2001: 19). To exploit and create knowledge effictively and efficiently it is necessary to concentrate knowledge at a certain space and time. By creating such space, knowledge-creating processes can be managed effectively (Nonaka and Konno, 1998). For example, the Japanese philosopher Nishida (1921, 1970) proposed a concept called 'Ba', that has been further developed by Shimizu (1995). 'Ba' is defined as a platform - where knowledge is created, shared and exploited - that functions as a medium for the resource concentration of organization's knowledge and the individuals who own and create such knowledge. It should be noted that this platform should include individuals from academic as well as non-academic knowledge domains.

Based on the above it is recommended to acknowledge that effective and efficient implementation of IWRM and AM, as well as improvement of the theoretical domain of the concepts, depends on a bottom-up approach. Contemporary literature and empirical evidence have indicated, however, that IWRM and AM are generally implemented in a top-down manner (as described in detail in Section 7.3.2). It is highlighted that policy makers give considerably more attention to policy development than to policy implementation, even though consequences of even the best planned, best supported and most promising policy initiatives depend eventually on what happens as individuals throughout the policy system interpret and act on these policies (that are based in this case on IWRM and AM principles). In this light, it is crucial to understand and investigate individual motivations and attitudes as well as internal (inter) institutional and other influencing conditions. It is therefore proposed that the starting point for drawing up integrated and adaptive water policies and action plans should be based on locally identified problems and needs, while taking into account and developing deeper understanding of the way individual attributes influence the implementation process and the ongoing iterative relationships between the different stakeholder groups.

Damonpour (1991) suggested that success of change processes and implementation of policies are ultimately determined by a fit between the specific content, context, process factors and individual attributes. These different key factors are interconnected and an oversight of how these factors interact has been provided in Figure 7.6 and 7.7 and the way they affect change processes have been described in Section 7.4. External factors such as existing culture as well as historical cooperation affect the way individuals behave and cooperate in change processes. In that sense it will also be difficult to change individual attributes and behaviours toward change. Although external and internal contextual factors are important in order to understand pre-existing forces and conditions, actual change is more likely to happen in the shorter term in the way change processes are organized and guided. Empirical evidence from the four selected case studies indicated indeed that major enabling factors experienced are process factors.

With regard to the way change processes are organized and guided, it should be noted, however, that if a management system or change process is too well integrated and coordinated (meaning that too many aspects are included and too many stakeholders are involved) that the system or process and no longer effectively accumulate adaptations and learn. As connections become richer or the system larger, so will the system's time required for adaptation increase. This implies that it is important to find the 'right' balance in the amount of stakeholder groups that are involved in the change processes as well as the amount of problems or aspects that are focused on at the same time. A requisite diversity of perspectives is necessary in order to be able to address complex problem solving, however, too many 'channels of communication' can cause noise and distraction. More research needs to be done on how this balance can be found and also how this balance changes according to the issues and needs that are being focused on.

As mentioned, change processes are depending on the leadership and vision. It is important to chose people to facilitate these processes that have throrough understanding of how to play with the divergence of personalities and

characters that are involved in change processes as well as of how to deal with and resolve possible conflicts and competition between different stakeholder groups and individuals. These individuals should have the capability to develop transparent and genuine communication and cooperation processes based on an atmosphere of inclusivity, legitimacy, efficiency and ownership. Stakeholders should be made aware of what is expected from them in the change processes and commit to these requirements. Frequent interactions between stakeholder should not only evolve around solving problems and issues, but about learning and reflecting on past experiences in order to improve and refine integrated and adaptive plans and actions taken. The way these change processes are organized will also greatly impact the way the individuals that are involved behave and cooperate.

8.3 Limitations of Research

Social science research often has subtler, practical difficulties to address with respect to access to data than research in the 'hard' sciences. Such research cannot be confined to a lab bench with careful control of all the variables. The research process for this study is no exception. A limitation is that there were only four case studies researched, each of those located in a Western or so-called 'developed' part of the world. Thus the ability to make generalizations is more limited than if additional cases from developing countries had been included. However, limitations of time and other resources made this impossible. In other words, mere practicalities of having access to people and data – such as time, money, access, availability of relevant people, geographic location – often make it impossible to obtain participants that represent a true cross section of the population of interest. However, in the case of this research an attempt has been made to address as many relevant stakeholder parties as possible.

The case study research method also has limitations in isolating variables and establishing causal links. And communication in both directions for in-depth interviews is based on subjective interpretations of language and meaning. This

reduced the reliability of isolated data, although triangulation (using literature, semi-structured interviews of four case studies and expert discussions) was used to improve the reliability and validity of the outcomes.

Certainly, the researcher's own filters and perceptions must be acknowledged in qualitative research, this being both an acknowledged strength as well as a weakness of the qualitative approach. However, it may be seen as a limitation only insofar as the researcher's world view is not declared 'up front' or if interpretive methods are rejected in whole or in part (Punch, 1994).

Also, the proposed conceptual framework for theory-practice of water management concepts is to an extent a speculative proposition based on empirical evidence, but not on actual field-testing of the final framework. However, since this framework is proposed as a tool to increase understanding of the process and dynamics, and not a blue-print or prescriptive framework, this tool can be experimented and tested in the future with other case studies.

8.4 Recommendations for Further Research

This study represents a number of areas for fruitful future inquiry, some of which are implied already in the foregoing discussion in Chapter 7.

The replication of the same research method but using many more cases located in a variety of contexts (including case studies in developing countries), would improve the reliability and generalizability of the results reported and the conceptual framework developed and proposed.

The proposed conceptual framework could also be field-tested. Ideally this proposed framework would be tested for more than just whether it could successfully enable to increase the understanding of stakeholders of the implementation process of IWRM or AM.

Further research is required on effective ways of bringing explicit knowledge on IWRM and AM to practitioners in order to close the divide between IWRM and

AM theory and practice. The benefit of this would also be that the explicit knowledge domain of IWRM and AM could improve and refine through a more frequent and continuous interaction with the tacit knowledge domain (i.e., practice).

As change success ultimately is determined by a fit between the different content, context, process and individual factors it might be useful to research whether some factors are easier to change in the short term and can trigger a change also in other factors. In other words, this interaction between these factors and the way they affect change in each other requires further research. It is important to refer to the importance of factors that have been identified such as: culture, resistance to change, and a historical perspectives – these factors point towards the fact that blue-prints for IWRM and AM implementation will not work.

At the core of the different mediating factors and their dynamics are the individuals (and their attributes) that form the basis through which the change planning and implementation is manifested. More thorough attention must be paid to the cognitive and psychological conditions underlying the resistance to change. Generally, few guidelines exist for defining how work is to be done, or performance is to be measured, and how people's positions and careers will fit and grow in the desired system state.

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Appendices

Appendix	*Title*	*Page*
1	List of Mediating Factors from AWRA Discussion	355
2	Interview Script	357
3	Email sent to Potential Respondents	363
4	List of selected Respondents	365

Appendix I: List of Mediating Factors from AWRA Discussion

Formalised-Interpreted	Interpreted-Implemented	Implemented-Impact
AM and IWRM are didactic theories that induce ideas. Both theories are abstract and holistic and could therefore be interpreted in various ways by practitioners.	Not enough time accounted for proper assessment, planning and policy making	Improperly setting and defining of achievable goals and management objectives. It is crucial to define and focus on the 'right' problem.
Gaps exist between the more technical and social sciences. Both concepts involve integration and cooperation between different disciplines and sciences. Also practitioners involved in the technical components could very well interpret the concepts different than the practitioners that focus more on the social-economical aspects.	Also theories are often developed and then 'blindly' taken over by policy makers and practitioners without assessing the true value of the theory in the specific context.	Monitoring and evaluation are crucial. No funding for monitoring and evaluation. Lack of performance measurement.
There has been no consensus about how to define exactly the concepts of Am and IWRM. Also the questions remain whether this is indeed a problem for the implementation of the concepts?	Insufficient transparency and accountability and unclear division of roles, functions and responsibilities. Also lack of leadership was discussed.	No flexibility in institutional and regulatory setting. No sustained institutional memory/ capacity.
In order to 'sell' and 'promote' theory, one needs to have sufficient practical evidence.	Lack or sufficient flexibility in the Institutional and regulatory setting. Also lack of commitment to the process.	Limited practical evidence to successful implementation of the concepts. The question remains what is success? Wrong idea/ theory or too late?
Also theories are often developed and then 'blindly' taken over by policy makers and practitioners without assessing the true value of the theory in the specific context.	Insufficient capacity in institutions and lack of funding to include and follow all the steps/ phases of the concept management cycles.	Uncertainties that have influenced success of implementation and were not foreseen in process of developing and implementing hypotheses/ experiments. Lack of resilience in the system.
Another question that remains for many practitioners is: how are the AM/ IWRM approaches to be implemented?	Managers, policy makers and practitioners have different management goals and objectives than scientists.	Performance and success are things that do not show up until the end or even longer.. Patience to wait for results and long-term impact

	No time for reflection. Planned schedules and budgets restrict time for reflection.	Commitment to the learning process
		Inappropriate scale (geographically/ authoritative)

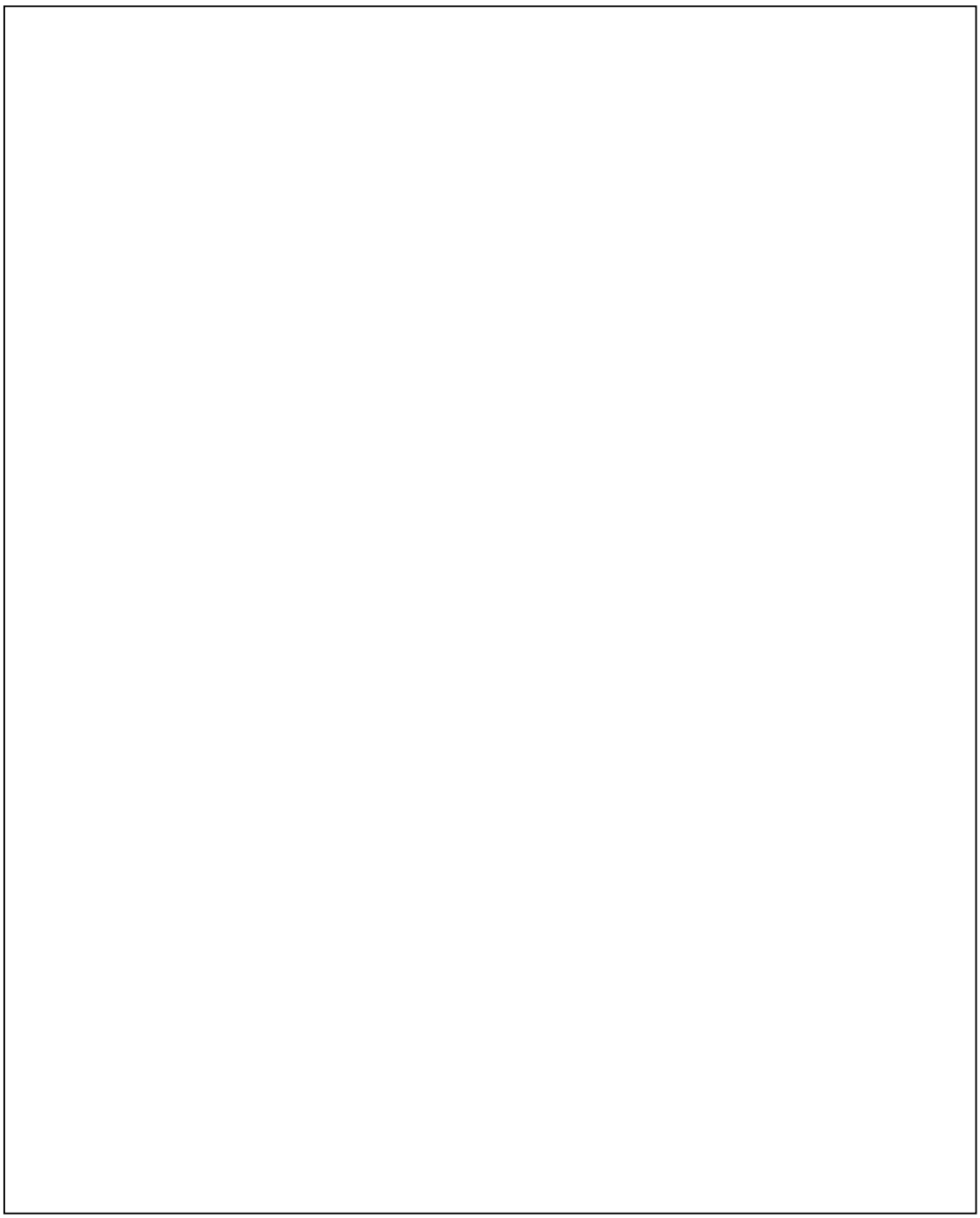
Appendix II: Interview Script

Section	Categories and questions
1	**Introduction**
	▪ Nice to meet you my name is Wietske Medema from the Centre for Water Science at Cranfield University. My research is funded through an Integrated Project, called NeWater, which is funded under the 6th EU Framework Programme. ▪ As you are aware from our earlier communication, my research focuses on evaluating the mediating factors that influence the implementation of concepts for water management. In the context of [--name of case study--], I would like to talk with you about your experiences in designing and/or implementing [--select IWRM or AM--] and the barriers and enabling factors that you have encountered during the implementation process. ▪ I would like to state that your anonymity will be preserved and that the responses and information you provide during the interview will be treated confidentially. All records, responses and data, from this interview will be transcribed and the original hard copies of notes and voice recording files will be stored for one year and then destroyed. Electronic versions of the transcriptions will be stored on a secure server once they have been validated and are only accessible to my supervisor and myself. For the purposes of reporting the work we will refer to Respondent '01', '02' etc. ▪ The interview will take around 45 minutes to one hour. After the interview I will prepare a transcription of our conversation and send you this to validate its contents. I will send it as soon as possible via email. ▪ Also, I would like to ask for your permission to record this interview with a Dictaphone, as recording our conversation will improve the quality of response records and the summary report. ▪ Before I start, I would like to know if you are still willing to participate in this interview session and if you have any questions?
2	**Personal information**
	I will start by asking you some questions about your professional background with regard to the application of [--select IWRM or AM--]
a	How long have you been involved in the implementation of [--select IWRM or AM--] in general?
b	And, how long have you been involved in the implementation of [--select IWRM or AM--] in [--name of case study--]?
c	How would you describe your role and main responsibilities within the [--name of case study--]?
d	Could you give me three examples of [--select IWRM or AM--] initiatives or activities that you have been involved in within the [--name of case study--]?

3	**Respondent's perception of AM**
	Through the next set of questions I would like to find out your understanding and perception of [--select IWRM or AM--]
a	Please explain to me in your own words what you understand by the term [--select IWRM or AM--]?
	-- Reconfirm their understanding of [--select IWRM or AM--] --
b	Please specify the general objectives of the [--select IWRM or AM--] approach? What do you consider it is designed to achieve?
	-- Write down these objectives --
c	Using this sheet, could you please draw the [--select IWRM or AM--] process and elements it exists of?
	-- Hand out sheet 1 --
d	How have you been educated or informed about the [--select IWRM or AM--] approach? (References/ key contributors/ papers/ reports/ etc)
	-- Continue to chase that question --
4	**Case study information**
	The following questions will focus more on implementation of [--select IWRM or AM--] in the context of the [--name of case study--]
a	When was the use of the [--select IWRM or AM--] approach initiated in the [--name of case study--]?
b	Can you tell me the reasons why this approach was proposed at that time?
c	What are the overall objectives of the [--name of case study--]?
	-- Write down these objectives --
d	Could you give me some examples of methods and tools have been used with regard to the implementation of [--select IWRM or AM--] in the [--name of case study--]?
5	**Mediating factors**
	I would like to discuss barriers and enabling factors that you have experienced during the planning and implementation of [--select IWRM or AM--] in the [--name of case study--]. Barriers can be described as factors that have hindered or stopped the implementation process of [--select IWRM or AM--]. Enabling factors are factors that have facilitated and enabled implementation of [--select IWRM or AM--].
a	Can you describe three barriers that you have encountered during the implementing of [--select IWRM or AM--] in the [--name of case study--]? Please describe clear situations in which you have experienced these barriers
	-- Write down barriers on Sheet 2 --
b	Could you choose the barrier that you perceive most influential with regard to the implementation of [--select IWRM or AM--] in the [--name of case study--]? And why this one?

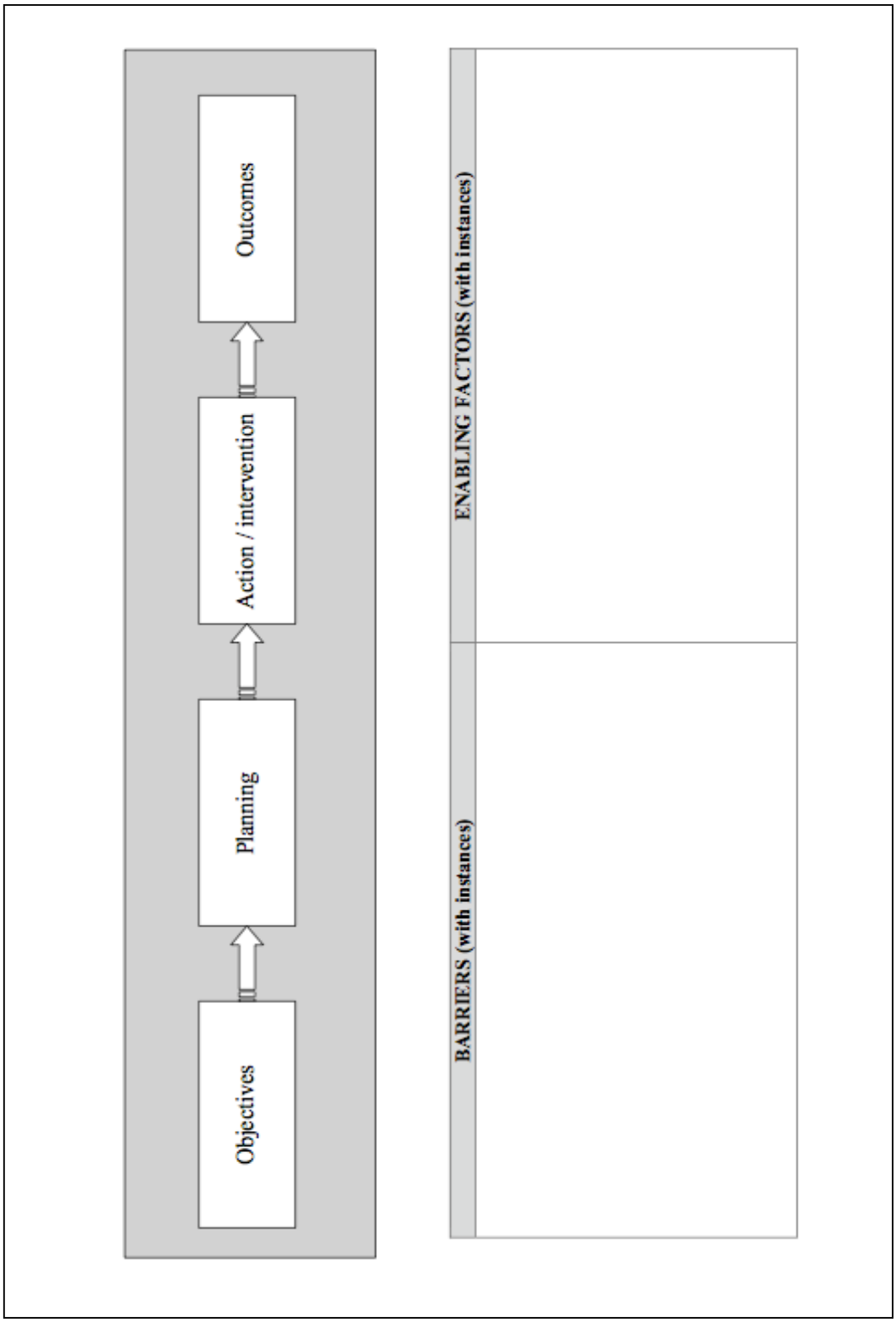
c	Could you also state three enabling factors that have facilitated the implementation of [--select IWRM or AM--] in the [--name of case study--]*?* Also please give clear examples when and how you have encountered these enabling factors.
	-- Write down enabling factors on Sheet 2 --
d	Could you choose the enabling factor that you perceive most influential with regard to the implementation of [--select IWRM or AM--] in the [--name of case study--]? Why did you choose this one?
e	Please have a look at this model *[see sheet 2]* that is a simple representation of a project process: can you describe where each of the barriers and enabling factors have been most influential in this process?
	-- Depending on time availability discuss all barriers and enabling factors or only the most influential ones --
6	**Pathway diagrams**
	The last part of this interview focuses in more detail on the barriers and enabling factors that you have identified in your responses. The aim of these questions is to get a better understanding of the causes and effects of these factors as supposed to just looking at the factors as single attributes..
a	What situations or events have led to this particular *[-- barrier or enabling factor--]* being influential? *[this will inform what are the first level causes]*
b	And what have been the causes that have led to those particular situations or events? *[this will inform what are the second level causes]*
c	*[-- if relevant and revealing, you can continue to ask for third or fourth level causes as well --]*
d	When you consider this *[-- barrier or enabling factor--]*, what have been its immediate effects? *[this will inform what are the first level effects]*
e	And could you also describe to me what came forth of these situations or events? *[this will inform what are the second level causes]*
f	*[-- if relevant and revealing, you can continue to ask for third or fourth level effects as well--]*
7	**Realised objectives**
a	If you look at the objectives you have mentioned in the beginning *[quickly remind the respondent of the objectives they have given before]*, to what extent have these ambitions and objectives for [--select IWRM or AM--] been realised in the [--name of case study--]?
b	Why have these objectives not been realised? Or, how have these objectives been achieved?
8	**Ending interview**
	Well, this is the end of this interview and I would like to thank you very much for your cooperation. Do you have anything to add to what we have discussed or do you have any questions? Again, thank you very much for your time and I hope you enjoyed this interview…

Sheet 1 - IWRM or AM representation



Respondent’s code:

Sheet 2 – Barriers and enabling factors



Appendix III: Content of Email to Potential Respondents

Subject: [--*select IWRM or AM*--] in the [--*name of the case study*--] - NeWater project

Dear [*name of potential respondent*],

[--*Name of person who provided contact details*--] provided your name and contact details to me. My name is Wietske Medema and I am a researcher with the Centre for Water Science at Cranfield University, working on a European Union project under the 6th Framework Program called NeWater.

My research approach is to analyze the (historic) pathways of Integrated Water Resources Management (IWRM) and Adaptive Management (AM) implementation and to identify mediating factors that affect the implementation of these concepts. In the light of my research aim and approach it would be most appropriate to speak to people and institutions that have considerable experience in the implementation of IWRM or AM within a specific context. For this research I will be focusing on two case studies for IWRM, the Rhine as well as the Murray Darling, and two case studies for AM, the Kissimee River Restoration Project and the Glen Canyon Dam Adaptive Management Program. My aim is to interview managers, scientists and practitioners that have been involved at different levels in the implementation of IWRM or AM within the four selected case study basins.

I am writing to ask you if you are willing to be interviewed with regard to the implementation of [--*select IWRM or AM*--] within the [--*name of the case study*--] and if you have suggestions for other appropriate persons that I should approach for an interview. I will be conducting my interviews in person during [--*name of month*--] this year, with each interview lasting around an hour at your place of work. If you would be interested, I can provide you with a more detailed project outline, together with a draft of my proposed interview structure.

I would very much appreciate your time to support this research – the website can be found at http://www.newater.info/everyone should you wish to take a look. If you would like to talk to me about the interview, please send me an email and I will contact you.

I am looking forward to your response,

Yours faithfully

Wietske Medema

Appendix IV: List of Respondents

Res Code	Yrs. Experience	Institution(s)	Position(s)	Academic Background
R01	15-20	Ministry for Transport, public works and water management; DG for water; Rijkswaterstaten (RIZA); ICRP	Deputy director for international affairs; director general; international cooperation; negotiations; advisor of the minister	Water resources management
R02	10	Rijkswaterstaten (RIZA)	Trainer; capacity building specialist; curriculum development; process management; consultants; advisor	Water resources management; intercultural studies
R03	10-15	Alterra (Centre for Water and Climate); Ministry for physical planning (VROM)	Researcher policy development (water & physical planning); project manager; advisor to national water management body & water boards	Physical planning
R04	10	University of Delft	Trainer; scientist; communication and public participation advisor	Environmental management; environmental impact assessment
R05	5-10	Rijkswaterstaten (RIZA); ICPR; commission for hydrology of the Rhine	Forecasting scenarios for climate change analysis; advisory role in Dutch delegation of ICPR on flood control	Hydrology
R06	10-15	Alterra	Consultant/ researcher/ engineer in agricultural projects	Civil engineering; agriculture
R07	15-20	Province of Flevoland, department of Environment & Water; Rijkswaterstaat and the ministries of agriculture, fisheries	Project manager of the third policy for water management and some other national policy projects	Civil engineering

		and VROM		
R08	10	Alterra	Modeller; consultant	Hydrology; land drainage
R09	20	ICPR; Rijkswaterstaten (RIZA)	Water quantity & quality management; negotiation; project management	engineering; water management
R10	20	ICPR; Rijkswaterstaten (RIZA); University of Delft	Scientist; assistant professor in the river engineering; head of the flood protection division in the Rijkswaterstaat; secretary ICPR	river engineering; hydrology; ground water and groundwater recovery
MD01	10-15	Murray Darling Basin Commission (MDBC); Water authority in Northern Victoria	Murray Goulburn Water Coordinator; Manager of natural resources services; community advisor	Natural resources management; participation
MD02	5-10	CSIRO; MDBC; Council of Australian Government	Scientist; policy advisor	Agricultural management; water resources management
MD03	15-20	MDBC	Director Water Policy Coordination	Natural Resources Management
MD04	10	State government of Victoria	Public policy development; legal decision making; executive support role	Economist
MD05	10-15	Australian government; agricultural dept.; Bureau of Rural Sciences	Working on integration of ground and surface water management	Engineering; ground water quality
MD06	10-15	MDBC	River Murray Environmental Manager; multi disciplinary and multi ownership types of projects	Environmental management; stakeholder participation
MD07	10-15	Goulburn Broken Catchment Management Authority	Manager and facilitator in multi-disciplinary projects; water sharing issues; Environmental Water Flow Coordinator	Engineer
MD08	10-15	CSIRO; Consultancy	Scientists; Consultant in land and water management plans; Manager, Research Adoption	Agricultural Science

MD09	10-15	CSIRO; Research Chair, Water Economics & Management; University of Adelaide	Consultant; advisor; scientist; fisheries, forestry, agriculture and environment; professor	Ecological economist
MD10	5-10	Charles University (CSU); School of Environmental Sciences	Senior Lecturer, Environment, Sociology and Planning; scientist	Agricultural Science; Natural resources management
MD11	15-20	MDBC; Deputy Chair of the CRC for Plant Based Solutions to Dryland Salinity	Chief Executive of the Murray-Darling Basin Commission; Deputy Chief	Civil engineering
MD12	5-10	Australian National University	Scientist	Water resources management
MD13	10-15	CSIRO; Australian Research Centre for Water in Society	Working in projects focusing on social aspects of water management; research scientist	Sociology
GC01	15-20	Bureau of Reclamation	Managing executive for GC Environmental study; Regional Director BoR; alternate to secretary's designee	Civil engineering
GC02	15-20	Bureau of Reclamation; Western Area Power Administration	Project management; representative for agency in AMWG; scientist	Biology
GC03	10	BoR	Program manager; coordinator; AMWG member; scienits	limnologist
GC04	5-10	Upper Colorado River Commission	AMWG member; TWG member	Water resources management
GC05	10-15	Western Area Power Administration	Former member of AMWG and TWG	Civil engineering
GC06	15-20	Western Area Power Administration	Consultant	engineering
GC07	5-10	Hualapai Tribe	Representative of Hualapai tribe; AMWG and TWG	Intercultural studies; sociology
GC08	10	Grand Canyon River Guides	Representative river guides; AMWG and TWG	River recreation and river use

GC09	10-15	GCMRC; Fish and Wildlife Service	Scientist; director GCMRC	Natural resources management; wildlife management
GC10	10-15	Hopi Tribe	Research; representative Hopi Tribe; TWG	Archaeologist
GC11	10-15	Grand Canyon Wildlands Council; BoR	Representative wildlands council; scientist; AMWG and TWG	ecology
GC12	10-15	GCMRC	Scientist	Engineering
GC13	10	FWS	AMWG and TWG	Wildlife management
GC14	5-10	Arizona Dept. of Water Resources; Arizona Game and Fish Dept.	AMWG and TWG	Water resources management
KR01	15-20	Cops of Engineers; SFWMD	Project engineer; project manager; private consultant	Engineering
KR02	10	SFWDM; BENSYS	Project manager; program manager	Civil engineering
KR03	10-15	SFWMD	Key modeler; director SFWDM	Hydrology; modeling
KR04	15	SFWDM; BENSYS	Planning & operations; executive director; private consultant	Geography; water resources management
KR05	15-20	SFWMD	Lead biologist	biology
KR06	10	SFWMD	Division director; scientific tech	Ecology and fishery
KR07	10-15	SFWMD	Senior supervising geographer	Geography; water resources mgt
KR08	15	USACE-JAX	Chief of Everglades Division; project and program manager; project planning	Engineering
KR09	10-15	USACE-JAX	Head planning division; project management; project planning	Engineering
KR10	10	USACE-JAX	Head of hydrology and hydraulics	Engineering
KR11	20	Corps of Engineers; SFWMD; consultant	Scholar; policy director and advisor; program manager; executive	Natural resources management; park & wildland mgt; political theory