1999

Assessment of capacity for water resource management: A case study of a small watershed in Nepal

Bhanu Raja Neupane
Wilfrid Laurier University

0-612-40324-6

ASSESSMENT OF CAPACITY FOR WATER RESOURCE MANAGEMENT: A CASE STUDY OF A SMALL WATERSHED IN NEPAL

by

Bhanu Raja Neupane

B.Sc. (IAAS), 1987; MS (AIT), 1992

Thesis

Submitted to the Department of Geography and Environmental Studies
In partial fulfillment of the requirements
for the degree of
Doctor of Philosophy
Wilfrid Laurier University
1998

ABSTRACT

Use of local knowledge, increased public participation, and capacity building – singly or in combination – are identified as major strategies to enhance sustainable and integrated management of water. Recently, *capacity assessment* has been recognized as one of the most effective means to operationalize these strategies in the context of water resource management. However, the contemporary literature shows local-level capacity assessment as one of the least explored areas. The literature shows that *capacity assessment* still lacks conceptual clarity and an inplementable framework. Efforts are being made in this direction, but very few focus below the national level. Many such efforts are theoretical, and those that do focus at the local level are confined to assessment of local needs.

Understandings developed through a systematic review of the literature were taken to a small sub-watershed, Gerkhu Khola, in Nepal and an *iterative approach* imbedded in *a case study* was used to explore the issue of capacity assessment. The approach was based on situated facts, integration and application of both qualitative and quantitative methods, and development of a method of assessment at the local-level with active participation of local-level stakeholders. The iterative approach also included local-level analysis of sustainable water resource management principles as given by the International Conference on Water and Environment in 1992 (The Dublin Principles: 1992), which helped to define an ideal condition for water resource management. Therefore, the thrust of this thesis is also to examine to what extent the recent ideas developed at the international and national levels are applicable at the local levels. All findings and syntheses of the case study were discussed with the grassroots level stakeholders to better justify and relate the findings to their knowledge and consensus.

The findings indicated that a *systematic exploration of actions, attitudes and preferences of local people* is essential for capacity assessment. It was observed that the local people are able to understand and analyze the relevance of sustainable conditions identified for water resource management viz., finiteness of water, participatory and users' involvement, women's role and the economic value of water. The *local reactions to these conditions were demonstrated through sustainable actions, strong attitudinal inclination and ability to prioritize*. Locally, capacity assessment is seen both as a solution and a problem. A framework developed based on the findings suggests that capacity assessment should be an iterative process with strong interdependence existing among the different modes of assessment. It is hoped that the framework developed in this thesis will streamline efforts to integrate and synthesize local-level capacity in water resource management. This study also found that the issue of local-level capacity assessment provides a challenging arena for further exploration.

ACKNOWLEDGEMENTS

First, I wish to thank the "**Dream Team**" that gratefully consented to be my thesis committee. I wish to express my sense of sincere gratitude, respect, and appreciation to **Prof. Gordon J. Young**, my supervisor, mentor, and inspiration, for an encouraging supervision throughout this research. Without Prof. Young's constructive ideas, invaluable suggestions and thought provoking comments, this study would not have taken a shape it bears now. With his help, during my Ph.D., I traveled to 19 countries, presented papers in well over a dozen international conferences, and worked for many multilateral agencies. *I am truly indebted to Gordon*. The enthusiasm shown and constructive comments made by **Prof. Geoffrey Wall** were immensely useful. Prof. Wall's editorial help as well as suggestion to carry out a cross-sectional analysis, which involved multiple tools and approaches, was very useful. Suggestions made by **Prof. Kenneth Hewitt** are sincerely acknowledged. Not only as a committee member, but also as a table-tennis partner, Prof. Hewitt provided a new direction and meaning to this research. Although the match record is still in Ken's favor (13: 4), I still win. Every match exposed me to a new dimension of academic enlightenment. Encouragement and support were available from **Prof. John FitzGibbon** even in short notices. Despite the distance between Laurier and Guelph, Prof. FitzGibbon's academic inputs always provided something new to experience, ponder and act. I also wish to thank **Prof. Slobodan Simonovic**, who acted as the external reader of the thesis and suggested key areas to improve the research.

I thank my respected respondents and research partners of **Gerkhu Khola Watershed**, who gave their valuable time, opinions and suggestions and bore with me for long hours of interviews, group discussions, analyses, and syntheses. They were arduous as well as (I must confess) boring, and I had nothing to offer to them than *chiya* (Tea) at Mahila Dai's *Chya-Pasal* (Tea Shop). I owe sincere thanks to **Barbara**, who helped me to materialize this endeavor in many ways. Special thanks are extended to my valued friends and supporters, especially *Bhushals*, and the Great *Neupanes*. I acknowledge all the help extended by my friends and well wishers at Laurier (**Mike English, Dr. McPherson, Adam, Corinne, George Yap, Nitin**...). My good friend (and my big brother) **Dr. Pietro** deserves my special thanks: he was always very helpful.

Finally, I would like to express my sincere gratitude to my respected father (Pitaji) **Roop**, mother (Aama) **Shama**, and sister **Indu**, who provided me a constant support and encouragement throughout the study. I thank them for teaching me the value of learning and critical thinking. I am greatly indebted to my parents for indulging with me in those long and costly, but equally encouraging, telephone conversations that helped decorticate my real potentiality and I could stay focused. I am most grateful to **Robi** – I sincerely apologize to him for what he had to go through during this period. I am also very grateful to **Neha**, whom I *still* love very dearly. Finally, I wish to acknowledge my own spirit, the few beautiful years that I spent on bringing this ordeal to a fruition, my increased cooking skills, my resilience, and my ability to withstand pain...

THE STUDY IS DEDICATED TO MY AAMA, PITAJI AND ROBI

Table of Contents

TITLE PAGE i
ABSTRACT ii
ACKNOWLEDGEMENTS iii
TABLE OF CONTENTS iv
LIST OF BOX ix
LIST OF FIGURES xi
LIST OF MAPS xii
LIST OF TABLES xiii
ABBREVIATIONS AND ACRONYMS xv

PART I 1

1. INTRODUCTION 2
   1.1 RESEARCH GOAL AND OBJECTIVES 2
   1.2 BACKGROUND 2
   1.3 SETTING THE SCENE 3
   1.4 RESEARCH EXPLANATION 5
   1.5 APPROACH AND LIMITATIONS 7
   1.6 NEED FOR THE RESEARCH 8
      1.6.1 Need for a Paradigm Shift 8
      1.6.2 Small watershed as the Lowest Appropriate Level 9
      1.6.3 Reversing the Approach 9
      1.6.4 People's Knowledge in Watershed Management 10
      1.6.5 Beyond Ethical Issues 10
      1.6.6 Nature of Management Response 10
   1.7 CONCEPTUAL FRAMEWORK OF THE STUDY 11
   1.8 ORGANIZATION OF THE THESIS 12

2. CAPACITY ASSESSMENT IN WATER RESOURCES 14
   2.1 BACKGROUND 14
      2.1.1 Objective of the chapter 15
   2.2 WATER RESOURCE PROBLEMS 15
      2.2.1 General 15
      2.2.2 Himalayan Water Resource Context 15
   2.3 WATER RESOURCE ASSESSMENT: PHYSICAL - SOCIAL DEBATE 17
      2.3.1 Physical Assessment in Water Resource Management 18
      2.3.2 Social Assessment of Water 24
      2.3.3 Social Systems in Water Resource Management 29
      2.3.4 Why People? 31
   2.4 CONVERGING THE MODES OF ASSESSMENT 32
      2.4.1 Assessment as a Human Centered Approach 34
      2.4.2 Small watershed as the Most Appropriate Unit for Capacity Assessment 35
      2.4.3 Capacity Assessment is Knowing Where to Hit 36
   2.5 REDEFINING THE NEED OF CAPACITY ASSESSMENT 37
      2.5.1 Assessment in Water Management as an Inductive Inquiry 41
   2.6 CAPACITY ASSESSMENT 41

2.6.1 Importance of Capacity Assessment 43
2.6.2 How New is the Concept of Capacity Assessment in WRM? 43
2.6.3 Closer Look at Capacity Assessment in Water Resource Management 44
2.7 Dublin Principles 48
2.7.1 Objectives of the International Conference on Water and Environment (ICWE) 48
2.7.2 Role of People 50
2.7.3 Demand Management 51
2.7.4 Resource Perspective 51
2.7.5 Rural Perspective 51
2.8 Conclusions 55
3. THE HIMALAYAN PHILOSOPHY: A NATIVE'S REVIEW 56
3.1 Background 56
3.1.1 The Objectives of the Chapter 57
3.2 Setting the Scene 57
3.3 Himalayan Philosophy Revisited 59
3.4 Approaching a More Suitable Philosophy for the Himalaya 61
3.4.1 Denaturalization and Humanization 61
3.4.2 Use of Scrutinized A-posteriori Truth 62
3.4.3 Sense of Empathy 63
3.4.4 Respecting the Human Spirit 64
3.4.5 Why People Accept Tradeoffs? 64
3.4.6 Local Arrangements for Resource Use 64
3.4.7 Understanding Bio-Ethics for Sustainability 65
3.4.8 Balancing Holistic and Reductionist Perspectives 65
3.5 Problem or Misinterpreted Potentiality? 65
3.6 Defining the Philosophy of the People 66
3.7 Conclusions 67
4. WATER RESOURCE MANAGEMENT IN NEPAL 68
4.1 Background 68
4.1.1 Objective of the Chapter 68
4.2 Physical Realities 68
4.3 Land Use 68
4.3.1 Rainfall and Climate 70
4.4 Socioeconomic Realities 70
4.4.1 Population 70
4.4.2 Administrative Structure 71
4.4.3 Infrastructure Base 71
4.4.4 Economy 71
4.4.5 Poverty and its Dimensions 71
4.5 Ecological Realities 73
4.6 Water Resources Realities 74
4.6.1 General 74
4.6.2 Water Quantity 74
4.6.3 Water Quality 75
4.6.4 New Directions 76
4.6.5 Water Sector Wide Policies and Regulation 76
4.6.6 Ownership of Water Resources 79
4.6.7 Water Rights 79

4.6.8 Government Institutions and Organizations 80
4.6.9 Cost Recovery 87
4.6.10 Budget Process 87
4.7 CONCLUSIONS 89
4.7.1 Water is a Finite Resource 89
4.7.2 Institution for Water Resource Development 90
4.7.3 Women's Role in Water 91
4.7.4 Water is an Economic Resource 92
4.7.5 Capacity Assessment 92
5. INTEGRATING THE SOFT AND HARD SCIENCES: METHODOLOGICAL OVERVIEW 93
5.1 BACKGROUND 93
5.1.1 Objective of the Chapter 93
5.2 STUDY STRATEGIES 93
5.2.1 Study Assumptions 93
5.2.2 Integration of Hard and Soft Sciences 94
5.2.3 Multi-actor and Multi-approach Research 96
5.3 RESEARCH METHOD 99
5.3.1 Basic Approach 99
5.3.2 Thematic Coverage 101
5.3.3 Multi-tool Approach 101
5.3.4 Study Area 101
5.3.5 Field Work 101
5.3.6 Secondary Data Collection 102
5.3.7 Primary Data Collection 102
5.3.8 Justification for Participatory Rural Appraisal (PRA) 103
5.3.9 Selection of Actor Groups 104
5.3.10 Sample Design 105
5.3.11 Questionnaire 106
5.4 ACTIONS ASSESSMENT 107
5.5 ATTITUDINAL ASSESSMENT 108
5.5.1 Steps involved in Attitudinal Assessment 110
5.6 PREFERENCE ASSESSMENT 112
5.6.1 The AHP Levels 118
5.6.2 The Steps Involved in Preference Analysis 119
5.6.3 Processing and Reporting 120
5.7 CONCLUSION 121
PART II 124
6. GERKHU KHOLA WATERSHED: THE STUDY AREA 125
6.1 BACKGROUND 125
6.1.1 Objectives of the Chapter 125
6.2 PHYSICAL SETTING 125
6.2.1 River System 130
6.3 CLIMATE 134
6.3.1 Soil and Vegetation 135
6.3.2 Landuse 135
6.4 SOCIOECONOMIC SETTING 136
6.4.1 Demographic Description 136

6.4.2 Land Holding ... 138
6.4.3 Agriculture ... 139
6.4.4 Livestock ... 140
6.4.5 Urbanization and Industrialization ... 140
6.4.6 Social Indicators ... 141
6.5 INSTITUTIONS AND ORGANIZATIONS ... 141
6.5.1 Locally Evolved Institutions ... 142
6.5.2 Local Institutions with Some degree of External Supports ... 143
6.5.3 External Organizations ... 144
6.6 MAJOR PROBLEMS IN THE AREA ... 147
6.7 CONCLUSIONS ... 148
7. UNDERSTANDING ACTIONS ... 149
7.1 BACKGROUND ... 149
7.1.1 Objectives of the Chapter ... 150
7.1.2 Process ... 150
7.2 PARTICIPATORY ANALYSIS OF DUBLIN PRINCIPLES ... 151
7.2.1 Approaching the Analysis ... 151
7.3 WATER SUPPLY, DEMAND AND BALANCE IN GERKHU KHOLA ... 155
7.3.1 Water Supply Structure ... 156
7.3.2 Landuse Changes During 1984-1997 ... 161
7.3.3 Supply Sources ... 161
7.3.4 Water Demand Structure ... 163
7.3.5 Water Balance ... 168
7.4 ANALYSES OF THE ACTIONS RELATED TO THE PRINCIPLES ... 170
7.4.1 Actions Related to Principle I ... 170
7.4.2 Actions Related to Principle II ... 175
7.4.3 Actions Related to Principle III ... 178
7.4.4 Actions Related to Principle IV ... 182
7.5 IMPLICATIONS OF ACTION ANALYSIS ... 185
7.5.1 The Problem Structure ... 185
7.5.2 Solution Structure ... 188
7.5.3 Dilemma of CATCH -22 ... 189
7.6 CONCLUSION ... 193
8. UNDERSTANDING ATTITUDES ... 194
8.1 BACKGROUND ... 194
8.1.1 Objectives of the Chapter ... 195
8.2 RESULTS OF ATTITUDINAL ANALYSIS ... 195
8.2.1 General ... 195
8.2.2 Sub-Principles under the First Principle of SWRM ... 196
8.2.3 Sub-Principles under the Second Principle of SWRM ... 202
8.2.4 Sub-Principles under the Third Principle of SWRM ... 206
8.2.5 Sub-Principles under the Fourth Principle of SWRM ... 211
8.3 SYNTHESIS OF ATTITUDINAL ASSESSMENT ... 216
8.3.1 First Principle ... 216
8.3.2 Second Principle ... 217
8.3.3 Third Principle ... 219
8.3.4 Fourth Principle ... 220
8.4 IMPLICATIONS OF ATTITUDINAL ANALYSIS IN CAPACITY ASSESSMENT ... 221

9. UNDERSTANDING PREFERENCES 222
9.1 BACKGROUND 222
9.1.1 Objective of this Chapter 223
9.2 AHP RESULTS 223
9.2.1 General 223
9.2.2 Individual Factor Preference 224
9.2.3 Individual Sub-factors Preference 224
9.2.4 Individual Preference to the Alternatives 229
9.2.5 Actor Group Preference 230
9.2.6 Overall Group Preference 239
9.2.7 Syntheses of Factor and Alternatives 240
9.3 SENSITIVITY ANALYSIS 243
9.4 IMPLICATIONS OF PREFERENCE ASSESSMENT 243
10. CONCLUSIONS 245
10.1 SYNOPSIS 245
10.1.1 Objective of the Chapter 246
10.2 CONCLUSIONS 246
10.2.1 Capacity Assessment as the Missing Link 246
10.2.2 Addressing the Conceptual Complexity of Capacity Assessment 247
10.2.3 Use of a Philosophy that is Situated and People Based 248
10.2.4 Administrative Structure, Legislative Framework and Capacity Assessment 249
10.2.5 Process-oriented Research 250
10.2.6 The Case Study: Gerkhu Khola Sub-watershed 251
10.2.7 Applicability of the Dublin Principles 252
10.3 SYNTHESIS OF THE CASE STUDY 252
10.3.1 Finiteness of Water 252
10.3.2 People's Participation and User's Involvement 254
10.3.3 Women's Role in WRM 256
10.3.4 Economic Value of Water 256
10.3.5 Collective Assessment 257
10.4 SKAPE 258
10.5 DEFINING A FRAMEWORK FOR CAPACITY ASSESSMENT 259
10.6 UNDERSTANDING THE LIMITATIONS 262
10.7 SUGGESTIONS FOR FUTURE STUDIES 264
10.7.1 Changes in Capacity 265
10.7.2 Conceptual Complexity of the Dublin Principles 265
10.7.3 NGO and Government 265
10.7.4 Extreme Stress and Local Capacity 266
10.7.5 Technological Audit 266
10.7.6 Conflict and Resolution 266
10.8 CONCLUDING REMARKS 266

LIST OF BOXES

Box Page

2.1 Functions of Water Resource Management 16
2.2 Himalaya and the Water: Convergence of the Problem 17
2.3 Man-Water Interrelation 26
2.4 Societies are mixed in Chaugadha, Nuwakot 27
2.5 Societal Distinction and Women's Involvement 28
2.6 Sub-watershed as the Most Appropriate Level 36
2.7 Stability and Instability of Water Resource 37
2.8 What exactly does capacity mean? 42
2.9 Perspective of Capacity Assessment 43
2.10 Initiating an Assessment Process 48
2.11 Objectives of the Dublin Conference 49
2.12 Concept of Sustainable Development as Perceived in Dublin Conference 49
2.13 Principles of Sustainable WRM in the Rural Context 51
2.14 Guiding Principles for WRM from ICWE 52
3.1 Mighty Problems of the Mighty Himalaya 59
3.2 Mountain Specificities 66
3.3 When Kuire Debate Continued 67
4.1 What to Believe? 73
4.2 Legislation Acts and Regulations Water Resource Sector in Nepal 78
4.3 Particulars to be included in the application forms 79
4.4 Agencies with Water Related Responsibilities 82
4.5 Composition of District Water Resource Committee (DWRC) 85
4.6 Chronology of Institutional Interventions in Water Resources 88
5.1 Distinction between Hard and Soft Science 97
5.2 Perception on Capacity Assessment 99
5.3 Key Elements of the Methodology 101
5.4 The Field Seasons, Themes of Exploration and Achievement 102
5.5 Questions To Help Identify Stakeholders 104
5.6 Actor Groups 105
5.7 Involvement of Actor Groups in Various Analysis 105
5.8 Respondent Numbers by Actor Groups for Different Analysis 106
5.9 Ranking of Content for Each Principle 111
5.10 Schema of Final Score Computation 111
5.11 Model for Analysis of Perception Variability 112
5.12 Analytical Hierarchy Process 114
5.13 Random Index (RI) 116
5.14 Description of AHP Scale 114
5.15 Factors, Sub-Factors, Statement Objectives, and Objective Functions 119
5.16 Expert Choice Software 121
5.17 Data Collection and Analysis Schema 121
6.1 List of Donors, INGOs and Local NGOs 146
6.2 Name.Location, Objective and Performance Rating of Locally Evolved NGOs 146
7.1 Total Number of Samples across the River-Reach and Administrative Area 151
7.2 Steps Involved in Participatory Analysis of Dublin Principles 152
7.3 Metacard Method 153
7.4 Principles and Sub-principles of Sustainable WRM 154
7.5 Stone and Stick Method 168
7.6 It is for the Mouse! 173
7.7 Pie chart Method 178

7.8 Mr.Nara Nath Ghimire's Effort 183
7.9 People would do Anything for water: Gerkhu Khola Experience 191
7.10 Bipolar Distinction of Management of Water 193
8.1 Limits to Technology: Dilemma of the Proposed Gerkhutar -Simutar Irrigation project 200
10.1 Main Conceptual Conclusions 247
10.2 Methodological Conclusions 250

LIST OF FIGURES

Figure	Page
1.1 The Problem, Solution and the Users in Water Resource	3
1.2 The Approach of The Thesis	11
1.3 Organization of the Thesis Chapters	12
2.1 Hydrological Cycle	19
2.2 Hydrological Cycle and Sub-cycles	19
2.3 Variability of Rainfall by Physiographic Zone, Nepal	20
2.4 Length and Gradient of Tributaries of Trishuli River, Nepal	21
2.5 Variation in Rainfall, Evapotranspiration and Water Requirement, Western Nepal	22
2.6 Source of Drinking Water in Rasuwa District	23
2.7 Relationship between Ability to Cover and Ability to Collect Information	34
2.8 Basic Institutional Structure	35
2.9 Assessment as Divergent Approach	40
2.10 Socio-ecological Framework for Information Collection	40
2.11 Space, Time and Resource Continuum: A Conceptual Diagram	46
2.12 Focus of the Proposed Research	47
2.13 Distinction Between the "Others" and Dublin Realization of WRM	50
5.1 Capacity Assessment in Perspective	100
5.2 The Detail Design of the Research	102
5.3 Likert Scale Scoring Schema	109
5.4 The Model for Preference Assessment (Analytical Hierarchy Process)	117
6.1 Mean Monthly Discharge of Major Rivers 1971-1996	130
6.2 Gerkhu Khola Watershed Discharge Measurement Data	131
6.3 Hydrological Relationship between the Landforms	134
6.4 Mean, Standard Deviation and Exceedence Limit of Precipitation (Gerkhu Khola)	134
6.5 Land Ownership by Type of Land	138
7.1 Proportion of Water Quantity Used at Home and at Source and Quantity Used by Activity	164
7.2 Average Episodes of Water Borne Diseases by type (per HH) and Incidence by Sex	165
7.3 Demand, Supply and Balance of Water: Gerkhu Khola	169
7.4 Seasonal Demand, Supply and Balance of Water: Gerkhu Khola	170
8.1 Average Adherence Scores Obtained by Actors in Principle I and its Sub-principles	198
8.2 Average Adherence Scores Obtained by Actors in Principle II and its Sub-principles	203
8.3 Average Adherence Scores Obtained by Actors in Principle III and its Sub-principles	208
8.4 Average Adherence Scores Obtained by Actors in Principle IV and its Sub-principles	213
8.5 Average SWRM and Principles Adherence Scores	218
9.1 Analytical Hierarchy Format	223
9.2 Individual Preference and Their Priority on Mode of Program Implementation	229
9.3 Synthesis of Overall Preference with respect to GOAL (Ideal Mode)	240
9.4 Performance Sensitivity with Respect to Goal for Nodes below Goal Most Preferred WRM	242
10.1 Relationship between Resource Scarcity and Resourcefulness	254
10.2 Synthesis of the Outcome	258
10.3 Perspective of Capacity Assessment	259
10.4 A Framework for Capacity Assessment in WRM	260

LIST OF MAPS

Map **Page**

4.1 Map of Nepal ... 69
6.1 Location of the Study Area ... 126
6.2 Gerkhu Khola Watershed, VDC Boundary Map ... 127
6.3 Gerkhu Khola Watershed, Land Use Map ... 127
6.4 Gerkhu Khola Watershed, Slope Map ... 128
6.5 Gerkhu Khola Watershed, Drainage Map ... 128
6.6 Digital Elevation Map, Gerkhu Khola Sub-watershed ... 129
6.7 Gerkhu Khola Land Use Map: 1984 ... 134
6.8 Gerkhu Khola Land Use Map: 1996 ... 135

LIST OF TABLES

Table | Page

4.1 Land Use Pattern in Nepal 70
4.2 Population Scenario in Nepal 70
4.3 Distribution of Operational Holding, Nepal 72
4.4 License Fee 80
6.1 Slope Class of Gerkhu Khola Watershed 131
6.2 Landuse Pattern – Gerkhu Khola 136
6.3General Demographic Characteristics of Gerkhu Khola Watershed 139
6.4 Population Characteristics in Gerkhu Khola Watershed 138
6.5 Educational Status in Gerkhu Khola 138
6.6 Land Holding 138
6.7 Crop Rotations in the Area 140
6.8 Average Number of Livestock Holding 140
7.1 Drinking water Standards 157
7.2 Physical Analysis of Available Sources 158
7.3 Summarized Bio-chemical Analysis of the Sources 160
7.4 Percentage Distribution of Primary Drinking Water Sources 162
7.5 Tap-Household Ratio, distance and Average Months of Use of Tap Water 162
7.6 Temporary Irrigation Canals in the Area 163
7.7Relationship between Quantity of Water and Income 165
7.8 The Reasons for Wage Loss in the Sub-Watershed Area (1st order only) 166
7.9 Consequence of Family Member Suffering from Water Related Illnesses 167
7.10 Problems Encountered by Farmers in Agriculture 168
7.11 Percentage of Respondents Knowledgeable about the Water Sources 171
7.12 Common Responses that support the Sense of Finiteness of Water 171
7.13 Percentage of Population Aware about Current Initiatives 175
7.14 Percentage of Population Who Spent Time in WRM 176
7.15 Percentage of Population Aware and Participated in the Planning and Budgeting Process 177
7.16 Percentage Response Regarding Awareness of the Water Rights and Legal Provisions 177
7.17 Responsibility of Water Collection (Percentage) 179
7.18 Average Time Spent by Women in Water Collection 179
7.19 Appreciation to Women's Work 180
7.20 Comparative Participation in Water Related Planning and Management Activities* 180
7.21 Comparison between two Drinking water Projects in the area 181
7.22 Common Responses that supported the Sense of Economic Value of Water 182
7.23 Priority of water use 183
7.24.Cost of Cultivation and Gross Margin of Major Crops of Upstream (NRs.Per hectare) 184
8.1 Attitudinal Variability - Chi-square Test Result, Sub-Principal I of Principal I 197
8.2 Attitudinal Variability - Chi-square Test Result, Sub-Principal II of Principal I 199
8.3 Attitudinal Variability - Chi-square Test Result, Sub-Principal III of Principal I 201
8.4 Attitudinal Variability - Chi-square Test Result, Sub-Principal I of Principal II 204
8.5 Attitudinal Variability - Chi-square Test Result, Sub-Principal II of Principal II 205
8.6 Attitudinal Variability - Chi-square Test Result, Sub-Principal III of Principal II 206
8.7 Attitudinal Variability - Chi-square Test Result, Sub-Principal I of Principal III 207
8.8 Attitudinal Variability - Chi-square Test Result, Sub-Principal II of Principal III 210
8.9 Attitudinal Variability - Chi-square Test Result, Sub-Principal III of Principal III 211
8.10 Attitudinal Variability - Chi-square Test Result, Sub-Principal I of Principal IV 212
8.11 Attitudinal Variability - Chi-square Test Result, Sub-Principal II of Principal IV 214
8.12 Attitudinal Variability - Chi-square Test Result, Sub-Principal III of Principal IV 216

8.13 Attitudinal Variability - Chi-square Test Result, Principal I 216
8.14 Attitudinal Variability - Chi-square Test Result, Principal II 217
8.15 Attitudinal Variability - Chi-square Test Result, Principal III 219
8.16 Attitudinal Variability - Chi-square Test Result, Principal IV....220
9.1 Individual First Order Preference of Factors Principles of SWRM 224
9.2 Individual First Order Preference of Sub-factors Under Finiteness of Water....225
9.3 Individual First Order Preference of Sub-factors Under Participatory Framework and Users' Involvement....226
9.4 Individual First Order Preference of Sub-factors Under Women's Role in WRM 227
9.5 Individual First Order Preference of Sub-factors Under Economic Value of Water....228
9.6 Summary Sheet: How Small Farmers Preferred WRM Programs....231
9.7 Summary Sheet: How Large Farmers Preferred WRM Programs....232
9.8 Summary Sheet: How Off-Farm Workers Preferred WRM Programs 234
9.9 Summary Sheet: How Women Preferred WRM Programs 235
9.10 Summary Sheet: How Local-level Implementers Preferred WRM Programs....237
9.11 Summary Sheet: How NGO Workers Preferred WRM Programs 239
9.12 Diverse Choice –Synthesis of Factors with respect to the Alternatives....241

ABBREVIATIONS AND ACRONYMS

ADBN	-	Agricultural Development Bank
ADO	-	Agriculture Development office
AHP	-	Analytical Hierarchy Process
APP	-	Agriculture Perspective Plan
APROSC	-	Agricultural Projects Services Centre
ASDB	-	Asian Development Bank
CARE/N	-	CARE Nepal
CCA	-	Cultivable Command Area
CDO	-	Chief District Office
CERID	-	Centre for Education Innovation and Development
CIDA	-	Canadian International Development Assistance
DACC	-	District Agriculture Coordination Committee
DANIDA	-	Danish International Development Assistance
DHM	-	Department of Hydro Meteorology
DIO	-	District Irrigation Office
DOA	-	Department of Agriculture
DOI	-	Department of Irrigation
DWRC	-	District Water Resource Committee
DWSO	-	Department of Water Supply and Sanitation
DWUIC	-	District Water Utilization Inquiry Committee
EIA	-	Environmental Impact Assessment
FINNIDA	-	Finnish International Development Assitance
FMIS	-	Farmers Management Irrigation System
GIS	-	Geographic Information Systems
GVS	-	German Volunteer Service
ha	-	Hectare
hh	-	Households
HMG/N	-	His Majesty's Government of Nepal
IAAS	-	Institute of Agriculture and Animal Science
ICIMOD	-	Internal Centre for Integrated Mountain Development
ICON	-	Integrated Consultants Nepal
ICWE	-	International Conference on Water and Environment
IEE	-	Initial Environmental Evaluation
IIMI	-	International Irrigation Management Institute
ILC	-	Irrigation Line of Credit
ILO	-	International Labour Organization
IMTP	-	Irrigation Management Transfer Project
INGO	-	International Non Governmental Organization
IP	-	Irrigation Policy
IPIP	-	Irrigation Policy Implementation Procedure
ISF	-	Irrigation Service Fee
ISP	-	Irrigation Sector Project
JMA	-	John Mellor's Associates
JMS	-	Joint Management System
JTA	-	Junior Technical Assistant
LDO	-	Local Development Office
M&E	-	Monitoring and Evaluation
MOA	-	Ministry of Agriculture

MOF	-	Ministry of Forest
MOWR	-	Ministry of Water Resources
MPE	-	Ministry of Population and Environment
NA	-	Not Applicable
NACC	-	National Agriculture Coordination Committee
NEPAP	-	Nepal Environmental Action Plan
NPC	-	National Planning Commission
O&M	-	Operation and Maintenance
OS	-	Overseer
PBME	-	Project Benefit Monitoring and Evaluation
PDDP	-	Participatory District Development Project
PRA	-	Participatory Rural Appraisal
PRT	-	Participatory Research Technique
R&M	-	Repair and Maintenance
RCC	-	Reinforced Cement Concrete
RD	-	Regional Directorate
RDA	-	Regional Directorate of Agriculture
RDOI	-	Regional Directorate of Irrigaiton
RTDB	-	Research and Technology Development Branch
RWSSDFB	-	Rural Water Supply and Sanitation Development Fund Board
SAPR	-	Semi Annual Progress Report
SCFC	-	Service Charge Fixation Committee
SCO	-	Supervision and Controlling Office
SFDP	-	Small Farmers Development Project
SKAPE	-	Sustainability, Knowledge, Attitudes, Preference and Evolutionary Perspective
SMC	-	Subproject Management Committee
SMEC	-	Snowy Mountain Engineering Company
SMTP	-	System Management and Training Program
SNV	-	Dutch Volunteer Service
STW	-	Shallow Tubewell
SWRM	-	Sustainable Water Resource Management
TA	-	Technical Assistance
UN	-	United Nations
UNCED	-	United Nations Conference on Environment and Development
UNDP	-	United Nations Development Programme
UNESCO	-	United Nations Educational, Scientific and Cultural Organization
UNFPA	-	United Nations Fund for Population Activities
UNICEF	-	United Nations Children's Fund
USAID	-	United States Assistance for International Developmnet
UTA	-	Utility Transfer Act
VDC	-	Village Development Committee
WECS	-	Water and Energy Commission Secretariat
WHO	-	World Health Organization
WMO	-	World Meteorological Organization
WRA	-	Water Resource Act
WRM	-	Water Resource Management
WRR	-	Water Resource Regulation
WUA	-	Water Users' Association
WUC	-	Water Users' Committee

PART I

Introduction, Background Review and Methodology

CHAPTER ONE

INTRODUCTION

> *[Local People's] perceptions and understanding of resource situations and problems are important to learn and comprehend because solutions must be viable and acceptable in the local context and because local inhabitants possess extensive knowledge about their resource settings (Grandstaff et al. 1987:11)*

1.1 Research Goal and Objectives

The goal of the research was to assess the capacity of major local-level stakeholders to manage water in a small Himalayan watershed. Using an iterative approach and participatory technique, this research aimed to contextually present the actions, attitudes, and preferences of these stakeholders. It aimed to understand how the local-level stakeholders' actions, understanding and preferences are shaped around the issues of quality and quantity of water, participatory and users' involvement in (abbreviated in this thesis as WRM) processes, women's roie in water management and the economic value of water.

The specific objectives of the study are:

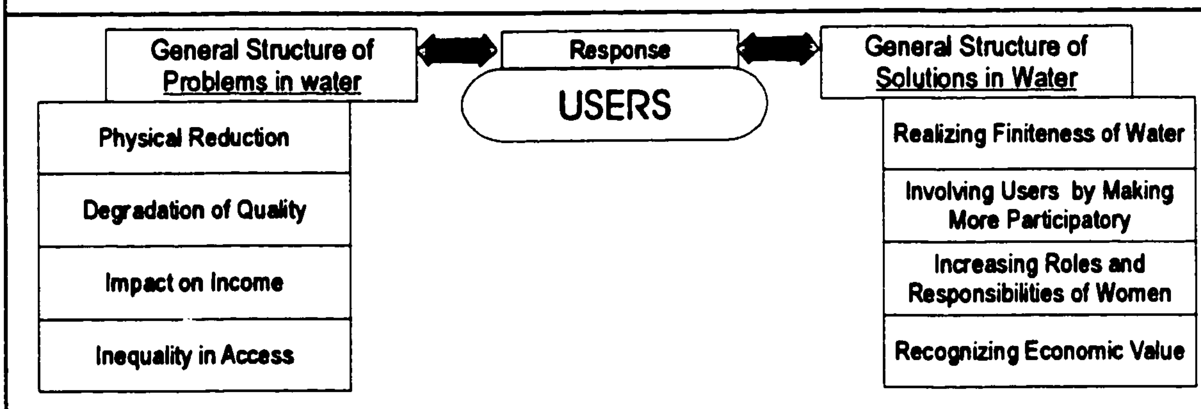
1. To provide a review of main issues that surrounds the context of capacity assessment.
2. To identify the major actions and awareness of people toward water by understanding the processes and practices of its use.
3. To ascertain attitudes of actor groups and their perception variabilities around an ideal water resource management framework.
4. To identify the preference of stakeholders for water resource management within the selected watershed.
5. To provide a framework for capacity assessment in water resource management in small watershed.

1.2 Background

> *'What is said to be needed in the short run to achieve is a massive transformation [in any water resource system]... a change in perception to bring about and welcome 'surprises'. Such 'surprises' apparently cannot be generated through imported goods and models. They must rather be built [sic.] upon and amalgamated with the indigenous cultural and social fabric in combination with the opportunities provided by the environment (Falkenmark et al.: 1990:32)*

No statement can better justify the start of this thesis than that of Falkenmark et al. (1990). This thesis attempts to study the context and realities that surround the issue of capacity assessment in water resource management in a rural Himalayan setting. The approach of this thesis is directed towards the social fabric of people living within a small Himalayan watershed. In this context, ideas consolidated through an extensive literature survey were taken to a small watershed setting in the form of a case study. The methodology for capacity assessment was allowed to evolve and all outcomes were discussed with the users to better justify and relate the findings to their knowledge and consensus. Primarily, it presents the understanding developed by studying the context and structure of 'responses' of the people toward water (Fig: 1.1[1]). It has done so, by addressing the major actions, attitudes, and preferences of the local-level stakeholders and arguing their significance. The research synthesized here is expected to help increase the appreciation for the knowledge and efforts of the people directly involved in WRM, and accept some 'surprises' provided by them as useful guidelines.

Fig. 1.1: Problems, Solutions, and Users in Water Resource



1.3 Setting the Scene

Since the publication of the Brundtland commission report in 1987, and with an added emphasis after Agenda 21 (UNCED: 1992), three issues in WRM – Capacity Building, Use of Indigenous Knowledge, and Participation – have increasingly gained popularity. These three issues have been identified as major strategies to operationalize the sustainable processes in WRM and extensively researched[2]. However, in order to effectively internalize them into action, a noticeable gap has been felt between the theoretical efforts in dissecting these terms and practical efforts to understand them on the ground (Alaerts et al. 1991a, Gupta: 1993, Hartvelt: 1996, Biswas: 1996, Hopkins: 1997). Clearly, there is a need to make more refined and consistent efforts to analyze the operational suitability of these terms on the ground. The most critical gap has been noticed in the area of capacity building (Alaerts et al.: 1991b, Hartvelt:

[1] In the figure, it is not the intention of the researcher to pin down all specific problems and solutions, but it is to address that the general structures of problems and available solutions are often best perceived by the users and are expressed in their responses.

[2] A recent Sociofile and Dissertation Abstract CD-ROM search resulted in over 7000 articles, reports and books published on these issues after 1986. Participation recorded highest with 2948, followed by 1980 and 1537 for indigenous knowledge and capacity building, respectively (Trellis CD ROM Search: 1998).

1996, Biswas: 1996, Hopkins: 1997, Bergkamp et al.: 1998). Seemingly, the context of this word is often misinterpreted as a prescription for providing more handouts to the beneficiaries (Alaerts: 1991, OECD: 1996, Borrini Feyerabend and Buchan: 1997). This misinterpretation has been categorically highlighted by many recent studies in WRM (Chalker: 1997, Nigam and Rasheed: 1998, Briscoe: 1998, Bergkamp et al. 1998).

Similarly, very few studies or concrete measures have dealt with matters concerning capacity assessment below the national level (http://UNDP.org/capmet~/text.htm: 1997). It appears that it has been very deterministically construed that the attention given at the larger level would bring about some meaningful changes at the local-level. However, such instances have rarely occurred in the reality as perceived and prescribed (Hopkins: 1997). Realistically speaking, some noticeable normative changes have occurred, but changes at the tactical and operational levels have yet to take place. In this context, there is a growing international consensus about the significance of studying this issue at the grassroots level (Alaerts et al.: 1991b, ICWE: 1992, UNCED: 1992, UNDP: 1994-97, Hartvelt: 1996, Nigam and Rasheed: 1998, Briscoe: 1998). Expressing the need for further exploration of this issue, Biswas (1996) asserted that:

> *"Unquestionably, capacity building is going to be an essential requirement for efficient water management in the 21st century, certainly much more than it is today. However, it is a very easy task to say it is going to be an important requirement...Already, the issue is receiving considerable rhetoric and lip service.... One would, however, be hard pressed to identify more than a few intelligent, well-conceived and operational plans that have the long-term commitment...In fact, there are many things that are being done in the name of capacity building, which could probably best be forgotten. The 'old wine in a new bottle' approach... can only bring marginal benefits...." (1996: 405)*

This researcher, however, agrees more with what Brikké et al. (1998:7) argued as the need for renewed learning perspective in capacity building. He argued that:

> *"...a learning perspective in capacity building..., as blue print approaches do not work. It is essential that the different perceptions of problems and solutions are shared in a learning environment in which academic knowledge and community experience are equally valued and shared in a dialogue that allows the adaptation..."*

However, the most reasonable argument has been given by Bergkamp et al. (1998:11), who stressed that:

> *...to ensure that we can answer these questions [on capacity building in WRM] we need to assess what is known, identify gaps in the available information, and set about filling those gaps so that high quality [sic.] advice is available to countries on demand.*

While Biswas argued on the utility of the issue and indicated on the need for a changed perspective on capacity assessment, Brikké et al. asserted on the need for a new approach to examine it. Similarly, Bergkamp et al. pinpointed on the need to identify the gaps in the present efforts of capacity building. However, hitherto the efforts have been more or less fuzzy and confined at the national level. Considering this limitation, the focus of this research has been much narrowly defined and it is limited to a small watershed area. Depending almost entirely on the local level stakeholders' responses and their perspectives on the water resources, this research has attempted to understand how local people have shaped their lives around water, how they perceive its management, their present knowledge about it, what is required, and how they wish outsiders to participate in their utilization of water.

1.4 Research Explanation

Observing the context of capacity assessment, Biswas (1996: 399) stated that "[capacity assessment] suffers from numerous conceptual...constraints...and it could have different meanings for different people..." Similarly, capacity assessment being the crux of this research, it can also provide ground for multiple interpretations. Admittedly, it needs to be clarified at the outset. This thesis is not an attempt to critically evaluate or salvage previous mistakes and assumptions in WRM approaches. It has equally relied on failures as much as on the success accrued from the applications of new and old approaches. Fortunately, there exists a consensus regarding the role of users in all WRM approaches. This consensus enhances the utility of this research, as it proposes a framework for capacity assessment, which is required in most WRM approaches.

To explain the research, all the key words used in the title of this thesis have been defined. The definition draws from the literal meanings provided in various dictionaries and relates them with most common definitions available in the literature.

Assessment:

Oxford Dictionary defines assess as: 1. to set an estimated value on, 2 to set the amount of , 3 to estimate or determine the significance, importance, or value of; evaluate. It defines assessment as the act of assessing.

Capacity:

Oxford Dictionary defines capacity as 1 the ability to contain, absorb, or receive and hold, 2 the point at which no more can be contained 3 the power of receiving and holding knowledge, impressions, etc.; mental ability, 4 the ability or qualifications (for, or to do, something), 5 maximum output or producing ability, 6 the quality of being adapted (for something) 7 a condition of being qualified or authorized; position, function, status, etc.

Capacity Assessment

The combination of the literal definition of the two words therefore completes the definition of capacity assessment as an examination and estimations through qualification or quantification of people's ability to contain, absorb, receive or hold the context of the given issue. It is also estimation and examination of people's ability to do something, their maximum ability to adapt or express what is good or bad for them.

This definition is entirely different from that of capacity Building, which is a concept that advocates on the need to improve the ability, knowledge, and attitude of people or institutions to better perform their roles. However, unless it is known beforehand what capacity already exists among the people or institutions in question, capacity building is less likely to succeed.

Water Resource Management (WRM)

There are both simple one sentence and multi-volume books are available that try to dissect the term WRM. For example, Petersen (1984:4) defined WRM as a process that "involves the development, conservation, enhancement, preservation, or maintenance of water and related land resources to achieve national and local goals of the society." Mitchell (1993:3) preferred to define it as a decision-making process "concerning policy or practice regarding how [water] resources are allocated and under what conditions or arrangements [water] resources may be developed." Fitzsimmons and Salama (1977:3) argued from human and utility point of view and posited that "an effective WRM involves two considerations. First, water must be used to meet growing set of consumption requirements, and at the same time it must not be degraded in quality. Second, water must be utilized by man not only to achieve economic gains, but also to satisfy a number of socially desirable objectives." A rather lengthy definition comes from O' Riordan (1971: 19), which is one of the most cited definitions in the contemporary resource management discussions. The researcher has modified his definition of resource management to fit into the context of WRM. He contended that WRM:

> *"...may be defined as a process of decision making whereby ...[it is] allocated over space and time according to the needs, aspirations, and desires of man within the framework of his technological inventiveness, his political and social institutions, and his legal and administrative arrangements. [WRM] should be visualized as a conscious process of decision involving judgement, preference and commitment, whereby certain desired resource outputs are sought from certain perceived resource combinations through the choice among various managerial, technical and administrative alternatives."*

This researcher, thus concludes that *WRM may be defined as a conscious decision making process, where available options are carefully judged against their costs and benefits, and the best one is applied to maximize the total utility to the human being from a given body of water resource.* Here, the perspective of total utility has been mentioned to avoid lengthy discussion of qualitative and quantitative issues of water.

Small Watershed

Watershed is defined in this thesis as " *a topographically delineated area that is drained by a stream system, that is, the total area above some point on a stream or river that drains past that point.* The watershed is a hydrological unit often used as a physical-biological unit and a social-economic-political unit for the planning and management of the natural resources (Brooks et al.: 1991: X). The word "small" placed before "watershed" is used simply to provide a sense of relative smallness the studied area (19.11 km^2). In Nepal, the watersheds below 25 km^2 are considered as a small or sub-watershed (NPC-NEPAP: 1994). In this thesis, small watershed and sub-watershed have been interchangeably used to refer to the study area.

1.5 Approach and Limitations

This thesis is an outcome of three field seasons spent in a small watershed, Gerkhu Khola, in central Himalaya between the period of May of 1995 and November 1997. It must be noted that the conclusions of this thesis may not be applicable to a year of climatological extremes, because the monsoon and winter precipitation, for all field seasons, were recorded as normal. Between 1995 and 1997, the average rainfall in the selected watershed and surrounding areas fluctuated by less than one percent from its 20 year mean value (DHM: 1997).

Similarly, it is not an attempt to unearth a panacea for WRM problems in small Himalayan watersheds. The findings are based on situated knowledge of human and physical significance and do not represent the entire Himalayan belt. However, its outcomes provide enough ground for generalization.

The international, national and broader demand- and supply-side arguments, provided in the beginning of this thesis, are not an attempt to undermine the case study. In fact, *the case study conducted in Gerkhu Khola watershed is the centre of this thesis.* Admittedly, however, the background discussion bears a significant relevance to critically examine issues relevant to the context of capacity assessment. It must be recognized that this thesis is based on the concept of capacity assessment that only *began to gain ground after 1991* (Hopkins: 1997). Considering that many issues surrounding capacity assessment are still unclear or emerging, the background information attempts to consolidate the argument of the thesis. Consequently, the thesis is presented in two major parts. The first five chapters essentially make the background of this thesis. The case study is presented in the second part, which starts from Chapter 6. All chapters are written as stand-alone units, which has, although unwillingly, resulted into some degree of repetition.

1.6 Need for the Research

This research is conceived out of the following realizations.

1.6.1 Need for a Paradigm Shift

Globally, a significant theoretical breakthrough can be observed in the field of WRM (Rodda: 1995). Stressing the need for policy change the freshwater resources Stockholm Environmental Institute and United Nations (1998) jointed argued that:

> *"Lessons from experience indicate that we must fundamentally change the way we think about and manage water. We must embrace new policies that are comprehensive, participatory, and environmentally sound. This will require difficult decisions and actions on the part of all of us. But, one fundamental point is clear: we have no choice..." (http://www.sei.se/cfwa/w97front.html: 1998)*

In this context, the preparation of the Dublin Principles (International Conference of Water and Environment [ICWE]: 1992) has been regarded as a testimonial to this intention (Rodda: 1995, Briscoe: 1998). Similarly, there is much evidence that some degree of paradigm shift has also started to occur at the national level (Jønch-Clausen: 1994, Boesen: 1994, Kahangire: 1994, Briscoe: 1994, Biswas: 1996, Hartvelt: 1996). However, while the global and national attempts are seeking to increase the level of participation and build capacity (Alaerts: 1991, Biswas: 1996, UNDP: 1994-97, Briscoe: 1998, Brikké et al. 1998, Nigam and Rasheed: 1998), these realizations are very slow in "trickling-down" to the sub-national and local levels (Chene: 1997). Consequently, their benefits are minimum and inconsistent to attention given to enhance the concept and relevance of capacity assessment at the local level. Stressing on the need to conceptualize a framework for capacity assessment at the grassroots level, Ghosh and Rasheed (1998: 10) argued that:

> *"While the importance of the participatory role of the community is recognized, often the policy makers put forward arguments on the lack of capacity and capabilities at that level. These myths are reinforced by the fact that capacity building exercises are often confined to the national level and neglecting the needs of local institutions and communities only perpetuates this myth...."*

Based on this discussion, two apparent conclusions can be drawn. First, there is a dearth of evidence that can adequately support the need and the context of capacity assessment at the grass-roots level. Second, there exists a need to conceive a design methodology for capacity assessment based on grass-roots level investigations. The framework of this research is built around similar challenges.

1.6.2 Small watershed as the Lowest Appropriate Level

It has been agreed through the Copenhagen-Dublin-Rio process that the identification of a suitable level of WRM is country-specific (Briscoe: 1994). Realizing the same, Brown (1991: 163) posited that for WRM all "countries differ." However, even within a country, this issue has remained very contentious, and ongoing attempts appear to be often too superficial or complex to be used to manage water at lower levels (IMMI: 1997a). This statement may be supported as a conclusion to four polemical issues. First, people's potentiality in managing water still needs to be properly defined. The efforts toward this direction often leads to some arguments against the context of 'cover everything (or holistic)' that current WRM approaches advocate (Montgomery et al: 1995, Nigam and Rasheed: 1998). Second, there is a background of multinational organizations arguing a different need such as: "...for effective capacity building, the first the most essential requirement is having a good cadre of capable senior managers" (Biswas: 1996:400). Therefore, the idea of downscaling of WRM may not be very appealing to those with power to decide. The third is the fear of losing "economies of scale" in WRM if it is managed at smaller levels (Khan: 1988). The fourth is the complexity of capacity assessment itself – is it at all possible to take it to the lower levels? As Alaerts et al. argued "*...the interest in capacity building is relatively new. Confusion still exists on its precise meaning, its role and on how to make it operational...*" (1991a: 15). These issues are properly realized in the context of this research.

1.6.3 Reversing the Approach

One of the most contested notions in WRM is the identification and acknowledgment of users' knowledge. So far, most efforts precede the task of preparing a ground for the users to participate in prescribed management practices. However, little effort has yet been made to prepare a ground for the outsiders to participate in the communities' responses to the problems. Here, Tolba's (1987) assertion holds true that "the managers/scientists are not only reinventing the wheel but also the wood of which the wheel is made." It is because the knowledge is available but it has remained under- or unused. Similarly, it must also be noted that because of the lack of proper concern the people's knowledge in managing and using water is also disintegrating or has also become dormant (APROSC: 1994).

A similar issue "is the integration of the concepts of sustainability and capacity assessment" (Segeren: 1991: Opening address to UNDP symposium on Capacity Building). The efforts, so far, have been made to define the conditions of sustainability and, in that, role the users are required to play (Alaerts et al.: 1991b: 73). The essence of capacity assessment, however, is desired to be just the opposite. Conceivably, if the sustainability is not present (at least in the eyes of the outsiders), the attempts need to be reversed to identify the elements of unsustainability (Jodha: 1990a, Jodha: 1990b). The construct of this thesis has realized these needs.

1.6.4 People's Knowledge In Watershed Management

The argument proposed here is for the involvement of the users in the decision-making process. However, it is more important to engage people and their knowledge in design and management of water resources than simply to create a framework where they can participate (Greyling: 1987). Gupta (1993) observed that often a coercive form of involvement of people in WRM is regarded as participation. It is shown in figure 1.1 that both problem and response structures can be analyzed through the immediate users' responses toward water. Thus, there exists a need to explore how the elements of such responses can be isolated? Arguably, to design such a framework it is essential to make a comparison of people and outsiders' capacities to understand each other; especially I argue, it depends on the capacity of the outsiders.

1.6.5 Beyond Ethical Issues

The thesis has used four principles of Dublin as the background to assess people's capacity in WRM. This serves two purposes. First, the thesis accepts the need for scientific rigor. *This thesis is not purely to advocate the "ethical issues"* (Maxey: 1991,K. Hewitt: Personal communication: 1997) involved in using people's actions, attitudes and preferences in WRM, but to give these issues a globally accepted scientific content (Rodda: 1995). Second, it can also help to put the Dublin Principles through a conclusive test to find their applicability at the local level. Thus, the argument proposed here is based on the possibility to build a bridge between scientific and ethical issues.

1.6.6 Nature of Management Response

It is accepted here, WRM activities in the Himalaya, or anywhere else for that matter, have to address one or a combination of the following issues:

a) WRM initiatives attempt to replace activities that the contemporary efforts define as unsustainable. However, there is a dearth of analysis of if activities presently undertaken by local-level actors are sustainable.

b) WRM requires decisions that involve either integration of policies or implementation of a combination of activities. These decisions require that those involved must accept radical departures from the existing efforts. Implementation of activities without proper appraisal of the key partners' preparedness to receive them can affect the envisaged results. This entails having an understanding of all actors' perceptions or attitudes toward the proposed or perceived changes.

c) The third issue is the requirement of an entry point. Often WRM fails because too many things are done at the same time. Some programs appear so simple to those concerned so that they lose their interest in them. Others are too complicated to maintain interest. Similarly, often programs or activities are given to the users in a bundle too complicated for them.

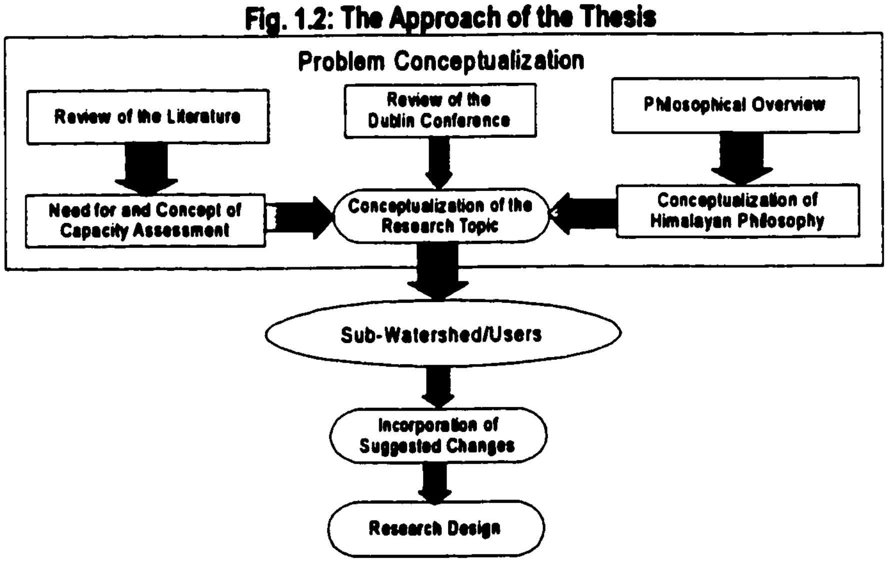
Thus, WRM activities are likely to address these issues more efficiently if they are based on, or are evolved out of the local stakeholders' capacity demonstrated in their actions, attitudes, and preferences. The rationale of this thesis can also be sensed in this requirement.

1.7 Conceptual Framework of the Study

Slowly, it is being accepted that global solutions may not work at local levels. As Ghosh and Rasheed (1998: 9) posited:

> *"The water crisis is more local than global but most interventions are now global. The global approach to the problem may help to articulate the issues but the solutions have to be suited to the local requirements."*

Fig. 1.2: The Approach of the Thesis



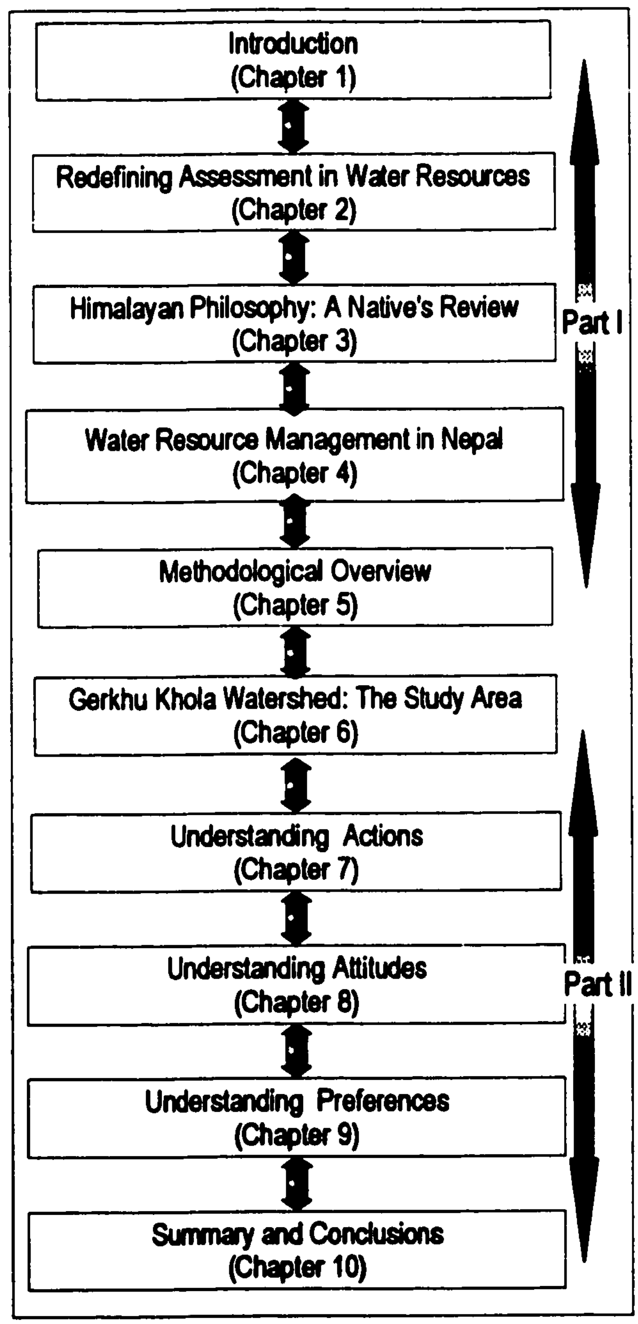
The statement given by Ghosh and Rasheed (1998) may be too far-fetched, but there are some strands of reality attached to it. Therefore, I argue that efficient WRM requires a deliberate attempt to internalize people's knowledge in new expertise. However, it is imperative that such knowledge is free from the researcher's subjective judgments. The syntheses of knowledge should be identified, filtered through, and scrutinized by the water users (Lynch: 1993, Frideres: 1992). The effort to use such information must be inductive and should provide an adequate basis for integration of different levels of analytical hierarchy (Saaty:

1990). It must also be understood that the single problem may require a multiple response. It is also essential to understand that different levels of stresses characterize WRM efforts. Similarly, this thesis respects the sentiment given by Glasbergen, (1990:155) who stated, "Water Resource Management is an ongoing process of rationalization." The approach of the thesis has been presented in the Figure 1.2.

1.8 Organization of the Thesis

Earlier, the researcher mentioned that in order to clarify all the contentious issues around the concept of capacity assessment, review of International, National, and Himalayan water resource management has been deemed essential. Consequently, the thesis is written in ten chapters and is divided into two major parts. Part I, Chapters 1-5 introduces the thesis, argues and explains various conceptual issues and introduces the methodology, as well as the relationship between the two (Figure 1.3).

Fig. 1.3: Organization of the Thesis Chapters



In Chapter 1, the study was introduced, and objectives and rationale was presented. Chapter 2 of this thesis provides a review of the physical and social modes of assessment as well as the International issues surrounding the context of this thesis. Chapter 3 presents a philosophical basis for the research. Chapter 4 reviews the water resource sector of Nepal, especially the organizational and administrative structure for WRM. Chapter 5 presents the detailed methodological framework and introduces the specific approach used in the thesis.

Part II expands the conceptual arguments around a practical setting. It begins with a detailed introduction of the research area and presents some of the "non-water" information collected during the participatory survey. Chapters 7, 8, and 9 provide action, attitude, and preference analyses. Chapter 10 provides a synthesis of the analyses and presents the major conclusions of the research. As mentioned earlier, all chapters, except this one, are written with distinct chapter objectives and are complete in themselves. However, distinct connections make all chapters interactive.

CHAPTER TWO

CAPACITY ASSESSMENT IN WATER RESOURCES

"Among the components of the capacity building process, the capacity assessment is the least well developed or understood. Most technical assistance programmes and projects focus on meeting capacity needs, without undertaking the analysis that would normally be required to ensure that the solution is the most appropriate one in the circumstances." (Dr. Thomas J. Hopkins: 1997)

2.1 Background

The topic of this research, **Capacity Assessment**, is very recent (Hopkins: 1997). In 1991, based on the review of hitherto project implementation modality, UNDP concluded that the issue of capacity assessment is either seriously lacking in most WRM programs, or is misinterpreted (UNDP: 1991, Hopkins: 1997). The realization was equally shared by the World Bank (Buky: 1990, Alaerts et al.: 1991b, Hopkins: 1997), WHO (Collaborative Council: 1989), UNICEF (UNICEF: 1989) and UNESCO (UNESCO: 1989). Consequently to explore the deficiency, UN organizations hired many consultants (e.g., Hopkins: 1995-7), and research groups (e.g., Harvard Team: 1994) and launched pilot projects all over the world[3] (Biswas: 1996, Hartvelt: 1996). Unfortunately, these efforts were conceived at a much higher level and most had little or no utility at the grassroots level (Ghosh and Rasheed: 1998).

Similarly, many studies were conducted during the 1980s and 1990s in the field of capacity assessment at the local-level (Freire: 1982, Drew: 1983, Easter and Dixon: 1986b, Butz: 1987, Garbretch: 1987, Falkenmark: 1991, Baland and Platteau: 1996, Fulton: 1994, Amanor: 1994, Kerr: 1995, Asafu-Adjaye: 1996, Neupane and Young: 1997). These studies covered a wide range of issues, including the possibility of internalizing local-people's knowledge in external efforts. Unfortunately, the recorded achievements on this front also are very inconsistent (Chambers: 1997). Arguably, the local-level efforts have generally declined to accept any limitations in the local knowledge (Anyanwu: 1988, Kindon: 1993). Thus, it is evident that the concept of capacity assessment is still fuzzy, and a design methodology capable of weaving external knowledge in the tapestry of local knowledge is lacking (Biswas: 1996).

This researcher argues that there is a conceptual similarity between the knowledge developed at the wider level and the situated knowledge of the local-level. The argument is based on the conviction that both seek to maximize the total utility from any given volume of water, and sustain it by minimizing externalities. Thus, I posit that it is possible

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[3] The UNDP's symposium of Capacity Building for Water Sector recommended that pilot studies be implemented in 10 countries: China, Vietnam, Lao, Mali, Ghana, Sudan, Swaziland, Mexico, Bolivia, and Peru. UNDP and the government of The Netherlands currently fund the research.

to design a converging platform and the two streams of knowledge can be effectively integrated. However, to achieve the goal it is essential to review different modes of assessments and, in that, ascertain people's roles and significance.

2.1.1 Objective of the chapter

The main objective of this chapter is to review the relevant literature that surrounds the issue of capacity assessment. Specifically, the chapter aims:

- to define existing problems
- to approach capacity assessment from different modes of assessments
- to elaborate on the need to study capacity assessment in WRM
- to elaborate the key concepts used in this thesis

2.2 Water Resource Problems

2.2.1 General

Among the multitude of problems faced by human beings, one of the most serious is the increasing demand of freshwater. Water plays a fundamental role in the welfare of any country and it is linked to almost all aspects of the economy (Fitzsimmons and Salama: 1977, ICWE: 1992, Biswas: 1993, Garduño and Arreguin-Cortes: 1994, Young et al.: 1994, Black: 1995). Water is necessary for human metabolism and it is needed for irrigation, industrial, municipal, and other purposes. In a broader sense, water can be regarded as an important factor of production and amenity (Munasinghe: 1992, APROSC/JMA: 1995). Thus, it must be recognized that water is an indispensable factor for two of the basic needs of the human being: health and food.

2.2.2 Himalayan Water Resource Context

Box 2.1 adequately establishes the role of water in the socioeconomic developmental process. In a similar context, the development process and future of the Himalayan country, **Nepal**, greatly depend on water resources (NPC/NEPAP: 1994, APROSC/JMA: 1995, Power in Asia: 1995, Bhattarai: 1997). The rivers originating in the Himalaya do not only provide water for basic survival, but also is the main resource that Nepal can potentially use for its development (Sharma: 1972, Neupane: 1993, NPC/NEPAP: 1994).

However, in contrast to this vast endowment, Nepal today faces more difficult problems in water resources than ever before. Nepal's rugged topography provides great potential for putting water to many economically productive uses. The total availability of water in Nepal is about 150 billion m^3 per year. This volume can irrigate 8-10 million hectares of land and produce about 47,000 megawatts of hydropower (Bhattarai: 1997). Despite this, the country presently faces an acute shortage of electricity, irrigation, and potable water. Thus, there is a very high demand for freshwater in the country and it is rapidly increasing. Similarly, the existing sources of supplies are deteriorating at a much faster pace under various partially explained – considered to be a combination of human-made and natural – pressures (NPC/NEPAP: 1994). The degradation in water quality has offset both the organized and unorganized attempts to increase the supply.

Box 2.1: Functions of Water Resource Management	
• Ecological maintenance and control – part of the basic ecosystem of the earth • Life sustenance – indispensable commodity to support life (disease control, health improvement, etc.) • Security – against man made and natural disaster • Available and predictable supply – ensure sufficient quantity of water • Available and predictable distribution – insure equitable distribution of water • Land Use – watershed management, maintain necessary water characteristics associated with land • Community function – for fire protection, parks, cleanliness	• Agriculture – use of water for irrigation purposes • Aquaculture – use of water for aquatic resource exploitation • Energy – use of water for generation of power • Industrial – for industrial production and operation • Interdependence and transportation – for navigation, trade and transit. • Recreation – swimming, fishing, boating and rafting • Tourism – as a part of the natural beauty • Religious function –cremation, worship, pilgrimage

Modified after Bruke and Heaney: 1975, Fitzsimmons and Salama: 1977

Both structural and management approaches are adopted to increase the supply. The success, however, has failed to keep pace with the increasing demand. The attempts are mainly on control over the timing and location of the country's uncertain water resource into reliable freshwater supplies (World Bank 1994, NPC/NEPAP: 1994). Following the World Bank's ruling against the Arun Hydropower Project in 1995, the Government of Nepal (HMG/N) has decided to gradually abandon the supply-driven approaches (Power in Asia: 1995: 16). Consequently, WRM has begun to embrace a much more decentralized strategy that advocates smaller-scale water resource projects (Pandey: 1995, Bhattarai: 1997). Although demand management is now realized as the main agenda, it has not borne expected results (HMG/N Economic Review: 1997). Simultaneously, some of the problems traditionally managed by the people using their ingenuity have also started to grow beyond their management capacities (DANIDA: 1997). The reason for the latter condition may be attributed to the changing water-human relationship and external factors, often alien to the local management strategy, influencing the water use systems

In a similar context, the ecological belt in which Nepal lies is not altogether free from controversies. Thus, WRM in Nepal suffers from two controversial ecological debates (Box: 2.2). The stewardship of WRM therefore requires a clear understanding of, and integration with the Himalayan development issues.

Box 2.2: Himalaya Water Resource Management: Convergence of the Problem
The review of literature on Himalayan water resources presents a few vital issues. First, it demonstrates that the WRM in Nepal is in a slow transition toward demand driven approach that advocates developing small water resource projects. Consequently, the need for researching various WRM issues at small watershed or community levels has escalated. The third issue is to appreciate that the complexity of both the WRM and the ecological reality that surround this resource in the Himalaya has escalated (Chalise: 1994).

2.3 Water Resource Assessment: Physical - Social Debate

[Water resource] development is being set back for years in some developing countries, because investments have not been made in basic data collection" (Action Agenda of ICWE: 1992)

The above concern expressed by the International Conference on Water and the Environment (ICWE) suggests that there exist serious limitations in water resource assessment and, in that, data collection and their interpretations are limited. Although, it was implied, this concern was merely a reiteration of a similar concern expressed by a similar gathering in Mar del Plata in 1977[3] (Biswas: 1996). The rerun of the episode can be (and still is) justified against radical changes and redefinition of priorities that took place during 1977 and 1998. For example: the context of people's participation has been redefined (Munasinghe: 1992), the basic need fulfillment program has now been abandoned; the water and sanitation decade has passed without any noticeable benefits (Harvey: 1994); the Brundtland Commission Report is published causing a noticeable shift in the development thinking (Jordaan et al.: 1993), the concept of capacity assessment has been introduced (Alerts et al.: 1991b); the Dublin Conference and Rio Summit have been convened in1992; hydropolitical awareness is reemphasized (Rodda: 1995), the "weak or strong sustainability" is now constantly debated (Beckerman: 1995), and the concept of water use[5] management is adopted as the main agenda in WRM (UNDP/ Harare Meeting Agenda: 1998).

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[3] "In most countries there are serious inadequacies in the availability of data on water resources, particularly in relation to ground water and water quality. Hitherto, relatively little importance has been attached to its systematic measurement. The processing and compilation of data have also been seriously neglected"(Report of the United Nations Water Conference: 1977:7)

[5] Although the terms water resource management and water use management are used interchangeably, there exist a fundamental difference between how these two words are perceived. While the former provides more physical and a theoretical content to water, the latter puts water resource in a more human related and practical context.

However, the Dublin process indicated that globally WRM efforts have suffered due to the failure in defining the nature of data and a process of their assessment. Consequently, it suggested rethinking of the context of the assessment in WRM. Rodda and Young (Foreword of ICWE Keynote Paper: 1992) stressed the need to clarify the required information, their probable sources, and a transparent methodology to gather such information. This researcher argues that the first step should be to clarify two core issues: *what needs to be covered, and what is the best way to cover what needs to be covered?* The following section analyzes information needed for an effective WRM and, in that, the role of the people as well as the need for capacity assessment.

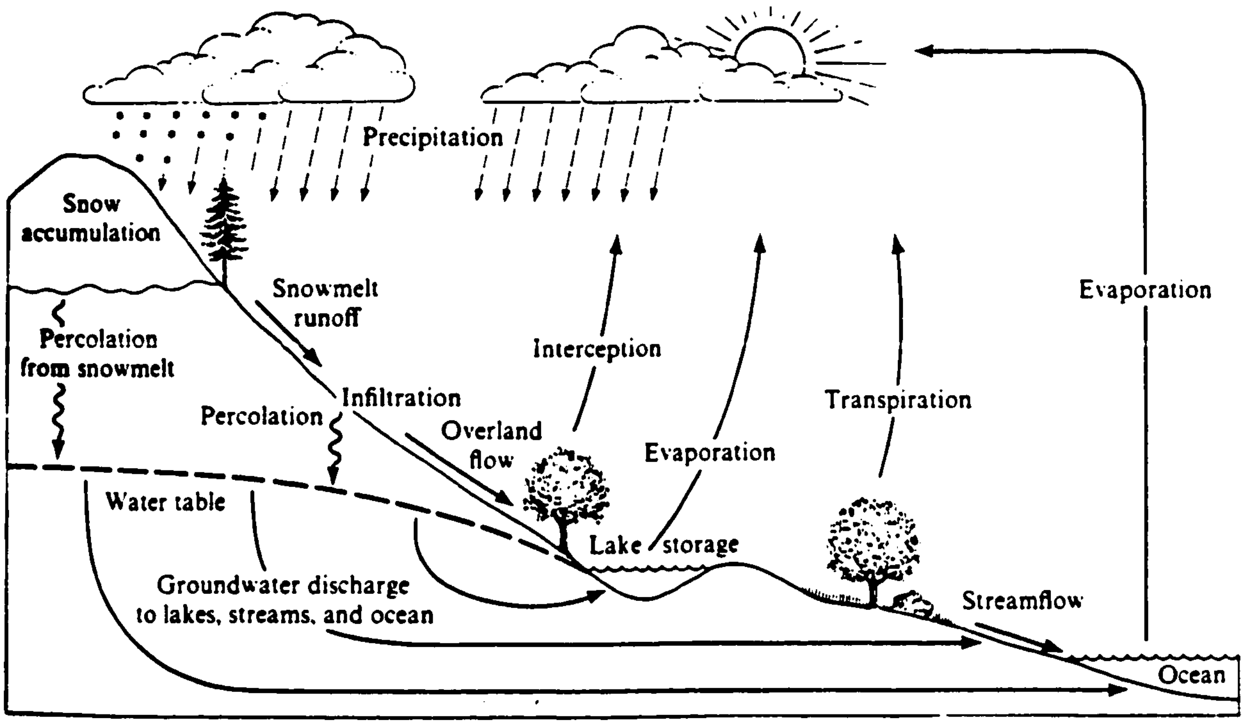
2.3.1 Physical Assessment in Water Resource Management

> *"Mountain environments generally are distinguished by more or less strong variations with altitude, aspect and, in extensive mountain areas, from one mountain range or valley, to the next. This is usually apparent in precipitation pattern, wind and avalanche activity, seasonal and perennial snow cover, degree of glaciarization, and patterns of runoff." (K. Hewitt: 1988:33)*

As a natural entity, water follows a natural system commonly known as the hydrological cycle (Figure 2.1). The cycle shows how water falls on the ground, travels downwards, over, or under the surface of the ground, reaches the ocean, and returns to the atmosphere by solar energy-induced evapotranspiration (Falkenmark: 1993, Ayibotele: 1992). The cycle is *normally characterized by many sub-cycles operating within it* (Figure 2.2). Distinct time and place characterize the occurrence of both the cycle and sub-cycles. Water users and managers seek to modify the sub-cycles to meet various uses and demands for water. In this context, WRM is normally defined as the application of structural or non-structural methods to alter and control the time and place of water to satisfy various human needs. Both users and managers seek to increase the effectiveness of various structural applications by applying non-structural methods.

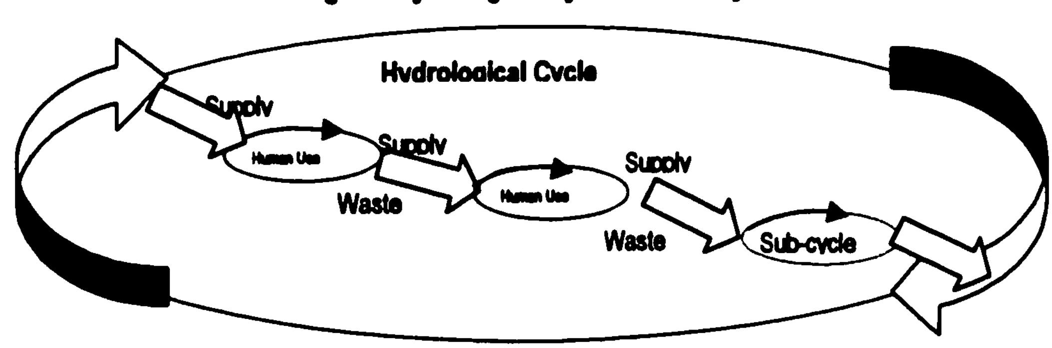
At the global scale, the hydrological cycle serves as the primary source of supplies in any given region. Global water resources are abundant and renewable for the existing technology (Frederick: 1993). In contrast, freshwater sources at the local-level are limited, uncertain, and found in different forms as characterized by the nature and functioning of sub-hydrological cycles (Young et al.: 1994). The hydrological sub-cycle is defined in this thesis as hydrological processes taking place in a local context, which is characterized by definite cyclic relationship between water supply, water use, and disposal. Locally, the sources are either natural or human made, represented by physical and socioeconomic settings. The availability of water at the local-level varies in time, space, and quality. Such variability depends on many hydrological variables, especially, rainfall and runoff (Moigne et al: 1994b).

Fig 2.1: Hydrological Cycle



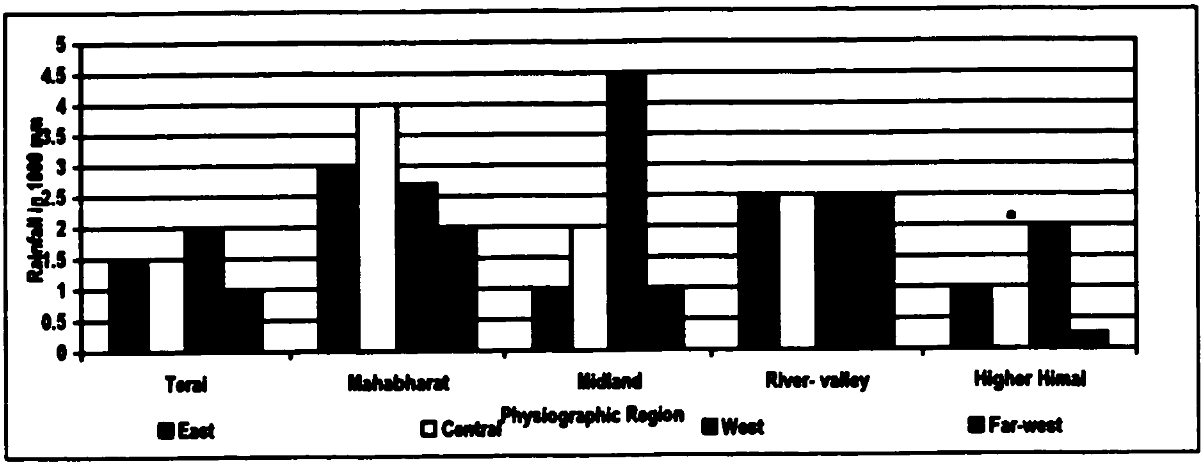
(Source: Dunne and Leopold: 1978)

Fig 2.2: Hydrological Cycle and Sub-cycles



The average annual rainfall in the Himalaya varies from virtually nothing in the rain-shadow areas to as much as four meters in some valleys (Ives and Messerli: 1989, Agarwal et al.: 1984, DHM: 1994). Figure 2.3 presents the variability in rainfall in different physiographic zones of Nepal. Such spatial variability is observed to take place even at the lowest planning/administrative unit (Chalise: 1994). A study conducted by APROSC (1994) in Nepal Himalaya Observed that rainfall varied by almost three times within an area less than 25 km² above Betrawati. The study found that the villages on the foothills not only received more rainfall but the combined runoff was about 30 times more than that in the upstream areas. A similar study conducted in Garhwal lesser Himalaya found that the annual runoff rate in different land types of the same watershed varied by almost 50 percent (Rawat and Rawat: 1994).

Fig 2.3: Variability of Rainfall by Physiographic Zone, Nepal



(DHM: 1993)

A wide range of physical factors characterizes precipitation, storage, evaporation, and runoff, which, in combination, determine the source and the supply of water in mountains. Such factors include windward or leeward situation of the community, local slope, relief, geology, topography, altitude, and snow and glacier characteristics. The example of windward and leeward variability can be illustrated by citing the variation in rainfall of Pokhara and Manang Valley. Separated by the Annapurna massif, within a horizontal distance of less than 50 km, the former receives precipitation in excess of 4500 mm/annum, while the latter receives less than 250 mm/annum (DHM: 1997). Similarly, local slope or relief is a very important factor in the Himalayan WRM, because most of the communities are situated in the hill-slope but the river flows in the valley bottom. The water retention capacity of the soil also depends on the physical characteristics of the slope.

A few individuals and institutions have looked into the possibility of groundwater exploration and water harvesting in the hills. However, these efforts, except for a few exceptions, have been unsuccessful (Gautam and Rao: 1988, DHM: 11 December 1989, DOI: 1993). Lift irrigation has been tried in a number of places to beat gravity, but the silt content in the water and unreliable power supply makes it both technically as well as financially unfeasible (APROSC: 1974, APROSC/JMA: 1995). ICON (1995) concluded that the efforts made by Agricultural Development Bank, Nepal (ADB/N) to install pump irrigation in the hills are unfeasible and must be abandoned.

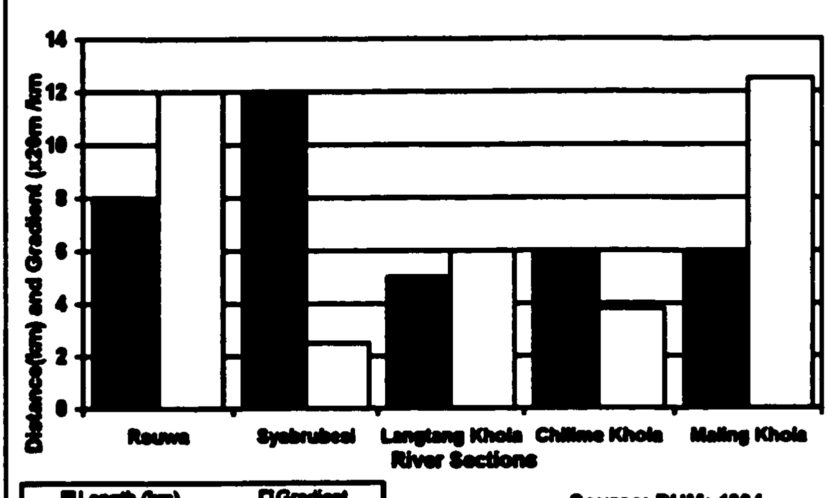
In his detailed climatological and socioeconomic study of a small village, Salme, in Nuwakot District of Nepal, Smadja (1992) observed that the rainfall varied significantly in an altitude between 1250 and 4000 meters. He observed that the rainfall pattern show August – as compared to July in the valley bottoms – as the month of maximum precipitation. This variation also affected the run-off pattern and the general agricultural practices downstream. Despite more than 3000 mm of rainfall, the author observed that the cultivation of rice is difficult on southward facing slope because of extended hours of sunshine resulting in excessive evapotranspiration. Butz (1987) also observed the variability in the runoff and topoclimatic controls on mountain hydrology in Hopar Nala Basin in Pakistan. Allan (1986) tried to prepare an altitudinal model based on accessibility and for that, he discussed a fair degree of meteorological variation in the mountain. Recently ICIMOD published a climatological atlas of Nepal, which has utilized Geographic Information System (GIS) to indicate a similar variability in precipitation (ICIMOD: 1996).

The topoclimatic control of water is also characterized by geology of the area. To find the relation between water discharge and the geology, Whol (1995) conducted a detailed study in ungauged mountain channels in eastern Nepal. Whol reported the difficulty in estimating stream runoff and its possible effect in the total water yield and its use downstream. Whol posited that such attempts although producing a few localized stream discharge values, could not be used for developing a model to estimate stream runoff.

> *"The absence of correlation between maximum discharge and either channel or basin characteristics imply, a) that statistical regressions used to estimate discharge at ungauged sites may be of low accuracy in mountainous channels, b) maximum discharge must be estimated directly at each site of interest" (Whol: 1995: 74).*

In this front, Marcus et al. (1992), and Caine and Mool (1981) have made similar observations. The researchers also tried to gauge the streams of the Colorado Rockies and Nepal Himalaya, but were unsuccessful in preparing a general model.

Fig. 2.4 : Length and Gradient of Tributaries of Trishuli River, Nepal

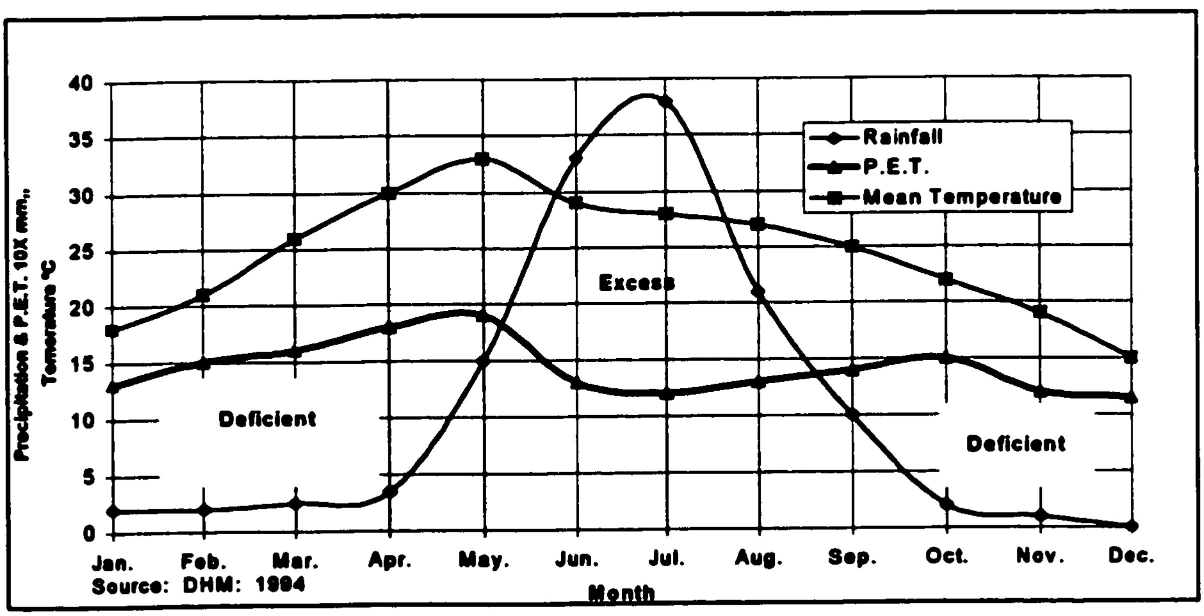


Source: DHM: 1994

The availability of water also depends on river characteristics. Figure 2.4 provides the relationship between discharge and gradient of different tributaries of the Trishuli River above Betrawati. An APROSC (1994) team observed that agricultural activities varied significantly in all of the Trishuli's tributaries, because the quantity and pattern of its availability were different at different slope conditions.

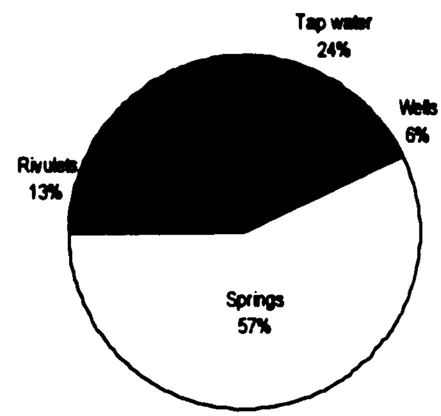
Various studies have established that rivers flowing from glaciers are more reliable than from the lower reaches (Japanese Society of Snow and Ice in Langtang glacier: 1974-1987, Snow and Ice Hydrology Project of Wilfrid Laurier University in the Karakoram: 1985-1990, Snow and Glacier Hydrology Project in Khumbu, Langtang, Makalu, Annapurna, Kanjiroba and Humla: 1987-1994, Arun Basin Project: 1982-1994, Sierra Nevada Snow Cover Study: 1989, Indian Glacial Research program: 1977-92). The Department of Irrigation in Nepal observed that the irrigation systems constructed in the glacier-fed rivers are more stable than those constructed in the rivers generating from other sources (DOI: 1993). The spatial variability of water is often aggravated by its temporal variability. The rainfall in the Asian Himalaya depends on the summer monsoon, snowmelt, and winter westerly winds (ICIMOD: 1985). An average of 75-80 percent of the precipitation occurs between the months of May and September as an effect of the Monsoon (DHM: 1994, Ives and Messerli: 1989). Figure 2.5 provides the temporal variation in rainfall, evapotranspiration, and water requirement in the western Himalaya of Nepal.

Fig 2.5: Variation in Rainfall, Evapotranspiration and Water Requirement, Western Nepal



At the micro level, a dearth of this kind of research is apparent. A few studies, such as that of Butz's (1987), have attempted to explain the relationship between discharge and water requirement in Karakoram. Similarly, Department of Irrigation of Nepal (1993), and Smadja's (1992) extended studies have made some noteworthy contributions regarding this issue in the central Himalaya. Nevertheless, lack of time series examination and failure to employ users in the study framework -- which the studies have conceded — weakened their findings.

Fig. 2.6: Source of Drinking Water in Rasuwa District



Mountain regions are characterized by diversified sources of water supply (Fig. 2.6). Sources such as, springs, rivers, and wells are used, individually or in combination, for drinking and irrigation. Springs are normally used for drinking water in the Himalaya, while the rivers and rivulets are used for irrigation, cottage industries and other household uses (APROSC: 1994). A DOI report stated that more than 75 percent of the springs dry up during the dry season (DOI: 1993). These unreliable conditions often lead to the failure of the projects and WRM activities.

Based on the foregoing discussion, it can be concluded that the cumulative availability of water in any geographical unit does not reflect the total "accessible" quantity of water. This aspect becomes more complicated when the geographical area is composed of complex geographical sub-units. It has been argued earlier that the availability of water in Nepal fluctuates by as much as 1200 percent in a spatial and 1800 percent in a temporal dimension (NPC/NEPAP: 1994). Thus, although the cumulative figures provide a sound picture, more than 40 percent of the people are reported to be deprived of the quantity and quality of water that is collectively termed as the "social minimum" (WHO: 1984, ICON: 1993b). The reason behind this dilemma has been identified to be the technological, managerial and financial constraints to cope with such variability, however, not least of which is also because of a sustained struggle which is black-boxed to develop a single strategy for all water resource problems in Nepal (Chalise: 1994).

Yet, most of the management approaches have considered aggregated, averaged or bulk data as useful for water resource analyses (Thompson and Warburton: 1985, Ives and Messerli: 1989). Nepal Environmental Action Plan (NEPAP) has also succumbed to a similar generalization (NPC/NEPAP: 1994). NEPEAP has contended that the management plan of the major watersheds in Nepal alone can solve all existing problems. However, such generalization can become totally irrelevant under the diversity, fluctuation, and variability of water resource characteristics; because, the water demands of population and other aspects of the economy must be satisfied with a definite amount of water, an optimal regime of its supply and proper quality. To identify and better understand the optimal regime, area-specific and micro-scale analyses become more relevant than exercises that produce general accounts on water resource structures.

The discussion presented here adequately demonstrates that the extreme variability and fluctuations that is currently on the main agenda for all WRM exercises are, in fact, part of the day-to day survival strategies of the people in the Himalaya. Conversely, the variables that characterize water availability in the Himalaya are extremely uncertain and difficult to capture through any scientific observation and measurements. Therefore, there exists a need follow an alternative means and build such information around people's reactions and responses to water that people are potential of demonstrating in their actions, strong attitudes, and preferential inclination.

2.3.2 Social Assessment of Water

"One can cite many examples of policies of government in which the failure to recognize that what was involved was essentially a social system has led if not to disaster at least to gross inefficiency... we have neglected the social aspects of the problems and treat... [them] as if they were physical systems." (Boulding: 1966)

Increasingly, water is being regarded as a social rather than a natural resource (Biswas: 1996). This departure can have two possible explanations. The first is based on the conviction that water is the basis of life – a major resource that can be used to enhance income and its distribution in the society (Munasinghe: 1992, Jordaan et al.: 1992, NPC/NEPAP: 1994). The second explanation is rooted in the discovery of a unique but changing interrelationship between water and human beings (Fitzsimmons and Salama: 1977, Hatley and Thompson: 1988, Postel: 1994).

Human response to water is more difficult to understand, identify, measure, and analyze than the natural processes. Human response to water is essentially a process-bound phenomenon, because human beings are required to follow a set rule in using water. This process can be examined by studying the socioeconomic structure of the communities and by understanding the context of water resources use. Therefore, problems related to sustainable WRM must be examined as a part of socioeconomic process. Many researchers have suggested the need for researching the interface between social processes and natural phenomena linked to water (Long and Field: 1974, Fitzsimmons and Salama: 1977, Chamber: 1978, , Sanwal: 1989, APROSC: 1994, Bandhopadhyay and Gyawali: 1994). There are efforts underway to understand the society-water inter-linkages, and the Himalayan water use system has not escaped this attention. These efforts can be observed in a wide spectrum of approaches– encompassing a range of pure economic research (Garduño: 1994) to physical engineering studies (Dunsmore: 1988, Whol: 1992, Smadja: 1992).

2.3.2.1 Human-Water Use Systems

To some extent, the ongoing efforts have been able to capture the scales and types of water use systems. First, the human-water use systems are typified by their sizes, in the sense of spatial coverage and population served, and local people's involvement (APROSC: 1994). Agarwal (1976, 1982) and Uphoff (1986) viewed that the water use systems in the Himalayan region can be typified by the control of people over the source. They both concluded that the size of the systems is negatively correlated to the extent of participation.

This classification, however, is unreliable and may be rejected, because the size of the water use system and level of participation are two unrelated aspects. For example, Rajapur irrigation system in Nepal, which is entirely managed by farmers, irrigates an area over 12000 hectares (APROSC: 1990). Similarly, there are empirical findings suggesting that the need and consensus of the community determine the scale of water uses (ICON: 1993c, Falkenmark et al.: 1980, Smadja: 1992, APROSC: 1994). In addition, it is now an established fact that the use of water depends on how people reflect themselves in the water-human relationship. For example: while evaluating Sunsari-Morang Irrigation system in Nepal, it was observed that a greater involvement of people do not always indicate a better water-use system (ICON: 1994). Such attributes of group dynamics and participation are also explored in other resources, viz. agriculture (Carson: 1992, APROSC/JMA: 1994), forest (Ives and Messerli: 1989, Bajracharya: 1986), soil and land use (Hatley and Thompson: 1987) and general resource use (APROSC: 1979, Byers: 1984). Similarly, the use of water is also typified by the context and scale in which the human-water system is interpreted (Hollings: 1995: 14-15). As has been presented in Box: 2.3, a human-water use system can be interpreted differently if a different viewpoint is taken.

Thirdly, the relation has been typified by a particular use of water (Garduño et al.: 1994, DOI: 1993, ICON: 1993b). However, in most cases, the supply sources are not restrictive to any particular use and often depend on the preference and orientation of the society. A Japanese International Cooperation Agency-sponsored study in Langtang (1984) observed that the rivers originating from glaciers are less preferred to those originating from the lower reaches of the mountains. Normally, farmers avoid irrigating with the melt-water, fearing that it can prolong the dormancy of the seeds. Butz (1987) has reported a similar pattern of water utilization in Karakoram Himalaya. Such preferences can affect the cropping pattern and socioeconomic response to water even at two the ends of the same community.

Box: 2.3 Man-Water Interrelation
Cornucopian or water as an infinite resource characterized by smooth improvement in both quality and quantity as the pressure increases (Kahn and Simon: 1984, Boserup: 1965)
Anarchic or the **hyperbolic view** on water characterized by constant degradation and reduction in total quantity (Eckholm: 1975, Rieger: 1981, Postel: 1995)
Balanced view on water characterized by sustainable principles. Need for adjustment and tradeoffs (Brundtland commission report: 1986, World Resource Institute: 1994, ICWE: 1992)
Resilience or the view of nested cycles characterized by fundamentally discontinuous events and processes, recognition for renewal, and the view that recognizes instability as much as the stability (Falkenmark et al.: 1980, Messerli: 1983.)
Evolving or the evolutionary and adaptive form of nature (Hollings: 1995)

Modified after Hollings: 1995

Similarly, the water-human relationship can also be typified by the social-orientation of the society. This appears legible, if seen from a perspective of growing consumerism and economic value placed by communities for water. Winiger (1983:103) eloquently argued this in the following words:

> *"Any assessment of a complex system in terms of its ability to provide a sustained production of energy or resources for human consumption depends upon the socioeconomic level attained, or sought, by the population concerned."*

Such human response in WRM is, however, very difficult to define or capture properly. As an illustration, Mu (1988), on his willingness-to-pay study, observed that all hypotheses developed to test the existence of hypothetical bias, strategic bias and starting point bias in the willingness-to-pay bids were rejected. More interestingly, the hypotheses that Mu had formed on the background of modern economic understanding all failed or were not convincingly conclusive.

Finally, the emerging philosophies on which WRM approaches are based have been very less effective to properly establish the basis for WRM epistemology. In this context, Rothenberg (1992: 74) questioned, "Whether "ecophilosophers" and conservationists should focus their attention on particular [resource], or on the communities of which the [resources] are a part, is of issue". Similarly, whether the "individual" or the "community " as a dynamic, inclusive social ecosystem is to be focused is yet to be properly resolved (Gupta: 1993).

2.3.2.2 The Context of Community-Water Relationship

The linkages between water and community are many and often hazy. They vary to a certain extent between a modern and a traditional culture. Conventionally, it is assumed that in traditional societies, water is regarded as a free good, their supply sources are natural, and the amount of water used is irrespective of the social strata of the users (Long and Field: 1974, APROSC: 1979). Similarly, in modern societies, it is assumed that water is considered as an economic good, the sources are modified by both structural and nonstructural means, and the users pay for the use of water (Chambers: 1978, Frederick: 1993, Jordaan et al.: 1993, APROSC: 1986).

However, it would be demonstrated in the succeeding discussion that such a black or white distinction is often irrelevant to the actual situation. The use of water requires incurring many tangible and intangible costs, and many of the characteristics identified in modern systems are sometimes more pronounced in traditional water use systems. In a modern society, progress may not necessarily mean more consumerism and alienation from the water resources. When societies shift their concerns to include broader goals (or modernize), they not only aspire to accumulate more affluence, but also more linkages that are social, local knowledge-based, and technology oriented (Long and Field: 1974, Rothenberg: 1992).

Seemingly, societies can display strands of both traditional and modern cultures. For example in Chaugadha VDC, Nuwakot in central Himalaya, an APROSC team observed an interesting composite of modern and traditional society (Box: 2.4). It is contended here that ignorance of such aspects has reduced the usefulness of the research conducted in the past.

Box 2.4 : Societies are Mixed in Chaugadha, Nuwakot

In the same small village of predominantly subsistence farmers, a few houses have all the modern bathroom fixtures and the owners have electric powered generators to pump water for their use. There are sprinklers in the fields for olericulture. The water management is, however, community defined and the rich farmers appeared to have succumbed to the decisions made by Water User's Association composed of predominantly small farmers. (APROSC: 1994)

Box 2.5: Societal Distinction and Women's Involvement
Gender issues and participation of women in WRM are increasingly receiving importance. Because in developing countries, as Young et al. (1994:4) posited, "...the pivotal role of women as providers and users of water resources and guardian of the living environment has seldom been reflected in institutional arrangements for the development and management of water resource... positive policies to empower women to participate at all levels in water resource programmes, including decision making and implementing in ways defined by them". While the "modern" water use struggles for women and minority's involvement in water resource projects, the strands of such involvement are found on various traditional water-use systems. In Jumla District of Nepal, women made decisions in both home affairs and in water related productive activities (APROSC: 1993). They are acknowledged as users, managers, and guardians of water resource.
In a study conducted in Lagos State, Nigeria, Oredugba (1991) reported that the women are mostly responsible for collecting water and allocating it to different uses. Women are also responsible for managing and conserving water resources. It is observed that women considered both quality and quantity while managing water.
Realizing the women's role in WRM, JAKPAS (a World Bank-funded drinking water development project in Nepal) and Gramin Bank in Bangladesh both operate projects entirely through women. Contrary to many interpretations, the projects managed by women are more efficient in terms of discounted payback period, benefit-cost ratio and cost of operation and maintenance (ICON: 1993a, ICON: 1994).

The notion of water banking, which is regarded as a breakthrough in WRM with "possibility of replication world-wide" (Frederiksen et al.: 1993, Arreguin-Cortes: 1994, Easter and Hearne: 1995) existed in the Himalaya for millennia. The users of irrigation systems in Western Nepal transfer their water use right in equivalent of pulses and mustard (APROSC: 1986, APROSC: 1989, ICON: 1995). Similarly, in Budhsingh VDC of Nuwakot District and Rajapur of Dhangadhi District in Nepal, the water right is transferred in equivalent of labor contribution (APROSC: 1994). In both of the cases, written codes of conduct do not exist and the transfers occur on folk understanding.

Several researchers have posited that users often fail to observe rules and regulations, while moving along a continuum of traditional to modern water use systems (CERID: 1979, DANIDA: 1997). This, as the following quotation from Indian Himalaya supports, is an unnecessarily generalized observation:

> *"A village panchayat (assembly of elder men) in Garhwal lesser Himalaya devised a unique rule of punishing people [who failed to participate in community water use activities or damaged or polluted water resources]... when did such an offense take place, the punishment decided was to ask the culprit to stand barefoot under the open sun in hot summer and feed the birds two and a half kilogram of grains from morning to evening." (Agarwal 1989 quoted from Gupta: 1990:4)*

The traditional societies have often been perceived as closed and self-sufficient. Yet, the bulk of the literature indicates that the Himalayan societies are self-reliant rather than self-sufficient (Gupta: 1993). This researcher views that in water use the former becomes more critical. In the era of deepening interdependency, few communities can prosper in isolation and without modernization. If one chooses self-sufficiency – an economic version of isolation – it makes its members suffer. Self-sufficiency could lead to inefficiency, and less diversification. Self-reliance, on the other hand, encourages one to look beyond the community and to diversify the use of water resources. There are many evidences in the Asian subcontinent, which support the argument that societies continuously struggle to become more self-reliant to manage available resources (Shiva and Bandhopadhyay: 1986, Thapa: 1990, Gupta: 1993, Neupane: 1993, Neupane and Young: 1997)

Similarly, water may be more expensive in traditional societies, than in modern societies. The voluntary labor contributions in traditional WRM, if converted to their monetary equivalents, are at least three times higher than the price (or users' fee) collected in highly subsidized "modern" drinking water, and six times more than "modern" irrigation systems[6].

2.3.3 Social Systems in Water Resource Management

Social systems in water use can be interpreted in terms of uncertainty existing within the community. The rural water-use contexts can be pictured as a complex system full of uncertainties. The water resource exists in nature as a system; thus, all people living in a hydrological regime are mutually interdependent. Although extensively explored through common property resources and water right surveys, it is still unclear as to how two communities and people living therein, up and downstream of the same rivulet, situated at two different vertical points, act and interact. Similarly, all water development projects have environmental and socioeconomic consequences and these are often matters of great controversy. In the same society, it is not uncommon to find a situation where a new project is unacceptable to a certain community due to unwarranted side effects, while another segment may be lobbying hard for the same for different reason(s) (Prof. G. Wall, U of Waterloo, personal communications: 1995).

Along similar lines, Messerli (1983) described that "the activity of one man in the mountain affects four others downstream." Conversely, its micro level of manifestation could be "the action of one man deciding and affecting the lives of the entire community." The communities are often so closely situated that the action of one community is directly reflected in the quality and quantity of the supply of water to another. Thus, the usage of water is wrapped around the construction of the society. The findings of APROSC (1994) study in Nuwakot district in Nepal illustrate this statement.

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[6] Calculated based on the current market price for "social minimum" and irrigation water for one hectare, ref: Uphoff: 1986, APROSC: 1986, Yoder: 1987.

The study observed that the adoption of improved agricultural activities and choice of the crop depend more on the timing and availability of the irrigation water and community-imposed water resource regulations rather than on the availability of labor and land quality. The extreme example of the social construction can be the drinking water project sponsored by CIDA in West Nepal, where, people in two communities refused to drink the piped water because it was aligned through another community inhabited mostly by people from the untouchable class (APROSC: 1993).

Hatley and Thompson (1983:366) observed a mutual adaptation of villagers, the landscape, and a forest-culture, which showed a continuously changing relationship. The authors' observation is equally valid for water-human interrelationships (Neupane and Young: 1997). Communities adapt themselves to changing water conditions, no matter what internal or external pressure there may be. Similarly, their actions to adapt to the water resource conditions are reflected in their attempts to manipulate the hydrological sub-cycle (Fig. 2.2) and accepted tradeoffs and adjustments. Moreover, the adjustments and tradeoffs are mostly culturally defined, which characteristically changes with any fluctuations in the physical aspects of water.

Due to the continued human intervention in hydrological cycles, this researcher argues that a pure physical water resource system is nowhere to be found. The hydrological sub-cycles are, in fact, adapted systems because their natural stability is anthropogenically modified to cater to various human needs. These aspects shape true capacity of the people, who express it in their actions, attitudes, and preferences. They may not always be sustainable or founded in scientific ground, yet the existence of refined local knowledge is unquestionable.

The WMO and UNESCO jointly pleaded that management efforts must be based upon comprehensive reliable water data and information if they are to succeed (WMO/UNESCO: 1991). This research entirely discards this statement because it fails to address the real need that exists at a water-user's level. It must be recognized that the goal of WRM is not only to develop data, but a set of understanding: the knowledge that can be applied in a meaningful context (Prof. G. Young, WLU: 1998, Personal Communication). Realizing the same, ICWE conference and subsequent attempts have pleaded to take the water management attempts to the lowest appropriate level. However, it remains to be elaborated satisfactorily, because scaling down alone may not solve the problem unless that process elaborates the roles that people can play in the given context.

2.3.4 Why People?

This review cited a number of current studies all indicating that the reliance on people's knowledge to carryout research is mandatory. Abraha (1991) observed that the management of water resources in the rural setup is a complex engineering-social problem. However, it is hardly ever considered that the indigenous people's knowledge is so much refined in WRM (Ives and Messerli: 1989, Butz et al.: 1992). In this regard, "open receptivity" of the managers and planners are needed to identify as to how the indigenous knowledge systems function (Abraha: 1991).

The ingenuity and the extent of people's knowledge of the physical aspects of water are proved in studies conducted in the other parts of the world. A research conducted in rural areas of Spain evaluated the context in which resource management is defined from a socioeconomic point of view. The study concluded that the function of public utility must be developed from the geographical point of view, based on situated knowledge, and should be able to respond to the social demands (Perez Esparcia: 1990). Similarly, a study conducted in the West Sumatra, Indonesia, revealed that the local people possess a long tradition of refined knowledge in WRM and create many relevant rural social institutions for the proper use of water (Ambler: 1989). The findings of West Sumatra support the findings recorded in the Rajapur Irrigation Project, Nepal and Hunza Valley in Karakoram (Butz: 1987, Neupane and Young: 1997).

Wilkins-Wells (1988) studied the modality of transfer management responsibilities to the users in Sri Lanka. He suggested that large, centrally managed projects are often characterized by weak institutional arrangements for water allocation, and can be tightened if the management responsibility is shifted to the farmers. Similarly, exploring the theory of development from within, Huddleston (1994) reported that the participation is the key to attain the development objectives. The main argument of Huddleston's thesis is that the local-level responses initiated by the rural poor are often the best and sometimes only available solution to cope with existing crises. Another study conducted in Sri-Lanka showed how people's utilization of domestic water supply and quality are linked to the supply of water and its local geohydrology (Myers: 1991). Thus, water utilization in the community is a function of physical characteristics of water, such as the taste, flow and accessibility of water. These studies have also established that the underlying social structures, community-based self-help groups, rules regarding access to water, and collective ownership support the efficient and equitable development and management of the water resource systems.

Studies have also established that communities develop a wide variety of physical and managerial technologies for WRM in response to different ecological conditions, climatic diversity and changing need and aspirations of the people (Wilkins-Wells: 1988, Myers: 1991, Chalise: 1994, Neupane: 1995). These activities range from the use of water wheels for lift irrigation (e.g., in Thar Desert in India), water-harvesting techniques (e.g., in middle Hills of Nepal) to sophisticated water proportioning devices construction in gravity-flow systems (Gupta: 1993, Chalise: 1994, Neupane: 1995, ICON: 1995, APROSC/JMA: 1995).

2.4 Converging the Modes of Assessment

> *"Water management literature (with exceptions of course) unfortunately reveals an unsystematic approach to planning [and decision making]... True, water resource practitioners live with the external environment and the water management syndrome day after day. However, when new... [methodologies] are proposed, they are likely to focus on specific problems from the perspective of traditional planning approaches. Little attempt is made to explore the broader societal context of planning activities that something insidious is "out there" (Bruke and Heaney: 1975:5).*

The preceding section demonstrated that hitherto the analytical methods developed within the water-society tradition are concerned mainly with explaining and predicting, in a comprehensive manner, the complex interaction of people and water. However, various complications, diversities, and uncertainties affect our knowledge of physical and social elements that need to be addressed in this type of analysis (Messerli: 1983, Thompson and Warburton: 1985). Incorporating the concepts of complications and uncertainties in decision making processes is essential, yet, equally essential is to pinpoint their extent and relevance at different operational levels – local, regional, river basin, etc. Obviously, this task entails the need for more in-depth and advanced research. Especially those with potentiality to explain "what actually <u>the people can offer to the scientific community</u>" and "<u>how can the scientific community relate the management efforts to the existing capacity?</u>"

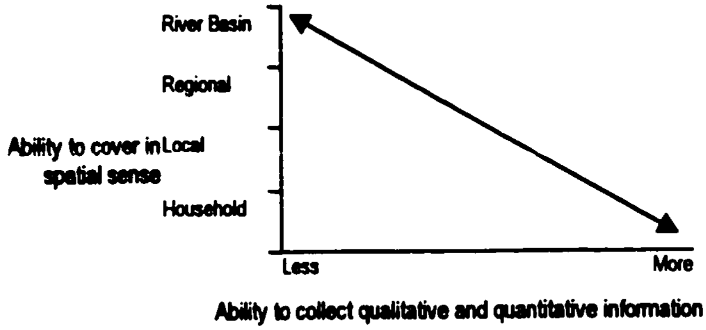
It is therefore essential to understand that, in short, WRM is like putting a complex jigsaw puzzle together. The better the small pieces are studied and designed, it becomes easier to solve the problem in its entirety. Thus, as a point of departure, understanding the nature of problems in WRM is necessary – which have been, to some extent, presented in the earlier sections. The nature of the problem suggests that the real WRM problems lie at the grass-roots level. Nevertheless, using the same analogy of water and a jigsaw puzzle, information collection and decision making at the local-level could mean just a small part of the puzzle perfectly designed and put together!

In this front, systems approach tries to solve complex WRM problems by analyzing the nature of the problem and by generating and identifying different solution alternatives (Simonovic: 1996). While doing this a WRM problem is approached in a holistic sense and all backward and forward linkages associated with the problem is analyzed by understanding the entire water resource systems (Simonovic: 1997). Similarly, systems approach recognizes the dominance of science in the process of alternative generation. However, Simon (1977) noted that most WRM problems are unstructured and characterized by fuzzy as well as routine complex processes for which concrete solutions do not exist. Similarly, Turban and Meredith (1994) noted the bounds of science. Thus, it is essential that both the science and arts operate on the same platform to solve the problem. While arts should be used to define the nature of the problem and its processes, the science should structure the processes through the application of appropriate tools and methods. This researcher recognizes the complexity and argues for the need of decomposition of problem structure. While it is not the objective of this thesis to critically evaluate what systems approach can or can not do, it recognizes that the problem of water resource management should not be looked in a black box. As much as the theoretical premise of systems approach appear to be sound, the practical significance of this approach are still debatable.

Similarly, it needs to be emphasized that management of water is complex and mutually inclusive of both supply and demand sides. In this context, Frederick (1993) argued that in less developed countries, WRM must be initiated at the local-level, because the demand and supply problems are relatively less complicated and the measures to solve them are locally available. Maintaining the balance and local-level integration of demand- and supply- sides of water is very important. The observed problem in Kamala and Sunsari-Morang Irrigation Projects in Nepal can be taken as examples to better state this need (ICON: 1993c, ICON: 1993d). These projects initially suffered as they concentrated more on the supply-side variables. In order to correct the problem, these projects abandoned the supply-side variables and introduced a number of demand-side considerations. Ironically, now both projects suffer from over concentration on the demand-side (ICON: 1994a, ICON: 1994b).

Therefore, water resource assessment at the local-level must be comprehensive and involve both supply and demand-sides. To accomplish this, first it becomes necessary to identify a level or a spatial unit, which can allow this convergence to best occur. Since the assessment is based on various quantitative and qualitative data, it must be realized that there is a tradeoff (Fig.: 2.7) between the level and volume of information collection and the scientific rigor of assessment (Hopkins: 1997). Secondly, it is essential to realize the relative advantage of concentrating at any particular level (Chambers: 1978). As Bottrall stated:

Fig 2.7: Relationship between Ability to Cover and Ability to Collect Information



> ....*to [effectively] manage water ... a "mix" of management skills [is required]. Most of the management mix are "compound factors." Technical (water source and delivery system), physical characteristics (climate soils, topography), Structural (drainage), Cropping Pattern (extensiveness, intensiveness), Water availability with relation to demand, ... (Bottrall: 1978: 315).*

Understandably, Bottrall's list is not exhaustive, and does not only relate to irrigation projects. Thus, it becomes essential that the context of assessment is explored in detail.

2.4.1 Assessment as a Human Centered Approach

> *"Starting with people, analyzing their needs, taking account of their culture and traditional practices, making certain that the roles of all sectors of the community are understood, and above all, to ask people to frame their own local, environmental goals are all prerequisites to satisfactory solutions of development and environmental problems" (Prince Charles' keynote address to the UNCED, April 1992)*

Very often, management of water is equivocal about who should benefit. Logically, the beneficiaries should include the people from all social strata and gender and the benefits should be equitably distributed. However, even when the initiatives are aimed at a grass-roots level, due to the lack of a sharper focus, the benefits go to the unintended beneficiaries[7]. Many water development projects, initiated based on the similar larger scale analyses, have ceased to function. The impact evaluation studies of Kamala Irrigation Project, Battar Irrigation project, and the drinking water component of CIDA-sponsored K-BIRD in Nepal indicate similar deficiencies during the project formulation stage (Uphoff: 1986, CIDA: 1993, APROSC: 1994, ICON: 1994a). Similarly, in Rajasthan, India, UNICEF funded hand-pump installation projects failed to provide anticipated benefits because of the communication gap between the regional and

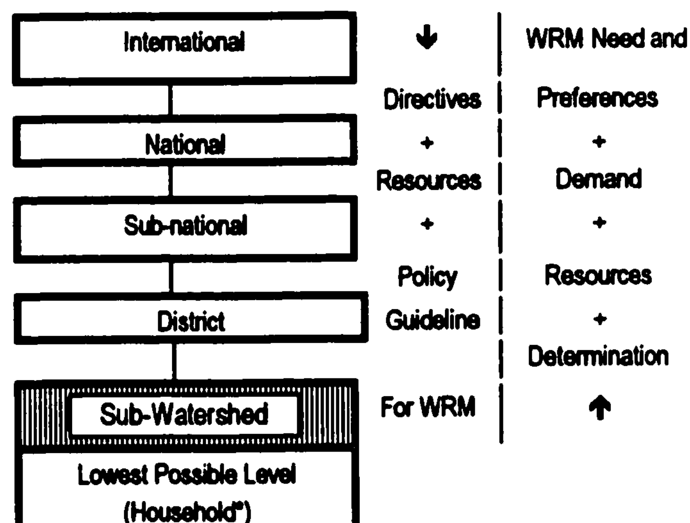
[7] In Chapter 7, considerable discussion on community's reaction on this issue has been made.

the local-levels of management (Gupta: 1993). The end result of these fallacies is so-called "leakage", a euphemism for the wealthier and more powerful persons dominating and benefiting from new opportunities at the expense of the poorer and less powerful (Cernea: 1985). Therefore, if the attempt is serious about reducing inequity, it is a prerequisite that the decision-making processes are clearly "targeted". However, it must be realized that it is not at all important whether or not local people are involved in the management strategies, but how best their survival strategies and capacities related to water are internalized in WRM initiatives.

2.4.2 Small watershed as the Most Appropriate Unit for Capacity Assessment

Preliminary research conducted to formulate this thesis in 1995 provided a sense that the lowest appropriate level for WRM is a household. Yet, this may not be a feasible solution given the practicability analyzing every household. However, as Figure 2.8 presents, the most appropriate level is different for specific condition and the intended use of water. A parallel analysis of the general water resource condition, the Himalayan topography, and intended use (small-scale terrace irrigation and drinking water) in small communities in the middle Himalayan belt provide a small watershed to be the most practical scale for WRM efforts (Box 2.6).

Fig 2. 8: Basic Institutional Structure



(Source: Young et al.: 1994) * Based on 1995 Analysis
The arrows indicate the direction of flow.

The analysis at regional or higher levels may cover a larger geographical area but it will only partially comprehend the complexity of geographical togetherness in terms of human interactions and dynamism (Hewitt: 1988, Allan: 1988, Jodha: 1992,). As it is discussed earlier, the management decisions must exploit the existing mutual relationships between human being and water that identify and shape the local-level ingenuity and, to some extent, ignorance. For example, the functioning of East-Rapti and Chhattis Mauja Irrigation Project in Nepal may be viewed. In these projects, to maintain the geographical togetherness, analyses were carried out separately for each of the tertiary and field canals, which then were collectively used to formulate the project level strategy (Yoder: 1992, ICON: 1993a). These projects now operate as the most successful irrigation projects in Nepal.

Box 2.6: Small watershed as the Most Appropriate Level	
• *A small watershed is a functional region established by physical relationships* • A small watershed area in the Nepal Himalaya often coincides with the administrative region, such as ward, VDC, or a combination. • A small watershed is a logical unit to evaluate biophysical linkages. • A small watershed is often a confluence of a single river; thus relating programs to the people within the watershed is more realistic and reasonable. • A small watershed is characterized by strong economic linkages.	• A people living in a small watershed identify themselves in a small socioeconomic unit and hence to a common resource management outlook. • A small watershed may be characterized as a complete system • A small watershed can be integrated to provide a framework for analyzing the effects of human interactions with the environment. • A small watershed can serve as a convergent point along the administrative hierarchy (Fig. 2.8)
(Source: Flaming: 1974, Easter and Dixon: 1986a, Ives and Messerli: 1989, Smadja : 1992)	

In the analysis of various socioeconomic facets that bear upon the process of management, the "control over" stands out as a dominant factor (Uphoff: 1986, Thapa: 1990, Shiva and Bandhopadhyay: 1986, Lazarus: 1994). If the utilization of water resource were to be sustainable and environmentally sound, local control over it and people's participation in the control are fundamental. The small watershed provides a basis to study the existence of such controls (Neupane: 1994). However, one stream of WRM also offers the view that water must be utilized at the regional scale (Khan: 1988). In this view, it is reasoned that the cooperation and integration of water resources offer economies of scale for joint development and management, enhancement in the reliability of water supply, and provides possibility for expansion. Yet, it is impossible to accept this argument if the geology of the area such as that of Nepal is taken into consideration. Furthermore, by increasing the spatial coverage, the total number of beneficiaries is bound to increase and the whole participatory framework may cease to function. However, the argument on the initial investment appears feasible, if there was never a need for maintenance of the system thus initiated.

2.4.3 Capacity Assessment is Knowing Where to Hit.

"The truism that the strength of a chain is determined by the weakest link may be well illustrated in water resource management..." (C.V. Lyle: 1961)

Water resource is characterized by stability – constancy, cyclicity, resistance and elasticity – and instability functions (Gigon: 1983). The regional level analysis can differentiate between instability and stability of water management, however, with the potential danger of misinterpretation (Box: 2.7). The ongoing dilemma of cynical resignation or arbitrary tyranny in Himalayan WRM can be attributed to similar misinterpretations (Ives and Messerli: 1989).

Box 2.7: Stability and Instability of Water Resource
Stability *Constancy*: The water resource system is not static but the changes are very difficult to notice in the short run due to systems resiliency. *Cyclicity*: The water resource system is characterized by cyclic oscillations. Resistance: The water resource system can have many disturbance factors, but the systems have no or very small effects due to its resilience. *Elasticity*: The water resource system is characterized by large changes. When the disturbance factors are no longer present the original state is restored
Instability The process of irreversible change of a system and the absence of capability for restoring to an original state after a change. (Modified after Gigon: 1983:96-97)

A related issue is the widespread expectance of the fact that asserts the resource utilization at grassroots in the Himalaya to be unsustainable (Rieger: 1982, CERID: 1984, Postel: 1994). If such is the case, the need will be to except that unsustainable practices are the true capacity of the people. The assessment of unsustainability can produce the context and dynamism for sustainability so that the elements of sustainability, which are lacking, can be isolated.

2.5 Redefining the Need of Capacity Assessment

> *... JTAs come and tell us to grow new crops, use fertilizer, insecticide and more irrigation water; staffs from soil conservation office come and tell us to stop digging irrigation canals and ditches on the mountain slopes that it can induce erosion; the overseer from Irrigation Office comes and tells us to keep the irrigation ditches clean to allow water flow smoothly and avoid cattle trample the canal; a forest ranger comes and tells us to grow grasses on terrace riser and, ditches for fuel and fodder, decrease the cattle population and have less grazing on forest cover; the livestock staffs come and tell us to improve animals, increase goat and buffalo population. We do not know what to do, whom to listen, what to accept or reject? Their sayings are always contradictory. ... and no one knows what we really want... (A farmer in Nuwakot District, (NPC-Nepal: 1994:21).*

During the past twenty years (after 1977 water conference in Mar del Plata), and with modest acceleration during the past six years (after Rio Summit), there has been a growth of concern about the word "assessment" in WRM. This concern covers a wide range of aspects (Such as: water use efficiency, irrigation management, people's participation, cost recovery, environment and water, watershed management, climatological studies, glaciological studies, river system management, water and behavioral studies, etc. UNCED: 1992). Because of this concern, there has been a significant increase in field studies and research. Such research has encompassed both the planned and operating water use systems, and the bibliography of this thesis will attest to this fact. Unfortunately, a majority of these have either "lost the ground" (Eckholm: 1978, Rieger: 1982); or have fall short to counterattack the existing "uncertainties" (Thompson and Warburton: 1985, Kattlemann: 1987), discern the complicated process of "instability" (Messerli: 1983, Gigon: 1983), scrutinize the Himalayan "specificities" (Jodha: 1992) and delve into the "dilemmas" in the Himalaya (Ives and Messerli: 1989). Unequivocally, the findings to these studies suggest that the underutilized people's knowledge and ill-focused and/or nonintegrated levels of analysis are the major reasons for the existing problems (ICWE: 1992, Jordaan et al.: 1994, Neupane: 1993, Chalise: 1993, Montgomery et al.: 1995).

A closer analysis reveals that the on-going research is based more on the anticipation of risks than existing potentialities (Ives and Messerli: 1989, Sanwal: 1989). There is no doubt that the lack of well-conceived time series data, accuracy of physical data and quantification of human related phenomena afflict the conduct and utility of the research. However, the use pattern and synthesis of available information and their interpretation cannot escape criticism. The end result of these failures is often a cliché – poor quality data or type I or type II error—that testifies a dilemma of "hitting without the knowledge of the problem" (K. Hewitt, personal communications: 1996). The need therefore is to redefine the problems of water, identify the targeted level and suggest the links that would join the levels together – at least in the context of the research.

Unfortunately, there is little design methodology specifically adopted or defined for such purposes, at least in the lexicon of the formally trained water resource planners/managers. Alternatively, even if it exists, it is biased toward the academic domain of the researchers (Chambers: 1997). Most of the techniques available for management of water are either too technical or excessively human-centered. Similarly, there is little explicit methodology for incorporating both of these in a systematic way. In this context, the research argues the followings:

First, the context of water use research can be extracted by understanding the water resource requirements. Such understanding would potentially reveal the human values attached to the natural entity, while converting it to a "resource" (Omara-Ojungu: 1992). More specifically, it would be relevant to know how people are using "water," which is a natural entity, as a "resource." Therefore, study of the capacity of people alone can provide a sufficient ground to begin a meaningful process to understand the context of WRM.

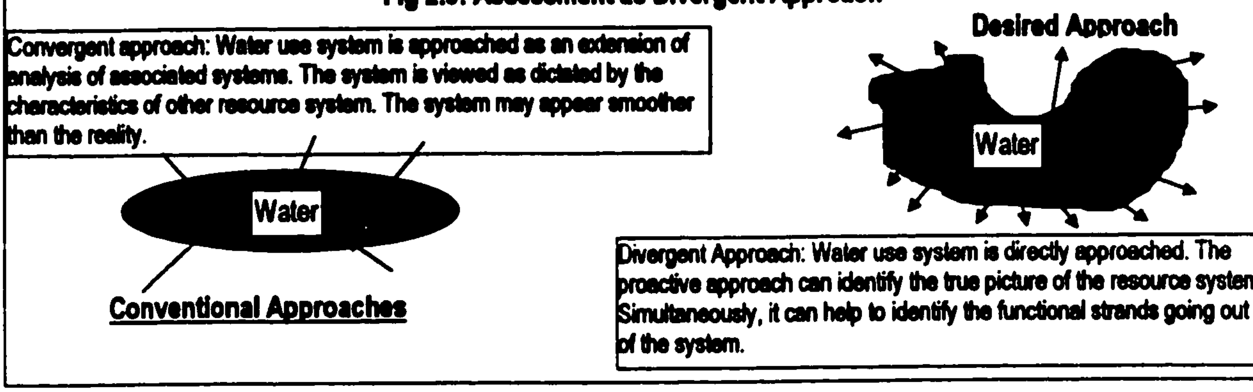
Secondly, there is a need to understand that adjusting ever-increasing demand for freshwater to decreasing and deteriorating supply has remained an issue of constant research in the field of hydrology, physical geography, natural science and social science. Commonalities, therefore, within these fields need to be appreciated. In other words, conceptual unity in hydrology, physical geography, natural sciences, and social sciences must be realized to initiate capacity assessment. Thus, the water can be studied by using both hard and the soft data (Mukherjee: 1985). It is unnecessary to assume that the process of WRM research must be black-boxed in the soft or hard method of data collection and analysis.

Thirdly, the design of WRM studies must fit into a participative, holistic and realistic dimension (ICWE: 1992). Participative dimension implies the external effort's ability to involve in the local water use (Narayan: 1995). Holistic is the need and ability to cover all the relevant interconnectedness (Water International: 1993). However, conceptual clarity would be necessary to balance the seesaw between holistic and reductionist perspectives, both of which probably represents the two ends of the same spectrum. In the same token, realistic means the ability to understand the existing realities in terms of limitations and opportunities (Bookchin: 1994). Mitchell (1990) explained realities in terms of strength, weakness, ability, and threats.

Similarly, the management perspective on WRM must change. Over the past, watershed management has been considered more or less as a euphemism or a sufficient condition for WRM. It is believed that once the watershed – which is normally taken as a unit of diversified land use – is properly managed, the entire water resource problems will be systematically solved (Neupane: 1993, Montgomery et al.: 1995). Consequently, integrated watershed management efforts are being considered as a general panacea for the existing problems (Carson: 1988, Agarwal: 1982, Easter et al.: 1986, Easter and Dixon: 1986b). Limited success accounted in contemporary approaches to some extent can be attributed to this subservience. Nevertheless, based on these premises, watershed management techniques cannot be altogether rejected. Although they are often biased toward land management or its influence on other resources, they contain valid strands that can be sensibly cultivated for an effective management of Water. However, unless these strands are logically placed in a "water-oriented" strategy, their effectiveness – in the context of management of water – may be seriously undermined (Ghosh and Rasheed: 1998).

Moreover, the researcher argues that the capacity assessment process must not depend on any particular WRM approach, because it is required in all approaches. Thus, there exists a need to recognize water as a dynamic unit and believe in the situated knowledge. It just requires that water is recognized at the center of all resources and humans are placed at the center of the water resource system (Fig.: 2.9).

Fig 2.9: Assessment as Divergent Approach



Capacity assessment must be based on a proactive approach, because the relevance of assessment can be realized only when the attempts are deliberate. Thus, it should allow decision making to come before the science and depend solely on what is existing on the ground. This approach requires a process-oriented analysis, rather than a threshold based and blind sampling approach. A process-oriented approach can create an interface between water and other socio-ecological variables. It can help identify socio-ecological processes in a matrix of substantive and operative contexts over physical and socioeconomic processes (Figure 2.10). Through substantive context, the research can identify variables having separate or independent existence, yet not merely inferential. Similarly, in the operative context, variables are identified very dependent and subservient to associated variables. Once these processes are visible, managing the causes can be easier than the symptoms that may sometime appear only when ecological or other socioeconomic effects are active.

Fig 2.10: Socio-ecological Framework for Information Collection

		Contexts	
		Substantive	Operative
Processes	Natural	Landscape Feature, Physiography, Climatology, Hydrology, Meteorology, Flora, Fauna	Ecological and Biological Activities, Interactions From Human Interventions
	Socioeconomic	Social Structure, Groups, Communication Networks, Interactions, Cultural Traits, Production Process	Social Dynamism, Decision Making, Conflict, Cultural Change

Modified after: Burke and Heaney: 1975

2.5.1 Assessment in Water Management as an Inductive Inquiry

"While Humans do not affect and are generally unconcerned about the volume of global water resource, they do affect and are vitally interested in the quantity and the quality of freshwater available for specific uses." (Frederick: 1993).

By presenting the issues in the above paragraphs, the researcher is not intending to advocate the notion of "small is beautiful" (Schumacher: 1989, Pandey: 1992). It is the intention of this chapter to analyze the utility and need for researching the water resource problem at the local-level. Such local-level research cannot be generalized due to the situatedness of the knowledge and due to intrinsic socioeconomic variability, but can be used to develop a conceptual understanding of the human interactions with the water. Considering the essence presented in Figure 2.2, existence of a concept of symbiotic relationship between sub-cycles may be accepted. Based on this conviction, a sub-hydrological cycle at the regional/river basin level can be processed as an accumulation of sub-cycles at the small watershed level. Thus, the relevance of analysis of a sub-cycle in order to generate understanding toward the entire WRM framework may be accepted. Conversely, this argument supports the assessment of water as an inductive process.

The researcher argues that unlike historical approaches, the assessment process must place an inductive inquiry into the water use. By inductive inquiry, it is implied here that situated explorations are needed to develop a general understanding. Consequently, the assessment should be able to establish a locally evolved and situation based knowledge having distinct implications at policy/ regional/river-basin level. Similarly, the approach must try to assess the capacity by letting the people in the area guide the research. It is argued here that collaborative research is essential, where both the people and researcher are both equally responsible in the knowledge-building process.

2.6 Capacity Assessment

"Capacity building is not just a matter of providing people -with the skills and know-how to accomplish tasks and solve problems; it also means providing the environment in which individuals can exercise their capabilities. Also, these skills and know how need to be mobilized and applied, involving factors such as the motivation and efforts of individuals to improve their livelihood and the mobilization of people to reach common goals that are mutually beneficial to a society" http://magnet.undp.org/cdrb/CAPMET~1.HTM

Water resource managers and scientists are increasingly asking the same question: Why the implementation of WRM approaches is difficult and often leads to success in a few and failure in many places (Hopkins: 1997)? The argument, however, remain less substantiated because the failures are publicized more than the successful cases. Yet, interestingly, the responses to the question often converge to a uniform answer that the concerned stakeholders' "roles, perceptions, and preferences" have not been identified properly. The core of this statement is that the people's capacity to receive and participate in these approaches has yet to be effectively studied and internalized.

The key to success in capacity building is not simply to "empower" the people, but to develop a process for external (which is alien to the area and being imposed) management approaches to understand what capability people have. However, there is a direct relation between the former and the latter. The capabilities could be comprehensively assessed in local people's actions, attitudes, and preferences toward water. Collectively, *capacity assessment include the study of stakeholders ability to conceive a task, exercise power to make decisions, design the modality to implement the task, and mobilization of different resources* (Box: 2.8) (Alaerts et al: 1991, UNDP: 1991, Hopkins: 1995, UNDP: 1998).

Box 2.8: What Exactly Does Capacity Mean?
Technical Capacity: The understanding of the physical aspects of water, including but not limited to the source water adequacy, infrastructure adequacy, and technical knowledge.
Managerial Capacity: Basic understanding of the management structure of the areas' water resources, including but not limited to ownership accountability, responsibility, other stakeholders, and effective linkages.
Economic Capacity: The willingness to share the responsibility for water resources development, including but not limited to revenue/labor sufficiency.
Social Capacity: Basic knowledge of the community vis-à-vis water resource set-up in the area, willingness to take activities that require to accept tradeoffs, and may be a significant departure from the present.
Extracted from: EPA: 1997, UNDP Capacity Assessment Guideline: 1997

The management approaches are currently giving an overwhelming emphasis to provide access to users in the planning process, and increase their potentiality to better use such opportunities (Greyling: 1987). This burgeoning body of experience of local "learning", "democracy", and "participatory development" can not be dismissed as irrelevant but it is essential to refine these words by adding the indispensable elements and a congenial process to operationalize them (Abraha: 1991). Conceivably, better understanding of actions, attitudes, and preference of the users can be expected to open new avenues toward this refinement (Box: 2.9).

Even in the developed countries, only in the last few years has capacity assessment started to become popular. Environmental Protection Agency of US recognized in late 1997 that Drinking Water Projects require a logical process of capacity development. Accordingly, EPA prepared a guideline on capacity development. <http://www.state.sd.us/state/executive/denr/des/drinking/capacity>

Box 2.9: Perspective of Capacity Assessment
Most discussions and papers tend to focus on "the need for capacity building," "the need for sustainability," "the desire for self-reliance," and "the need for new approaches and models." These issues find a broad agreement. However, after thirty years of relative discouraging results there is a need to revisit and rethink technical cooperation and capacity building in general, including the methodological point of view in particular. The methodological aspect adds substance to policy initiatives. The new thinking must include capacity assessment frameworks and methodologies (strategies, data collection, presentation formats, analytical matrixes, computational analysis, data base management, etc.). The possibilities are vast. It can generate a most simple planning approach, where one knows what is before, and determine what should be. *Capacity Assessment for what? For the design of better capacity building strategies and programs. How? Using rigorous assessment strategies, data collection and dissemination methods.* (Hopkins: 1997, http://magnet.undp.org/cdrb/CAPMET~1.HTM)

2.6.1 Importance of Capacity Assessment

It is now realized that gaining a better understanding of capacity building is closely related to development and refining of a methodology for capacity assessment (Hopkins: 1997). In this context, many WRM efforts have started to concentrate on capacity assessment. However, the on-going approaches are concentrated more at the national level. This literature survey concludes that research on capacity assessment at a sub-national or small watershed level has never been conducted before. *This paucity necessitates that an iterative approach is adopted, where the finding of one exercise would clarify on the need to explore another aspect on capacity assessment.*

2.6.2 How New is the Concept of Capacity Assessment in WRM?

- Although bilateral and multilateral agencies were involved in the business of capacity building for many decades, many of its preconceived assumptions and hypothesis were wrong. What many have now come to realize is that capacity building is difficult (Hartvelt: 1996).
- In 1991, UNDP organized a symposium on capacity building for the water resource sector. There were three main concerns of the symposium: a) creating an enabling environment with appropriate policy and legal frameworks, b) institutional development, including community participation, and c) human resource development and strengthening of managerial systems (Alerts: 1991).
- In 1992, UNDP commissioned a study with the mandate to analyze objectively the results of the past 30 plus years. By virtually every criterion, UNDP capacity building projects failed to meet their objectives. In most of the projects, sustainability was alien or non existent.

- In May 1993 the World Bank joined "new awareness renaissance" and articulated "Capacity Assessment" as the "Missing Link" in development (Hopkins: 1997).
- The 1993 publication of "Rethinking Technical Cooperation: Reforms for capacity building in Africa" provided a comprehensive review of the literature and evidence to date and an in-depth analysis. It started a new era of capacity building.
- UNDP in 1994 published a seminar paper "Beyond Rethinking Technical Cooperation: New International Cooperation for capacity building in Africa" provided some macro-level assessment.
- Through "Building a new UNDP: Agenda for Change", UNDP (1994) articulated an "emerging vision of development as human centered, equitable and socially and environmentally sustainable," or "sustainable human development."
- There are pilot projects underway in 10 countries to understand capacity assessment at the national level. The pilot projects are yet to report the success or failure incurred from them (Biswas: 1996).
- So far, not a single attempt has been made at the sub-national or local-level.
- This issue, the researcher hopes, will receive widespread attention during the forthcoming UN conference on sustainable WRM (November 1998). (UN: 1998)

UNDP is currently trying to broaden the concept of capacity assessment into a national definition. In essence, the definition is being shifted from a public sector organization biased one to what is termed a "national" approach to capacity assessment (Hopkins: 1997). Thus in a country like Nepal, which is overwhelmingly dependent on external assistance, it is extremely unlikely that any functional attempt will be taken to translate the thinking to a sub-basin level for many years to come.

2.6.3 Closer Look at Capacity Assessment in Water Resource Management

2.6.3.1 Balancing the Holistic and Reductionist Perspectives

One of the fundamental deficiencies in WRM is recognized as the inability of managers and planners to decide its focus (Briscoe: 1998). Most of the current efforts are based on the assertion that water must be managed holistically. However, neither is the term "holistic" properly defined, nor is the suitable "whole" to represent the water resource characteristics adequately elaborated (Hollings: 1995). Rather, the efforts are geared to incorporate more variables and define these variables' direct and/or indirect relationships with water. Thus, there exists a philosophical as well as a practical significance to balance the seesaw between the holistic and reductionist perspectives.

2.6.3.2 Resource Focus

The current efforts to manage water require attention, because a management methodology that water can claim to be its own does not exist. Most of the current WRM frameworks are either offshoots of land-based management strategies (Montgomery et al.: 1995), and integrated WRM models (Biswas et al. 1994, Jordaan et al.: 1992). Or, they are presented in ecosystems or ecological perspectives, where water is often so feebly defined that the theoretical success of management concepts outweighs the significance of water (Slocombe: 1993, Hollings: 1995, Bergkamp et al.: 1998).

In nature, there is no doubt that resources are indistinguishable during their utilization. For example, irrigation development is often linked to the management of land and its utilization or, for that matter, drinking water is often linked with forest conservation and so on (ICON: 1993b). This intertwined resource characteristic inhibits any form of explicit analysis of one resource (Montgomery et al.: 1995). However, when it comes to management, it becomes essential that some resources are considered more important than others are. This invokes the significance of the resource being managed and possibility to provide a meaningful "human content" to the resource (Omara-Ojungu: 1992). A related issue then emerges to determine what other resources need to be included in the analysis. Logically, this aspect must be left to those who are in direct association of the resource being managed. For WRM, the utilization pattern of the people in direct contact with water can determine the significance of implicit analysis of associated resources. Similarly, this process can help in maintaining and identifying the local interpretation of synergism.

2.6.3.3 Temporal Focus

Another criticism of ongoing WRM efforts comes through the misinterpreted temporal dimension of this resource (see Chapter 2.3). It is still unclear whether the past or the present or the future – predicted based on past and the present characteristics of water resource – or a combination of these dimensions is taken as the focus of management. Understandably, how water resource behaves in the present is an outcome of the water characteristics in the past, and how it will behave in the future is affected by the present management (Ekins: 1989). Therefore, there must be a balanced perspective while selecting a time frame for research.

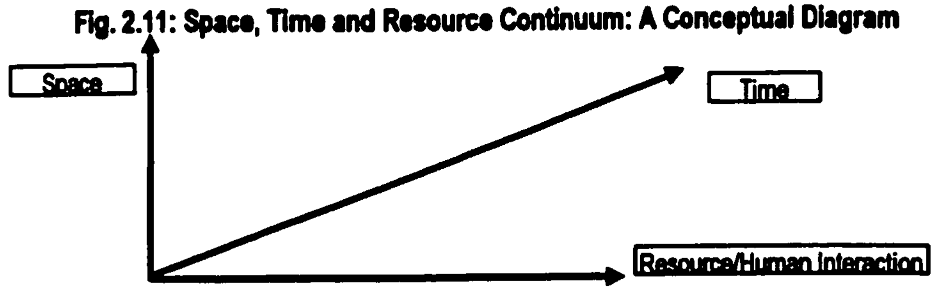
Conceivably, WRM can be more meaningful if the efforts can meet the current need of the population without compromising the needs of the future (WCED: 1987). The definition of sustainability unwittingly provides the temporal focus of WRM. The consideration must be placed to understand what tools and techniques are available today, by analyzing what were lacking in the meaningful past, in order to provide a sustained benefit from WRM to the population in the future. Thus, the approach must focus on a meaningful past and predict the situations for a meaningful future by analyzing primarily what the resource characteristics are at present.

The problem, however, is to define what the "meaningful past and future" signify? Although this can be contested, the most pertinent way to identify the meaningful past is to rely on the community in direct association with the water resource. Normally, the period from when the communities can explain major change in water characteristics to the immediate past must be identified as the meaningful past. Similarly, the meaningful future should be based on the dynamism of identifier variables (population, major interventions, and introduction of technologies). The identifier variables can also be derived based on the analyses of the meaningful past.

2.6.3.4 Spatial Focus

Equally, the current management is criticized in view of the spatial relationship of water resource (Ghosh and Rasheed: 1998). Water resource characteristics often change when the spatial context is changed (Rawat and Rawat: 1994). An individual's preference of water use can be totally different from his/her community, and so does a community's, when it is compared with the regional preference (Ives and Messerli: 1987). Similarly, the characteristics of those responsible at each of the possible levels vary with their management preferences and nature of interventions. As the water resource is a dynamic resource having a clear spatial linkage between all levels, identification of a level of analysis depends on the scope and the type of management desired (Bergkamp et al.: 1998).

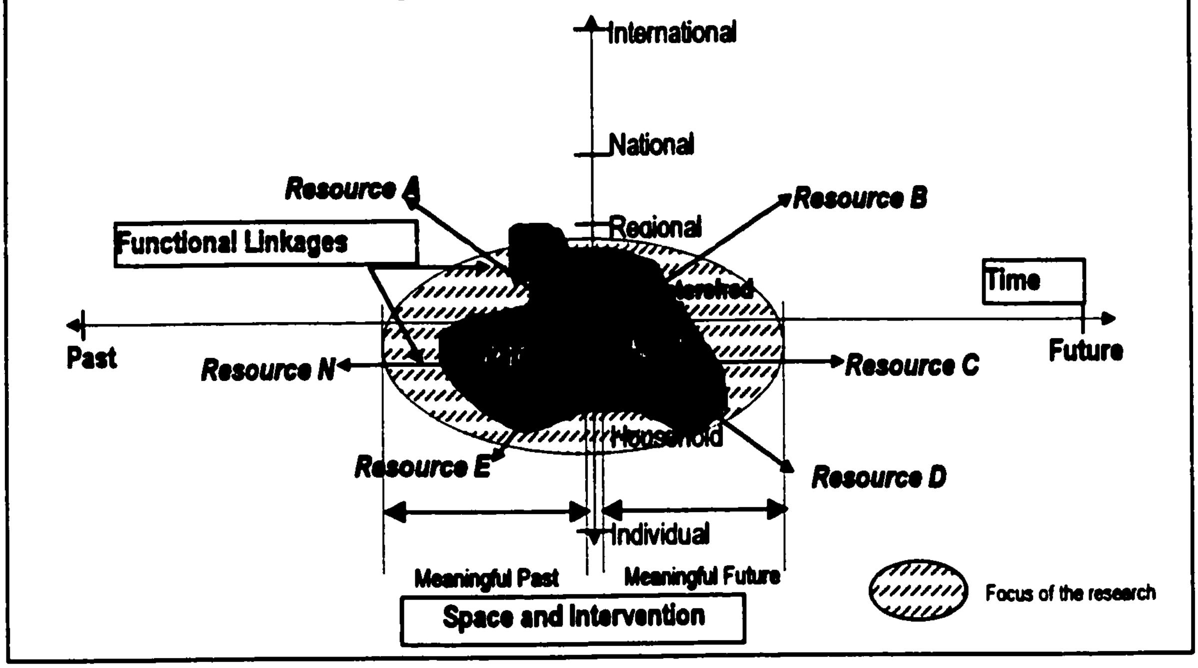
Fig. 2.11: Space, Time and Resource Continuum: A Conceptual Diagram



(Modified After: Prof. G. Wall, University of Waterloo)

Thus, it is essential to consider that the management in a society can be traced in a continuum characterized by the temporal variability, spatial responses, and their interactions to the changing resources. Considering the above discussion, if different resource combinations are placed in a linear continuum, the theoretical presentation of the focus of this research is presented in Figure 2.12.

Fig 2.12: Focus of the Proposed Research



2.6.3.5 Scaling Down

Capacity assessment is based on the contexts of multi-objectivity, multi-actor, and multi- attribute decision making. The assessment process must acknowledge that the usage of water in a community can be more than one, and it varies both in terms of requirement and source characteristics. Management of water is reflected in the interplay of people involved at various decision-making levels having various demands and potential use (or concern) for water. Conversely, it has all potential of being interpreted differently by different sectors.

As has been described in an earlier section, WRM is characterized by anti-reductionism, synergism and calls for a holistic action. These words imply indivisibility of certain water-related variables or possible misinterpretation if they are divided. Undoubtedly, the decision-making process should be precise to the extent possible, however, "hair-splitting" analyses of complex issues can make them unrealistic and theoretical (Montgomery et al.: 1995). Thus, the purview of capacity assessment weaves around a complex tapestry of – sometimes impossible to identify and interpret – physical and socioeconomic information. Understanding and interpreting such information is often questionable against their suitability in different contexts, and of different levels of analysis and decision making. Thus, accepting the arguments of both reductionist and holistic approaches are essential

Seemingly, there is no clear-cut and pre-defined methodology or a research technique for capacity assessment. UNDP has recently prepared a guideline for capacity assessment (Box: 2.10), however, it is very recent, equally contentious, appear unrealistic and yet to be applied to assess its effectiveness. This thesis defines capacity assessment in WRM as *'a process of understanding actions, attitudes, and the preferences, which is demonstrated by the immediate users and facilitators involved in WRM in terms of their resource condition, and temporal as well as spatial interpretation.'* Failure or success of the design methodology or the concept of capacity assessment – explained as the outcome of actions, attitudes and preferences – itself is debatable. It will depend on the perception and philosophical inclination of the user of this thesis. The uniqueness of this thesis lies in the same sentiment; it regards capacity assessment as a deliberate attempt to welcome surprises.

Box 2.10: Initiating an Assessment Process
Participation : Assuring that all users participate
Regulation : The assessment falls within the legal structure
Transparency : Processes, institutions and information bases are directly accessible to those concerned
Responsiveness : The loyalty needs to be properly expressed
Consensus-building: Differing interests are mediated to reach a broad consensus that satisfies the group's best interest.
Equity : All women and men have access to participate
Effectiveness and efficiency: The assessment must be initiated with an achievable objective
Accountability : To the people
Strategy: A joint strategy is conceived.
A successful capacity assessment exercise requires the full involvement of the stakeholders in a consultative process (http://magnet.undp.org)

2.7 Dublin Principles

'The ...ICWE [held] in Dublin, Ireland, on 26-31 January 1992... saw the emerging water resources picture as critical...Fundamental new approaches to the assessment, development and management of freshwater resources...can only be brought through political commitment and involvement from the highest levels of government to the smallest communities. Underlying all these must be a greater interdependence of all peoples, and of their place in the natural world... the conference ... urge all governments to study carefully the specific activities and means of implementation recommended ... and to translate those recommendations into urgent action programmes for Water and Sustainable Development. (From the Dublin Statement on Water and Sustainable Development, 1992: 3)

2.7.1 Objectives of the International Conference on Water and Environment (ICWE)

ICWE was organized with broad objectives as given in box 2.11 and its findings are recognized as the most articulate, expressive, to the point, and focused at the operational rather than at the policy level (Briscoe: 1994). It is accredited for best defining the meaning of sustainability and economic development in the context of water (Box: 2.12).

"Sustainable water resource development is development that promotes the quality of human existence and the natural functions of the biosphere" (ICWE: 1992).

Box 2.11: Objectives of the Dublin Conference
• To assess the current status of the world's freshwater resources in relation to present and future water demands and to identify priority issues for the 1990s; • To develop coordinated inter-sectoral approaches towards managing these resources by strengthening the linkages between the various water programmes; • To formulate environmentally sustainable strategies and action programmes for the 1990s and beyond to be presented to the UNCED Earth Summit; • To bring the above issues, strategies and actions to the attention of governments as a basis for national programmes and to increase awareness of the environmental consequences and developmental opportunities in improving the management of water resources. (ICWE: 1992)

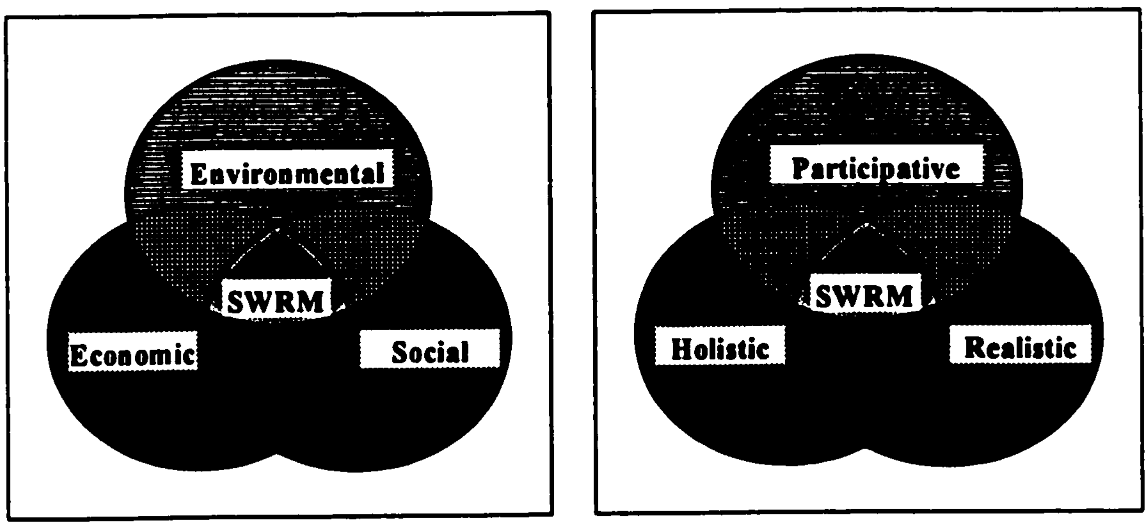
The conference stressed that effective WRM depend on the degree to which the holistic, realistic and participative focuses are internalized in a single framework (Fig: 2.11). This consideration is much more refined than those based on the Brundtland Commission's prescription characterized by the economic, social and environmental focuses. The Dublin consideration leaves very little room for those critiques, who have labeled the traditional view on sustainability as 'weak' and 'strong' (Beckerman: 1995). This 'weak' version of sustainability is based on neoclassical theory in which even a pure economic consideration with very little social and environmental content can qualify as sustainable. The 'strong' sustainability, on the other hand, is based on the balanced economic, social and environmental focus. This, to many experts, is too perfect to be implemented (Simon: 1989, Singh: 1992, Steer and Lutz: 1993). In such a critical environment, the Dublin focus is very less likely to be branded as 'weak' and 'strong,' because it has a straightforward and simple realization.

Box 2.12: Concept of Sustainable Development as Perceived in Dublin Conference (1992)
1. The synthesis of economic, social and environmental considerations; 2. Processes which compare and evaluate alternatives which do not deplete the resource base and thus not affect present and future generations; 3. The greatest possible efficiency in the use of water and energy, including appropriate and safe reuse, recycling, and conservation of all water resources; 4. The quality of human life and the protection of the biosphere.

The conference also recognized the interrelationship of water with other natural resources, and emphatically stressed that the water must be placed in the center of all resources. It was the first major meeting that unanimously stressed to focus on the holistic management of water in an integrated framework of human and environmental issues (Rodda: 1995). It stressed the need for fundamental new approaches to development and management through political commitment and involvement from the highest levels of government to the smallest communities.

Fig. 2.11: Distinction between Exiting Realization and Dublin Realization of WRM

Existing Perspective | **Dublin Realization•**



Source: WCED: 1987, Barbier: 1987, ICWE: 1992

2.7.2 Role of People

While implementing integrated WRM, ICWE asserted the need to initiate it at the lowest appropriate level. It emphatically asserted that it is essential,

> *"...to ensure that users, local institutions and the formal and informal private sectors can play a more direct part. A key aim must be to improve accountability to the public... water resources should be managed at the lowest appropriate levels. Integrated water resources development and management therefore should be delegated to those lowest appropriate levels which would ensure the representation of those concerned or affected and integration of sectoral demands (ICWE: 1992: 15).*

The most important consideration of ICWE (1992: 16), which also guides the spirit of this thesis, can be sensed in the following quote:

• The considerations are defined in Chapter 2.5.

"Water resources development and management should be planned in an integrated manner, taking into account long-term planning needs as well as shorter horizons, i.e. it should incorporate environmental, economic and social considerations based on the principle of sustainability; it should include the requirements of all users... and it should be an integral part of the socioeconomic development planning process".

2.7.3 Demand Management

Concerning demand-management, ICWE asserted that water should be recognized as an economic and life-sustaining resource. It argued that the demand management initiatives must be executed through, water conservation and reuse; resource assessment; financial instruments; and impact monitoring (ICWE: Chapter 3.11: 1992).

2.7.4 Resource Perspective

Most notably, ICWE provide a renewed perspective to see water as the nucleus of resource-system (Young: 1998, personal conversation). This provides justification to trace the functional strands going out from water to other resources (Fig. 2.9). This theme is supported by the recognition on the quantity and quality of water as common issue. It stated that "There is a growing recognition that issues of water quality cannot be considered separate from water quantity. It must also be recognized that freshwater quality is impacted directly by natural and human activities outside the water sphere, such as land-use practices, erosion, and deforestation (Chapter 4.1: ICWE: 1992)."

2.7.5 Rural Perspective

Box 2.13: Principles of Sustainable WRM in the Rural Context
• Water should be regarded as a finite resource that has an economic value with significant social implications;
• Local communities must participate in all phases of water management ensuring the full involvement of women in view of their crucial role in the practical day- to-day supply, management and use of water;
• Water-resource management must be developed within a comprehensive set of policies for human health; food production, preservation and distribution; disaster mitigation plans; environmental protection and conservation of the natural resource base;
• The need to recognize and actively support the role of rural populations with particular emphasis on women, given their role in feeding the world's population and protecting its environment.

The Dublin conference recognized the need of water for agricultural development. Toward this end, it voiced concerns for cost-recovery mechanisms; demand management; close monitoring of irrigation system performance and water management at the field level; improvements to irrigation and on-farm infrastructures; and promotion of adaptive technological research and development as well as the dissemination of results. Box: 2.13 provides the principles of sustainable WRM in the rural context.

2.7.5.1 Understanding the Spirit of Dublin

There are four main conclusions that ICWE drew on water resources development and management. These conclusions adequately reflect back on the large and diversified experience gained since the United Nations Water Conference, Mar del Plata, 1977; and avoid "serious errors and unwise biases" (Rodda: 1995). Notably, these conclusions support the idea of being self-critical and provide space for quick and contextual correction in WRM.

Box 2.14: Guiding Principles for WRM from ICWE
Fresh water is a finite and vulnerable resource, essential to sustain life, development, and the environment
Water development and management should be based on a participatory approach, involving users, planners, and policy makers at all levels.
Women play a central part in the provision, management and safeguarding of water
Water has an economic value in all its competing uses and should be recognized as an economic good.

(Source: ICWE: 1992)

The first conclusion of ICWE stress on the need to acknowledge that water is a finite resource. The second conclusion demands a participatory framework in WRM. In this context, it stresses on the participation of the users in all aspects of planning, implementation, and evaluation of water projects. The third conclusion argues the need to realize central role of women in the provision, management and safeguarding of water in all WRM initiatives. The final conclusion recognizes water as a resource with an economic value. In this context, ICWE concluded the importance of water to the society, underprivileged getting right of reasonable access at an affordable price; and provision to take the opportunity cost as a measure in sustainable water resource development.

2.7.5.2 Is Dublin Unpopular or Theoretically Imperfect?

Currently, WRM approaches are struggling more to acquire theoretical perfection than to provide practical solutions (Falkenmark: 1995). Conversely, many major milestones on WRM are now being forgotten as "old" and "obsolete" (Harvey: 1994). This may be equally true in the case of the Dublin conclusions. Seemingly, while the Dublin principles advocated all required elements that any WRM should contain, its limited use and appeal can not be totally ignored (Woods: 1995, Biswas: 1997). It is often argued that Chapter 18 of Agenda 21 was more or less based on the

Dublin principles (Briscoe: 1994, Serageldin 1997a), yet many refuse to agree this claim (Woods: 1995, Biswas: 1996). Biswas (1997:32) criticized the Dublin process in the following words:

> *"More than five years after Dublin, the proponents of the Dublin principles have failed to indicate how these principles can be put into practice in the context of water management in the real world"*

Arguably, such negative remarks about the principles can be attributed to the lack of their application on the ground. For example, in contrary to fact that there are over 3458 AltaVista search entries for the Rio Summit, Dublin only has about 20. The Sociofile and Dissertation abstracts both do not have any entries on the Dublin Principles, whereas about 112 entries is found on Agenda 21 (Trellis CD-ROM Search: 1998). Admittedly, the Dublin conclusions have not only failed to attract the research community, but also the academic community.

While reviewing ICWE, this researcher also realized a few of the limitations of the Dublin Conclusions. For example: the section on water resource assessment does not assign any roles to the people. It appears that the conference regarded the role of the people in WRM simply as information-provider, but not as information users. Although, the document adequately addressed the need of data for decision making and planning, its access to the local public is not properly acknowledged. Consequently, the loop that links raw data into refined knowledge is very poorly defined. The section on water use assessment suffers from professional hegemony of water-science and provides very limited role to people or, for that matter, to those who are 'scientifically illiterate' (expressed in terms of inability to understand meteorology and hydrogeology). Conversely, the affirmation written elsewhere in the Dublin document about the "use of indigenous knowledge and management skills" and "assuring the incorporation of water-resource information in decision-making processes" becomes redundant.

Similarly, while expressing the need for research and development in the water sciences, ICWE failed to address the importance of local people's knowledge and indigenous technology. In addition, it has not only identified fresh water as a unitary resource but also identified as part of a system. Contextually, the approaches are contradictory and fail to provide a ground to balance the perspective on "whole" and "part." In its sixth chapter, ICWE discussed the issues for the water for sustainable food production and rural development and drinking water supply and sanitation but it failed to present anything meaningful with potentiality of implementation.

Apart from the limitations noted in preceding paragraphs, the principles must be recognized very useful in the operational context. As Abu-Zeid presented his views that,

" Dublin conference...emphasized the importance of a more integrated approach to water management that treats water as an economic good, manages water at the lowest appropriate [administrative] level, involves water users, particularly women, and takes into account the impacts of water use and development on the environment" (Abu-Zeid: 1995:41)

At the local-level, Jønch-Clausen (1994: 10) reported that " [Dublin]...process will be catalytic in promoting preparation and implementation of National Action Plans for integrated WRM." He argued that the widespread use of Dublin principles is constrained by the dearth of meaningful studies to operationalize the conclusions. Except for a few SIDA funded projects in Central Africa, India, Brazil and Vietnam, and two independently conducted in Nepal, there are hardly any significant studies conducted to find the applicability of these principles (Jønch-Clausen: 1994, Boesen: 1994, Kahangire: 1994, Appasamy: 1994, Dong and Andersen: 1994, Kelman: 1994, Neupane and Young: 1997. In this context, Briscoe stressed that, "paradigm shift is a difficult task, but it happens through repeated testing – may it be successful or a failure" (1994: 96). He further posited "... Copenhagen/Dublin/Rio principles appear repeatedly as ones that are respected in the sustainable, efficient and equitable WRM systems.... But just as important as the universality of these principles is the fact that application of the principles cannot be a mechanical process but must take account of the natural, cultural, political and social factors which are so fundamental in managing water resources" (1994: 97).

Evidently, Dublin conclusions suffer extensively in attempt to put together the best of all management approaches that are currently in practice. The unpopularity of the principles to water resource managers may be due to a similar mix-up. This thesis, however, argues that ICWE was not an effort to salvage the previous mistakes of UN Water Conference (UN: 1977) and the failure of the international water and sanitation decade (Harvey: 1994). Its aim was to provide a new direction to the world's WRM. The bottom line, therefore, becomes to make the conclusions more practical and put them into use rather than occasional citation of its "principles" in conferences and meetings. Such citations often provide criticisms such as:

In recent years, it has been "politically correct" for... international organisations and individuals to speak glowingly of the Dublin principles, as it by themselves they could contribute to rational and efficient water developments. It is high time that we realised that the so-called Dublin principles, which incidentally were not incorporated in Agenda 21, are basically bland statements of the obvious, which if ever implemented, will <u>not</u> provide sufficient conditions for sustainable water development...(Biswas: 1997:31)

Apparently, to many "scientists," such as Biswas, ICWE did not offer any "promising management options"; it is because its theoretical foundation is generally "unappealing." However, it will not be an exaggeration to say that the whole water sector lacks a universally implementable option. There are other options too, but all require a logical process of refinement and fine-tuning. As for the Dublin principles, it is apparent that very few attempts have been made for their refinement. As Boeson (1994) argued that the essence of these principles could be better realized only when they are used right from the project conceptualization stages. However, the applicability of the principles will definitely improve if a first hand knowledge is generated on some of the fundamental issues. For example, WRM would certainly benefit, if we had information on: a) how the Dublin findings appeal to the users, b) to what extent their utilization pattern already subscribes in them, c) what form of management intervention are essential, d) whether or not it is applicable in small watershed conditions, where water resource is constrained by several problems. This thesis focuses to generate a first-hand answer to some of these issues and concerns.

2.8 Conclusions

The current approach to WRM is plagued by certain limitations that no one wishes to acknowledge. The most crucial limitation can be noticed at the conceptual level and the use of local people's knowledge in WRM. While the former suffers from the lack of proper delineation and integration of demand and supply aspects of water, lack of an "appropriate level of management" and a design methodology. In the same token, the latter suffers, not due to the lack of a participatory framework, but due to the inability of external approaches' to duly internalize the local potentialities. Capacity assessment is a relatively new approach that is gaining popularity in WRM. However, it is yet to trickle below the national level. For the whole concept of capacity assessment to trickle down to the lower levels, considerable efforts are required. This research expects to find answers to some of the questions that this literature survey has revealed.

CHAPTER THREE

THE HIMALAYAN PHILOSOPHY: A NATIVE'S REVIEW

"...Man is part of the ecosystem; his communities are real and dynamic and subject to change as the man-resource relationship is altered...community analysis [vis-à-vis resources] must consider the joint interdependence of resources and communities in terms of societal stability and maintenance as well as exploitation..." (Field et al: 1974:8).

3.1 Background

There is a pleasant similarity in the fourth century BC travel account of the Chinese historian Huen Sang and the CNN's prime-time coverage on Hillary Clinton's proposed visit to the Himalayan countries (Shah: 1973, CNN Prime Time News: 11 March 1995). Huen Sang's travel account and the CNN's review, in essence, presented an analogous picture of the Himalaya, its resource set-up, and the people. Both accounts stressed how the enthralling beauty of the Himalaya has remained the same – "untouched and well-preserved." Similarly, a convergence of idea can also be traced to Myrdal's "Asian Drama" and country reports of a few of the Himalayan countries presented at the Rio-summit or Dublin (Myrdal: 1969, NPC-Nepal: 1992, Sharma: 1992, NPC-India: 1992). These, in poignant contrast, present an ecologically and economically degraded and deteriorated face of the Himalaya.

The comparison of two sets of accounts provides a sense that over the centuries, the mountains, and the resources therein, have remained unchanged. If the accounts of the latter reports are analyzed, they suggest that, for centuries, the countries have remained underdevelopment and that this is also a chosen destiny of the people living in the Himalaya. Apparently, any "conscious" response to the first set of comparisons should acknowledge the contribution made by the native-mountain people. Similarly, the response to the second set should question whether the people living in the mountain have such negative outlook.

However, if these accounts are put together, it will generate a third perspective. It will portray that mountain degradation, resource management, and exploitation are mainly in the minds of the individual or group preparing the accounts. Thus, it must be acknowledged that the people living in the Himalaya also have a distinct mind-set, which is what shapes their use (or abuse or misuse) of resources. Unfortunately, most of the contemporary literature on mountain WRM appears to be unaware of this.

This chapter attempts to approach the Himalayan WRM issues and related problems by answering two underlying questions. First, it reviews the inapplicability of metanarrative approaches used in WRM and development in the Himalaya. Second, and based on the first argument, it approaches and then proposes a philosophical base for this thesis. It deals primarily with the epistemological foundations for sustainable WRM.

3.1.1 The Objectives of the Chapter

This chapter is written on a premise that those who use the resource, and live where the resource exists are more likely to understand it best. As Berg (1993) asserted "... objectivity and truth come to be seen as concepts which are historically situated and situationally specific." This chapter proposes that the epistemology should be based on the "uniqueness and situatedness of the Himalayan phenomena." More specifically, the objectives of this chapter are:

- To provide a short review of previous philosophical approaches taken in studying the Himalaya in general, and WRM in the Himalaya in particular;
- To critically analyze the philosophy behind those studies and identify their weaknesses; and
- To present a new philosophical basis to study water resource management in the Himalaya.

3.2 Setting the Scene

Many development ideologists, philosophers and paradigm developers seem to believe that the Himalaya should be abandoned as an object of developmental efforts and treated as a "degraded" area "thriving beyond its carrying capacity". They reason that if developmental efforts are concentrated exclusively in the plains areas, jobs and income created there will draw people from the mountains and reduce the poverty, erosion and other ecological problems of the latter areas (Eckholm: 1975, 1976, Rieger: 1981, Lall and Moddie.: 1981). Similarly, restrictive actions taken against people would allow sufficient time for the convalescence of the Himalaya's regeneration capacity. The WRM in the Himalaya and the problems related to it have not escaped this generalization.

This misinterpretation about the Himalaya can be attributed to what Omara-Ojungu (1992) viewed as existing dualism between resource conservation and socioeconomic phenomena, and sketchy or scattered literature. The latter, sketchy and scattered literature, generated mainly through "armchair epistemological exercises" (Hewitt: 1995) – are originating from three different extremes.

On one extreme, conservationists and economists view the Himalayas as a habitat of "ignorant and illiterate" people responsible for ever-increasing environmental degradation – the aftermath of which repeatedly transcends the international boundaries (Eckholm: 1975, 1976, Rieger: 1981, Newsweek: November 7 1987, UNICEF: 1995). On the second extreme, naturalists and human ecologists view mountains as "the land less traveled" or "the untouched Shangri-La"–a geographical region with none or insignificant human activities (Hewitt: 1988, Hewitt: 1995). Finally, on the third extreme, the ongoing "tug of war" between different modernist philosophies, and their incoherent applications produces a body of literature in itself. The results of these three misconceptions converge to the comments like "abandon" or "take harsh measures" or "is there a need?" or "why human?" etc. As the following statement will reveal, even the Rio Summit was hasty in making conclusions.

> *"Nearly half of the world's population is affected in various ways by mountain ecology and the degradation of watershed areas. About 10 percent of the Earth's population live in mountain areas with higher slopes, while about 40 percent occupy the adjacent medium- and lower-watershed areas. There are serious problems of ecological deterioration in these watershed areas. ... The mountain and upland areas of the Himalayas..., which make vital contributions to agricultural production, are threatened by cultivation of marginal lands due to expanding population. In many areas this is accompanied by excessive livestock grazing, deforestation and loss of biomass cover" (Rio Agenda: Chapter 13.13: 1992)*

This thesis, being written by a native of the Himalayas, philosophically argues that even a pure output growth strategy for this region must give due attention to the mountains as a separate and most important entity. Given the trade, migration, and fiscal interaction between the lowland and the mountains, the latter cannot remain as a dependent, but must become an active participant in the region's overall development or sustainable development strategies.

If observed from a WRM point of view, the inseparability of mountain from the plain becomes more critical. The management of water in the Himalaya not only determines the total physical availability of water, but the quality of the water and most of the economic activities of the plain. The rain and snow fall in the mountain yields, as much as 96 percent of the total water availability to the plains of Nepal (DHM: 1994).

Yet, what appears easy to explain (Box 3.1) is equally fuzzy and complicated in analysis. As Warf posited, "these phenomena could be explained as a puzzle of infinite complexity" (1993). The linkages, social, economic and environmental actions and interaction are all a function of how human being use resources available in their surrounding. Emphatically said, the problems, or solutions in the mountain have a fundamentally nonlinear cause, therefore the concepts that are useful come from nonlinear dynamics on socioeconomic adaptation, characterized by roller-coaster changes and conditions that invoke perpetual surprises.

Thus, maneuvering through these uncertainties and understanding the perpetual surprises require the help of expert navigators -- the native mountain people. Epistemology, thus, must give due priority, listen, and incorporate what people think or say. More precisely, it should develop on the philosophy of the mountain people. Mere mega-theoretical analyses, significance tests and systems approaches can never be sufficient to prepare strategies or, for that matter, consider the whole gamut of the "closely woven and complex" problems. Chapter 2 of this thesis has provided many examples in both the demand- and supply-side of water. There exists a need to merge, therefore, the two types of analyses to produce a body of information that can be used as an understanding.

Box 3.1: Mighty Problems of the Mighty Himalaya
It cannot be overruled that the Himalayas endow resources of inestimable value. Yet, it is currently figured among the most impoverished areas in the world. This is due largely to the unique ecological conditions that the mountains pose. In the last 20 years, the population in the Himalayan range has doubled. The increase is characterized by steeper increase in the people living below the poverty line. During 1987, 75.8 percent of the people living in the region were poor in absolute terms. Major valleys were choked with population pressure and the carrying capacity of basic services was exhausted. The calorie-deficiency across the region ranged from 403-450 and the average day in unemployment was 65.6 days per annum. Because the markets are poorly developed in the mountains, people have little cash-income and they cannot rely on off-farm employment or food purchase. Therefore agriculture remains the only option and is based on an attempt at self-sufficiency in the production of basic subsistence requirement. Unless effective strategies based on the existing physical and socioeconomic conditions are formulated and implemented, the "spiral-down" of the problem is inevitable (Ives and Messerli: 1989). These physical and socioeconomic conditions are characterized by declining productivity, inconsistent technology, and incoherent policy-level cures. Unless arrested timely, these may speed the rate of land degradation beyond the scope of available remedies (APROSC: 1994).

3.3 Himalayan Philosophy Revisited

Historically, the efforts to understand the Himalayan phenomena go back to European geographers, G.D. Airy and Rev. J.H. Pratt in 1855 (Jhingran: 1981). However, contemporary work (those related with resource development and management) began after the opening of Nepal in 1951 and, philosophically, upon the acceptance of Schafer's challenge[9] in 1954 (Ives and Messerli: 1988, Golledge and Amedeo: 1974). Subsequent adoption of a policy by Nepal to let "the western experts" use Nepal as a test venue for development ideas, led to a surge of such attempts (Ives and Messerli: 1988, Bista: 1992).

In the last 150 years, from Airy and Pratt to Post-Rio period, the laws and theories developed to study mountains and Himalayan water resources, at best only partially represented the existing phenomena. This researcher thinks that all attempts having "human" components were only partly successful. Despite this, the sustenance of

[9] "... the present conditions of the field [of mountain resource management] indicate a stage of development, well known from other sciences which finds most geographers still busy with classification rather than laws (Schafer: 1954:229)".

metanarrative discussion as the principal philosophical framework in the Himalayan resource management can be attributed to the positivists' capability to provide an "appealing complexion" to the existing phenomena. Like Porter blatantly referred "... does not matter if a statement is true so long as it is interesting" (1977:281). Ives and Messerli observed this arrogance and noted that:

> *"...world level effort ... in the Himalayan region ignores the sea of uncertainty that surrounds it ... understanding of the process operating in the region, whether geophysical, environmental, social, economic or political is tenuous at best. Differentiation between cause and effect is thwarted by ... unreliable, even manufactured data ... confounded by a pervasion of assumption, conflicting convictions and latter days myths" (1989:xvii)*

In the contemporary Himalayan resource, modernists' attempts can therefore be regarded as inappropriate. This blunt statement can be attested by "reciting the level of respect" extended to the native mountain people. In cultural terms, mountain people are uncivilized (CERID: 1984); in economic terms, they are half-starved, wretched and ignorant (Lall: 1986); in social terms, they are stupid and ignorant (Myint 1970); and, in environmental terms, they are savages, destroyer and enemy of the entire humankind (Eckholm: 1976, Rieger: 1981, Newsweek: November 7, 1987. UNICEF: 1995). This list of references, however, is not exhaustive.

Similarly, one must also admit that the modernist epistemology has failed to capture the entire societal structure. These approaches lack clear focus and voice for women and other oppressed within the society (Acharya and Bennett: 1983, ILO: 1986). As Ives and Messerli observed that, " ... the physical 'facts' [of the Himalaya] are wrongly described, why should the human 'facts' be any better" (1988:147), most of these efforts appear to have been filtered through a definite mind-set of the researchers. The history of unsuccessful social development programs, I/NGO approach and women's development programs, can be taken as a few outcomes of similar wrongly constructed epistemological foundation (APROSC: 1994). Another problem associated with these efforts is associated with their dependence on the language; as "... descriptive language, no matter how precise and exhaustive can never succeed in anchoring itself to a reality[10]..." (Stromayer and Hannah: 1992).

In order to hide similar limitations, more Himalayan researchers use mostly uncontextual, mathematical symbols. The increasing use of mathematical aesthetics or some nebulous form of non-predictive understanding, however, as Mauch explains, is much to "impress than inform" (1983:114). In spite of this fact, the contemporary writing

[10] This statement inspires some of the mathematical tools used in this thesis. However, the outcomes of all mathematical analyses are taken back to the subjects of the thesis so that they could be verified.

among the elite-circle is usually considered inadequate and unworthy unless they are liberally sprinkled with an array of algebraic symbols. Most of these efforts, therefore, fall under a philosophical approach, what Bloom (1989) says "Disneyland Version of Philosophical Thought." A few behavioral and analytical mathematics used in this thesis are definitely not to impress but to substantiate the findings and to put them in a context that is more understandable to the audience of this thesis.

The shifting and fudging of the aims of Himalayan WRM and its epistemological foundations have also been reflected in the shifting and fudging of its methodological principle. The methods or criteria of a subject depend on the aim and claims with which the subject is pursued. As Fish stressed it, they depend on "the job to get done" (1980:23-4). If there is no clarity regarding the aims of the subject, there can hardly be any kind of discussion of its epistemological foundations, or for that matter methodology of the subject. With the erosion of the true objective of the Himalayan WRM and geographical studies, the foundation and legitimacy have also been eroded off the prevailing methodological principles. The distinction and demarcation presented by the European experts of Himalaya were definitely not to elucidate the geographical understanding in the Himalaya (K. Hewitt, Personal Conversation: 1995). Surprisingly, when the later scientists and resource managers attempted, as far as possible, they aimed at testing or falsifying the same understanding. There are hardly any new attempts made so far that detach themselves from testing of some predetermined hypotheses. More often, such hypotheses do not even remotely present any relationship between the existing variables.

3.4 Approaching a More Suitable Philosophy for the Himalaya

3.4.1 Denaturalization and Humanization

Although enough testimonies exist to attest the inapplicability of metanarrativism, still many Himalayan resource managers' attempts revolve around it. This situation is aggravated – as many true Himalayan geographers, resource scientists and experts note – due to either very poorly or wrongly perceived man-mature relationships (Ives and Messerli: 1989, Hewitt: 1987, Sanwal: 1987, Thompson and Warburton: 1985, Mahat: 1987, Gurung: 1981). Many further argue that the recent surge of studies geared toward sustainable development has worsened this situation (Neupane and Young: 1997).

Contrary to its mandate, WRM in Nepal has been very less successful to consider the uncertain and incomprehensible human component, which is perpetuating the domination of metanarrativism. This domination has led to a tendency of naturalization (attempt to put all phenomena in the context of the nature) of the existing mountain phenomena (Chalise: 1994). It is reasoned that once the phenomena are naturalized – they become more predictable and definite to be captured by theories. Apparently, these attempts are misleading, as they tend to invoke biocentricity. Often, dependence on natural law and antihumanism deny what is most distinctive in all human being– their ability to think and understand (Bookchin: 1990). What matters is the human's ability to reason, to foresee, to will and to act insightfully with nature and enhance nature's development. Not only does naturalization downgrade the human capability, but also it separates these attributes from nature.

What is essential, therefore, is to evoke, elaborate, and give ethical content to the "human core" of nature. With an understanding that, if there is no human beings, there is no nature. Furthermore, this process of naturalization tends to reduce human being to mere commodities. As Bookchin asserted, "...the commodification of humanity takes its most pernicious form in the manipulation of the individual as a means of production and as a means of consumption" (1990:117). Admittedly, what is required therefore is to humanize. Not only the factors in direct interaction, but also those remotely associated with the human being should be humanized. Humanization evokes uncertainty and the existing ingenuity and ignorance of the people, from where the real quest to define and identify the interrelationship between variables and other phenomena can be initiated.

3.4.2 Use of Scrutinized A-posteriori Truth

Most of the contemporary efforts on the Himalaya are based on a priori truth. However, as L. Wittgenstein said " Whatever we see could be other than it is, whatever we can describe at all could be other than it is. There is no a priori order of things" (Tractatus Logica Philosophius). Thus, developing epistemology in the Himalaya should have its own way of producing knowledge. It should be based in the past endeavors and the future endeavors should have their base on what is happening now. The most proper way "now" can be properly defined is by pursuing a posteriori truth duly attested by native people. If not the danger is imminent that resource management efforts will be left with vague ideas and institutions that do not coincide with a clear view or provide a guide for effective action. The researcher argues that there is no a priori truth and a posteriori truth can be wrongfully described, unless it is learnt directly from the Himalayan people. The current efforts to study the Himalayan phenomena, however, dwell in a different dimension. As Hewitt has observed,

"...interesting case is the two impressive volumes of the international Karakoram Expedition (Miller: 1984). The first represents conference proceedings given before most of the participants carried out field work . . . second volume is especially the result of a summer field work" (1988:8-9)

Such research fail to address the a-posteriori truths such as local uniqueness, questions of actions related to survival, attitudinal inclination, and most importantly, the local preference. There is a need to understand that the mountain people have a different set of attitudes, societal structure and mind-set; thus these need to be deconstructed before bringing them under the scope of the research[11]. They should be regarded as more than "data" or "data-set," but as the educators and builders of any epistemological foundations. As Porter said " . . . you help people at the local level, you can educate a wider public" (1977:280), the epistemology should be based on the a posteriori order of truth identified and scrutinized by the local people.

3.4.3 Sense of Empathy

Borrowing from Mann (1986:4) this researcher argues that the mountain "societies are much messier than our theories of them". The difficulty, therefore, exists in understanding this intricate and uncertain society. Until now, most of the theories of mountain degradation – no matter in what ethical standard they may have been constructed – blame the human societies in the mountain (Rieger: 1982, UNICEF: 1995). Here, the marginalization and ignorance of ethno-methodologies becomes obvious. To disguise this ignorance, and underdeveloped sense of empathy, the metanarrativism emphasizes the physical aspects of the Himalaya. In this context, Hewitt argues that " . . . generally symbolic that these . . . [mountain people] on the dust jackets are shown in the shadow, passive and dwarfed by the brilliantly lit snow covered crags of the central Karakoram" (1988:19).

Few human geographers and resource scientists have constantly warned about what could lead to the permanent demise of human geography and resource management. In this context, Porter (1977:290) argued: "If we fail to engage...in inquiring about human understanding of the earth and even such things as human attachment... we will impoverish our discipline and reduce our understanding of who and what we are". The danger is all the more horrifying, because the Himalayan people now have started to discard these inapplicable attempts (Hatley and Thomson: 1985, Sanwal: 1987). Partly, this rejection can also be attributed to the burgeoning meritocracy in the Himalaya[12]. If current resource management continues with its stubbornness, the danger is imminent that the entire

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[11] This is one of the reasons why this thesis decided to let people analyze the Dublin Principles and arrive at their own sub-principles (Chapter 7).

[12] As Sierra Tamang argued in her Newspaper article, the meritocracy has not helped much (Box: 3.3).

efforts will be rejected as "... a branch of science with clear class structure ... nourished through with aggressive and predatory nature of ...imperialism" (Watts: 1974:321-322 cf. Porter: 1977:289).

3.4.4 Respecting the Human Spirit

One of the meanings of sustainability is the application of right technology for the right use of resources. However, without "spirit," neither can such technologies be used properly nor can they ever be translated to a meaningful context. An effort like that of Dor Bahadur Bista, the man responsible for teaching self-reliance among the people of Jumla, Humla, or of Gandhian Sundar Lal Bahuguna's Chipko movement (anti-logging movement that bar loggers to cut trees by embracing the tree) are seldom sustainable (Shiva and Bandhopadhyay: 1986). Yet, a non-sustainable act like this can inspire a sustainable process. What is required therefore is to unfold such latent energy existing within the mountain areas.

3.4.5 Why People Accept Tradeoffs?

In most of the mountain societies and cultures, strands of philosophies are found which justify the rights of the "perfect strangers" like the unborn and other sentient living forms that provide the much needed biodiversity (Ariyaratne: 1992). It is necessary for outsiders to understand the process through which such consciousness is cultivated in the day to day use of resource and observance of the boundaries. A typical example could be observed in the pattern of migration in the Himalaya. Migration is often an effort of neutralization of the mountain resource constraints (Gupta: 1993).

3.4.6 Local Arrangements for Resource Use

Effective WRM requires a very high degree of empathy and understanding on the processes through which different classes of the community adjust to risks or use the resource collectively. Hewitt (1988) and McDonald (1994) have observed similar phenomena in terms of hazard management in the Karakoram Himalaya. Neglecting such socially woven risk aversion or resource utilization strategies not only weakens but completely disintegrate these adjustments. Many examples of water resources, forest and pastoral management can be found across the Himalayan region. A thorough research can identify that the rural mountain households must diversify their strategies of resource use to survive and most of the time such actions are collective. The Himalayan institutions involve collective intervention and simultaneity and include attributes such as, leadership, stake building, value orientation, value reinforcement, clarifying norms and rule, capacity building, innovation and creativity, self-renewal and networking processes. The Rio

Summit has also acknowledged this fact. In chapter 14.16 it has emphatically stated that "greater the degree of community control over the resources on which it relies, the greater will be the incentive for economic and human resources development" (Chapter 14.16: Rio Agenda: 1992).

3.4.7 Understanding Bio-Ethics for Sustainability

The sustainability of resource use requires development and demonstration of an ethic that can guide decisions regarding current versus future consumption of resources. The conceptions of different interrelationships between different human and natural factors are defined, if not determined by this ethic. The bio-ethics raise different choices over the extent and amount of resource use and the much-debated equity and sharing of such resources. Most of the actions taken for resource use in the Himalaya directly or indirectly reflect such bio-ethical choices.

3.4.8 Balancing Holistic and Reductionist Perspectives

The Himalayan epistemology should attempt to spearhead the current holistic approach to a manageable size. While doing so, two basic issues need to be acknowledged. First, the extent (or how much to cover) should be identified and defined by the people; and secondly, it must not become too optimistic to undermine the existing uniqueness and situatedness of the phenomena. What is required therefore is to balance the sea-saw between the holistic and reductionist perspectives – which are the two ends of a single spectrum. Saaty (1973:5) provided some explanation to this approach. He argued that,

> *"...everything must be reduced, decomposed and disassembled to simple elements such as atoms, cells, [human being], etc. These are studied by themselves and the knowledge derived is used to infer the behavior of the entire system. The method of thinking involved is analytical, wherein the whole is taken apart, studied and optimized, then aggregated."*

3.5 Problem or Misinterpreted Potentiality?

Designing an effective strategy for WRM in the mountain would require a changed perception on the existing resource conditions and characteristics. What previous "disabling" development theorists have termed "problems," are in fact "specificities" of the mountain areas (Jodha: 1990). In simple terms, the conditions characterizing mountain areas, this for operational purposes, separate mountain-habitat from other areas, can be called "specificities." All the specificities are characterized by a definite set of objective circumstances. By objective circumstances, this researcher understands a set of constraints and potentials blended in the existing uncertainties and difficulties that influence the choice and pattern of activities in the Himalaya. These actually suggest the existing survival strategies (Box: 3.2).

Box 3.2: Mountain Specificities	
Specificity	Objective Circumstances
Inaccessibility	Remoteness, distance, closeness, restricted external linkages, pocket-economy (Rieger: 1981, Lall: 1981, Price: 1981, Hewitt: 1988)
Fragility	Vulnerability to irreversible damages, low carrying capacity, limited but unique production options, high overhead cost, ingenuity (Hewitt: 1988, Eckholm: 1975, Eckholm: 1976 Gigon: 1983, Winiger: 1983, Messerli: 1983, Mauch: 1983)
Marginality	Cut-off from mainstream, pocket economy (Chambers: 1987, Messerli: 1983, Mauch: 1983,
Diversity	Complex of Opportunities, interrelationship and interdependence of production basis, biological adoption, heterogeneity (Sanwal: 1989, Price: 1981)
"Niche"	Limited but unique production opportunities, comparative advantage, diversification (Hewitt: 1988, Hewitt: 1994, Ives and Messerli: 1989)
Human adoption mechanism	Indigenous technical knowledge, folk-agronomy, ethnoecology, ethnoengireering, participation, institutions, security, self-reliance, diversification, tradition and culture (Ives and Messerli: 1989, APROSC: 1994, Hewitt: 1994, Sanwal: 1989)

3.6 Defining the Philosophy of the people

Starting a quest for Himalayan WRM thus requires a conscious understanding of the existing Himalayan phenomena. This process warrants an understanding of not what is around the Himalaya, but how it exists and thrives around human being. Epistemology to study the existing phenomena, therefore, should build around this heterogeneity and uncertainties of the Himalaya. It should be based on the teachings of Veda and Puranas (Himalayan Philosophical Epics) and ethno-knowledge passed from one generation to the other. Logically, the efforts should be geared to find out in what way humanity fits into the Himalaya, which should be followed by developing the capabilities of the research to confront the complex uncertainties and challenging societal interrelationships.

The village level understanding, ethno-methodology, and the native's vision on the existing truth are what this research has collectively termed, the Himalayan Philosophy. It also refers to the uncertain, multi-textured and complex phenomena existing at the local level, what only local people can fully experience through their survival strategy. It advocates a radical breakup from the ongoing modernist approaches by attacking the metanarrative characteristics and embraces the uniqueness, difficulties, heterogeneity, diversities, ambiguity, inconsistencies and ephemerality of the Himalayan phenomena (Warf: 1993, Dear: 1994). In essence, it seeks the people in the Himalaya take lead in the process of epistemology development. The points outlined earlier are the basic underpinnings of this philosophy. The limited review in Himalayan Development in general and the Himalayan resource management scientists/geographers in particular, reveals that the demand for a philosophical outlook based on the uniqueness of the Himalaya is growing (Gurung: 1981, Bajracharya: 1986, Hewitt: 1988, Thompson: 1988, Mahat: 1987, Griffin: 1987, Shepherd: 1987, Hatley: 1988, Ives and Messerli: 1989, Jodha: 1990a, Gupta: 1993, Shiva: 1995, Neupane and Young: 1997). There is therefore a distinct indication that people's knowledge and its use are getting attention.

3.7 Conclusions

As a concluding remark, it can be asserted that existing thinking on Himalayan development or, for that matter, the philosophy of Himalayan WRM must change. There is a need to realize that the mountain people have a distinct and sustainable philosophy of their own. It is relevant to end this chapter by extending a genuine plea, that the natives of the Himalaya have always been considered as a part of the problem, while all along they could proven to be the best solution. Siera Tamang's article conveys the similar plea (Box: 3.4).

Box 3.4: When Kuire Debate Continued...

...Especially as it is we Nepalis who read English newspapers, who act as translators and go between the "natives" and the Westerners, who go to conferences etc - who should be most vocal critics of Kuire [Slang for a Caucasian] worship - are invariably the ones to first drop to our knees. ... What are those dominant collective images in Nepal? We have the "Lords of poverty" zooming in their air-conditioned, blue-license plated imports through dirt filled roads; expatriates filling supermarkets where prices of goods are obscene; and tourists out to experience the exotic and be with the natives - "so nice to visit but such a relief to escape back home to civilization".

... The relevance to the use of Kuires? Well no Nepali could possibly be impervious to those images highlighting Nepali inadequacies and Western perfection. And yes, after nearly fifty years of being "developed" with no real tangible gains, we Nepalis may be getting bitter. And yes, we've noticed the lack of clean water supplies and we also realize we're too poor to daily buy the bottled water those foreign 'experts' living in mansions do. ...

Nepali people need to be seen, heard and understood as people who think, feel and reconstitute the flows of information which surround them... Moreover, Nepalis need to stop denigrating their own worth as thinkers, doers, and enlargen the definitions of not only what is and who has "knowledge" but the spaces in which "knowledge" can be found. ... It may not be a fancy hotel or a big government office conference room, but the type of discussions held there [can] make [big conferences] seem like kindergarten.

Source: Seira Tamang: The Kathmandu Post November 23, 1997

CHAPTER FOUR

WATER RESOURCE MANAGEMENT IN NEPAL

"One of our chief resources in Nepal ...is water which if harnessed and managed properly holds a magic key for all round development of our country" (HM the King of Nepal Birendra cf. Vikas, September/October 1992, Vol. 12-2.)

4.1 Background

This chapter presents a background discussion on Water resource Management (WRM) in Nepal. The relevance of this chapter lies in the unique water resource set-up of the country. Nepal's water resource structure provides a very interesting position, if it is viewed against the backdrop of the physical availability and management approaches (IIMI: 1997b). On one hand, Nepal's water resource is characterized by continuous struggle of people against extreme variability of water in temporal and spatial scales (Ives and Messerli: 1987, Chalise: 1994). On the other hand, the support structures for viable people-based WRM systems are slowly eroding away in favour of more scientific, but culturally incompatible, approaches (Chene: 1997).

4.1.1 Objective of the Chapter

This chapter presents some of the major realities associated with water in the country. It also reviews Nepalese legislation on water sector and organizational set-up for capacity assessment. The main objectives of this chapter are:

- to introduce the physical, social and ecological realities of Nepal,
- to introduce the context of water resource/use management in Nepal, and
- to review government legislation, policies and regulations that have been introduced to create a favorable environment for WRM.

4.2 Physical Realities

Nepal is a small landlocked country sandwiched between India and China, the two largest and most populous countries of Asia (Map: 4.1). The size of the country is 147,181 km² (CBS 1997). Within its east-west length of 885 km and north-south width of 130-240 km (mean width 193 km), a wide range of climate and topography can be found. Topographically, the altitude ranges from 80 to 8,848 meters above the mean sea level (CBS: 1998).

4.3 Land Use

Geographically, the country is divided into three regions extending from east to west, namely, Terai, Hills and Mountains. The landuse pattern in the country is presented in the table below:

Map 4.1: Map of Nepal

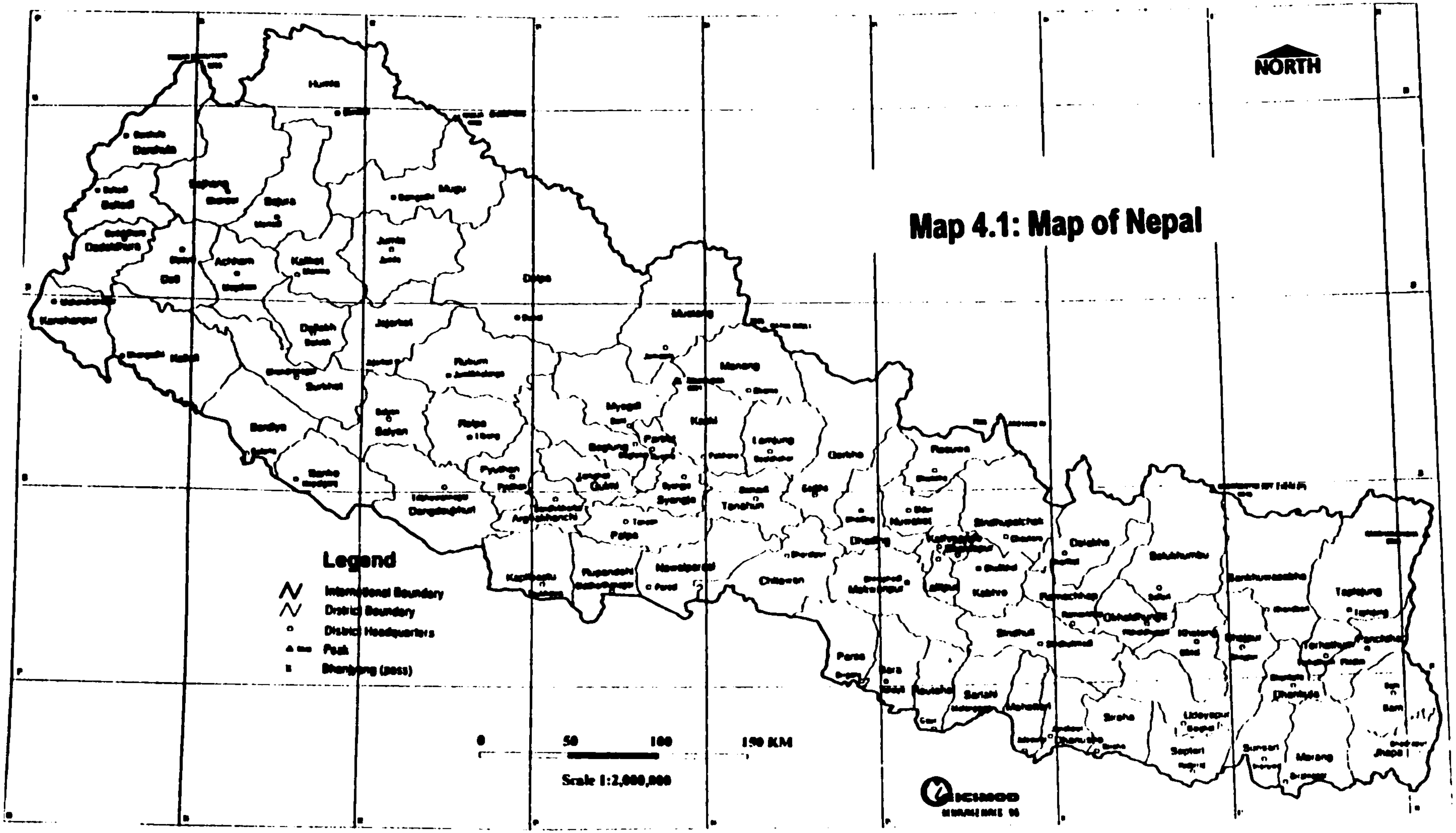

Table 4.1: Land Use Pattern in Nepal				
Land Use	**Mountains**	**Hills**	**Terai**	**Nepal**
Forest	1332 (25.7)	2634 (42.9)	1424 (41.9)	5390 (36.6)
Cultivated area	260 (5.0)	1276 (20.8)	1423 (41.8)	2959 (20.1)
Area under snow	2106 (40.6)	141 (2.3)	0 (0.0)	2247 (15.3)
Pasture	734 (14.2)	1138 (18.6)	106 (3.9)	1978 (13.4)
Roads & settlements	9 (0.2)	49 (0.8)	46 (01.4)	103 (0.7)
Other	742 (14.6)	896 (14.6)	403 (11.8)	2041 (13.9)
Total	5182 (100)	6134 (100)	3402 (100)	147181 (100)

(Figures in the parentheses are percentage) Source: Land Resource Mapping Project, 1986.

4.3.1 Rainfall and Climate

The climate range from humid tropical, where the temperature reaches to a high of 45°C during the summer, to tundra, where the temperature remains below the freezing point throughout the year (DHM: 1997). The annual average rainfall for the whole country ranges from 1,400 to 2,500 mm (CBS: 1998). In the hills, the skewness for precipitation is greater, and it varies from 900 to 3,000 mm per year. About 80 percent of the rainfall in the country occur during the monsoon period, between the month of June to September (Ives and Messerli: 1987). The hottest months are March to September, and the coolest month is January (Fig. 2.5).

4.4 Socioeconomic Realities

4.4.1 Population

The population estimates for 1998, extrapolated based on 1991 census, is 21.84 million (Table 4.2). The average family size in the country is nearly seven persons per household (CBS: 1998). During the last 20 years, the population of Nepal has been growing steadily at an annual growth rate of 2.08 percent (CBS: 1998). The current population in urban areas is estimated to be about 12 percent (CBS: 1998). However, if the population growth trend is compared with the growth in food production, it reveals that the former is about 1.9 percent higher than the latter (APROSC/JMA: 1995). Consequently, the number of population below the poverty line is increasing at an alarming rate. Recent studies have indicated that, due to the seasonal nature, 90 percent of the rural population are under-employed in Nepal (APROSC: 1998). The total unemployment is about 17 percent for the total economically active population (APROSC/JMA: 1995).

Table 4.2: Population Scenario in Nepal		
Age Group	1998	2000 (estimated)
< 14	9.6	10.4
15 – 64	11.24	13.3
> 65	0.64	0.8
Total	21.48	24.5

Figures are in millions Source: CBS: 1998

4.4.2 Administrative Structure

For administrative purposes, the whole country is divided into 75 districts, and 5 developmental regions, consisting of 10-20 districts. Similarly, for local level planning, the country is divided into 3913 village development committees (VDC) and 58 Municipalities (CBS: 1998).

4.4.3 Infrastructure Base

The road transport network serves only 56 districts (74%). The lengths of the blacktop, graveled and seasonal roads are 3533, 2662 and 4529 km, respectively (CBS: 1998). There are 39 airstrips, including an international airport in the capital city, Kathmandu. It has one railway that runs a distance of 51 km. The country has been able to provide digital telecommunication facilities in all district headquarters and major cities (CBS: 1998).

4.4.4 Economy

Despite a reasonable resource base, the growth in the economy of Nepal has not been satisfactory (MOF: 1996). Although the country has experienced 40 years of planned development, its economy is stagnated (World Bank: 1996). For 1997, the per capita income of the country was estimated at US $ 208 (World Bank: 1997). The value of Gross Domestic Products (GDP) was estimated to be NRs. 293.5 billion CBS: 1998).

The economy of Nepal heavily depends on agriculture. This sector contributes about 40 percent to the total GDP and employs about 90 percent of the population (CBS: 1998). Mounting population pressure on limited land resources, and decreasing productivity afflicts agriculture (APROSC/JMA: 1995). Equally bleak is the prospect of the industrial sector of the economy. Because of a narrow economic base, small domestic market, political instability, and inconsistent fiscal and monetary policies, the recent bids to liberalize the economy have not recorded any significant success (World Bank: 1996). The cumulative effect of poor performance of agriculture and industry can be observed in the growing trade deficit. Economic Review (1997) reports that during 1996/7, the total trade deficits to India and other countries were respectively, NRs. 20.4 and 53.13 billion (CBS: 1998).

4.4.5 Poverty and Its Dimensions

In contrast to Nepal's strong commitment to abate poverty, its incidence is rapidly increasing. A recent APROSC document based on well being and food sufficiency ranking provided the latest account on incidence of poverty in Nepal. According to this document, 41.6 percent people are ultra-poor, 29 percent are poor and.29.4 are non-poor (APROSC: 1998). There are a number of policies adopted in the countries. However, neither have these efforts, like in most of the "structurally adjusted" developing countries (Simon: 1996), served as a precursor for growth, nor have they led to any success in lowering the incidence of poverty (APROSC: 1998). The existing mass poverty is not only widespread but it is a rural phenomenon, because about 90 percent of the poor are rural population. However, the expanding urban centers have resulted in the proliferation of slum areas, and a deteriorated standard of living among the urban low-income dwellers.

The caste hierarchical system is one of the major factors associated with income inequality in Nepal. Lack of opportunity forces the lower caste groups to play customary and traditional roles in the society, which are very poorly paid. Consequently, their disadvantaged position has perpetuated. The legal provisions are present to do away with the distinction based on caste. However, notable achievements are yet to accrue at the grass-roots level (APROSC: 1998).

Various studies indicate that the income share of Nepal is highly skewed. A recent study revealed that the income share for the bottom 40 percent of the population is 29 percent (APROSC: 1998). This figure is marginally higher than 1974/75, when their income share accounted at 14 percent (AREP: 1986). On the other hand, during the same period, the income share of the top 10 percent of the population increased sharply from 32 to 47 percent. Consequently, the Gini coefficient – the measure of the dispersion of income – increased from 0.37 to 0.42. However, the national report on environment and development in 1992 provides a Gini coefficient of only 0.25 and states that the income distribution in Nepal is fair (NPC: 1992).

Table 4.3: Distribution of Operational Holding, Nepal

Size of Holding (ha)	Percentage of the Population
0.15 - 0.5	46.0
0.5 - 1.0	29.0
1.0 - 3.0	17.0
3.0 and above	8.0

Source: CBS: 1998

Poverty in Nepal is also linked to the shortage of productive land. The distribution of operational holding is presented in Table 4.3. The absolute poor in the Hills are defined as those owning less than 0.5 ha (over 60%), and in the Terai, those owning less than 0.3 ha (about 30%) (NPC/NEPAP: 1994). A composite profile of the rural poor presents that a homestead of just under 0.5 ha can hardly produce enough to feed a family of 7-8 for more than six months of the year.

4.5 Ecological Realities

Box 4.1: What to Believe?
"The ecological problems have profound adverse impact on livelihood and survival of ...communities. Typical hill watershed contributes total sediment loss of 21 ton/ha/year.... In a sub-watershed area of about 540 ha (e.g. Jhiku Khola) the sediment in extreme transition is calculated at 40 ton/ha (Carver and Schreier: 1995). Consequently, the yields of major food crops ...have either been stagnated ... or declined over the period of last one and a half-decade (HMG/N: 1996). The most affected are the water resources, which have declined both in qualitative and quantitative terms. Apparently, no serious measures have been put in place that can, if not reverse, check these adverse processes (Natural Resource Management Sector assistance Programme (Project no. NEPDK/WMP/1997): 1997: Preface)
... Document contains the results of a six-year study on resource management problems in the Jhiku Khola Watershed in Nepal. It examines trends in forestry, agriculture, hydrology and socio-economic conditions and uses Geographic Information Systems (GIS) technology to display the rate of degradation and outlines options and alternatives to improve the resources conditions and management practices. A watershed approach was used and all resource data was placed into a georeferenced GIS database. The trends and rate of degradation in forestry, agriculture, hydrology, sedimentation, soil fertility, and socio-economic conditions were examined in detail and models are used to project the impact of degradation on the long term productivity of the watershed. ICIMOD/UBC/IDRC Project on Mountain Resource Management in Nepal, http://www.idrc.org.sg/cbnrm/nepal/pantc.htm. June 1997
... Recently introduced community forest management practices has helped to increase the forestland from 34.55-sq. km in 1978/79 to 39.71-sq. km in 1994. Large areas of shrubland and grassland have been afforested. This type of community forestry program was introduced in this area by Nepal/Australian Forestry Project which has contributed significantly in organizing Forest User Groups and plantation and management of natural forest... community forest management practices is now common. Adhikari, M.(1997) Forest Resource Management in the Middle Mountains of Nepal: A Case Study of Jhiku Khola Watershed, International Workshop on Dynamics of Land-Use/Land-Cover Change in the Hindu Kush—Himalaya June 1997., Central Department of Geography, Tribhuvan University (CDG/TU), Kathmandu, NEPAL
...Household sample survey data shows that the agriculture pattern has changed significantly during 16 years in the study area. There have been remarkable changes in the type of crops grown and cropping intensity. There have also been significant increases in farmer's adaptation of new production technology, improved seeds, chemical fertilizer, and pesticides. Improved accessibility, after the construction of Araniko Highway, to major market centers such as Kathmandu, Banepa, Dhulikhel has shown its impact. Subsistence framing particularly in nearby areas of roads has given away to heavy emphasis on commercial fruits and vegetable production as well as dairy products... Krishna Karki (1997) Change in Agricultural Land Use in the Middle Mountain of Nepal: A Case Study of Jhiku Khola Watershed, International Workshop on Dynamics of Land-Use/Land-Cover Change in the Hindu Kush—Himalaya, June 1997. CDG/TU, NEPAL

It is believed that Nepal's ecological conditions are rapidly degrading. The effects of the ecological degradation and its causes have been researched in increasing incidence of poverty, large-scale migration of the people living on the mountain and increasing incidence of diseases and other social problems. However, a definite relationship between the ecological degradation and these factors has not been established (Eckholm: 1978, Lall: 1982, Ives and Messerli: 1986, Mahat et al.: 1986, 1987. However, such attempts are continuing (UBC Project http://www.idrc.org.sg/cbnrm/nepal/pantc.htm). For example, a very recent report published in late 1997 stressed that, "... the combined effect of ecological disorders has been massive, resulting in soil erosion and water resource degradation in thousands of small watersheds in Nepal" (DANIDA: 1997). It was discussed in detail in Chapter 3 that much of the understanding developed regarding the ecological realities is confusing. Box 4.1 adequately demonstrates the fuzziness existing in the ecological research in Nepal.

4.6 Water Resources Realities

4.6.1 General

It is reported earlier that the vast water resource potentiality of Nepal stands in poignant contrast to existing widespread poverty and underdevelopment. Nepal's rugged topography provides great potential to put this resource to economically productive uses (Bhattarai: 1997). Despite this, the country presently faces an acute shortage of electricity, irrigation, and potable water. NPC estimates that less than 30 percent of the country is electrified, drinking water is available to 40 percent of the people, and just above 60 percent of the arable land receives reliable irrigation (NPC/ NEPAP: 1994). Therefore, reestablishing a match between water resource characteristics and their use pattern has become the fundamental requirement to enhance sustainable development and for better stewardship of the fragile Himalayan ecosystem.

In Nepal, the water resource problems are experienced mainly in three ways: i) physical reduction in total availability; ii) degradation in quality; and iii) the impact on production and economic activities by the lack of, or degradation in quality of water. A number of circumstances are responsible for the unusual difficulties in abating these water resource problems.

4.6.2 Water Quantity

Nepal is drained by three major river systems and more than 6000 tributaries (Sharma: 1972). According to a study, river discharges average about 150 billion m^3 per year (Bhattarai: 1997). However, the estimates on water resources potentiality from these rivers significantly vary in different studies (IIMI: 1997). The river discharges in Nepal vary significantly across seasons. The discharges in most of the rivers and streams tend to diminish by as much as 100 fold during the winter season (DHM: 1991). Therefore, most irrigation projects are developed to provide reliable water supply only during the monsoon season, primarily to reduce the risk of crop failure, and to extend the monsoon cultivation period. Figure 2.5 presented the precipitation, evapotranspiration, and water demand/deficit in Nepal.

Nepal's potential area for irrigation development is estimated at 2.18 million hectares including forestland, and 1.77 million hectares excluding it. Considering the developed infrastructure, the irrigated area is estimated at 1.09 million hectares or 62 percent of the potential figure. However, not all the developed area for irrigation is brought under irrigation. The actual commanded area is significantly less than the potential. The actual irrigated area is 0.78 million hectares (72%) of which only 38 percent receive year-round irrigation (CBS: 1998). The Agriculture Perspective Plan (APP) documents the annual surplus water resources at 200 billion cubic meters for surface irrigation and about 12 billion cubic meters for groundwater development (APROSC/JMA: 1995).

The combined annual flow of rivers also provides a theoretical hydropower potentiality of 83,000 MW from a combined run-off of 6,396 m3 per second (Bhattarai: 1997). Out of this, 44,600 megawatts or 53.5 percent of the total can be economically harnessed (NPC/ NEPAP: 1994). To date, the country has an installed facility to produce 253 MW of electricity (Bhattarai: 1997). Several prospective sites for installation of hydropower plants are identified, however, due to a weak economic base, foreign aid dependent economic policy and extreme environmentalism, the country is left with minimum choice for hydroelectricity development. Moreover, the government's policy to privatize the energy sector and development of small low-cost power plants in people's active participation has failed to receive the needed popularity (Bhattarai: 1997). In recent years, however, a number of national and international organizations are actively involved in the hydropower development in Nepal (Power in Asia: 1995). The use of water resource is equally an issue of bilateral significance between India and Nepal (Gyawali: 1991, Bandhopadhyay and Gyawali: 1994).

Only 38 percent of people received piped drinking water from the organized (government and I/NGOs registered with the government) sector until 1992 (NPC: 1992). Those served by water supply projects received a per capita supply of slightly over 62 litters per day.

4.6.3 Water Quality

The quality of water is emerging as a new threat for environment and health in Nepal. In 1996/97, 3,200,000 people contracted water borne diseases. There were 783 (more than two per day) fatalities resulting from water borne diseases (NPC: 1997). The drinking water supplied through the organized bodies is generally polluted IAPROSC/JMA: 1995). A team of doctors found as many as 1200 e-coli per 100 ml of water supplied from the municipal system in

Kathmandu Valley (The Rising Nepal: July 7, 1996). A study carried out by DISVI International in the middle hills area during 1990 found 20-1400 E-coli count in most drinking water sources (DISVI: 1990).

In the irrigation sector, the most serious issue is the sediment load in the irrigation water. In addition, the concentration of chemical and heavy metal is rapidly becoming a threat in irrigation water (Sharma: 1986). Despite this, the environmental action plan of 1994 and environmental guideline published in 1996 have very inadequately defined the need to maintain water quality in the country.

4.6.4 New Directions

Since 1986, with the publication of Building on Success – a HMG/N and IUCN's joint publication on action plan to attain a balanced development (HMG/IUCN: 1986) – and with added emphasis after 1990, when Nepal received an official invitation to participate in the Rio process, it has taken a number of measures in WRM (HMG/N: 1992, HMG/N: 1994, NPC/NEPAP: 1994). For example: Two major water resource policies (HMG/N: 1992, HMG/N: 1994) have been drafted; strict water related laws and regulations are being designed; participatory frameworks and environmental act and guidelines are introduced, large-scale irrigation projects – built and operated by the government – are now being handed over to the people, and a 20-year Perspective Plan for agriculture (APP) is now under implementation (Khadka: 1997, IIMI: 1997, HMG/N: 1992, HMG/N: 1994, HMG/N: 1997, APROAC/JMA: 1995). These attempts are considered to increase the chances of success in WRM across the country. Yet, real changes with long-term effects are yet to occur, since the resource outlook and the mode of implementation of programs have remained the same (IIMI: 1997). However, it is expected that the country's ninth plan (1998-2003) would elaborate more on some of the unresolved issues (HMG/N: 1998).

4.6.5 Water Sector Wide Policies and Regulation

The problems that restrict sustainable use and development of water resources in Nepal must be seen, at the outset, in the light of policies and regulation that have so far been promulgated. The need for adequate water administration and legislation is evidenced by the ever-growing demand for water, and by the importance of this sector for social welfare and economic development. The policies and regulations in the water sector in any country are expected to provide a definite guideline to manage, primarily, the priorities and preferences related to its use. More explicitly, the prerequisite for effective water use and development is an institutional and legislative framework able to resolve conflicting demands and enforce standards (Young et al.: 1994).

It is observed in different studies that the capability of a user to utilize water depends on the legislative structures prepared in water. Ferrell-Dillard (1991) conducted research to find out whether and to what extent legal and administrative factors (e.g., constitutions, statutory law, common law, executive orders, and administrative rules, regulations, and procedures) influence the adoption of response measures in water supply systems. He observed that the greater observance of legal structures lead to greater responsiveness of the people toward WRM process. However, in Nepal, the water managers do not accord greater importance of these factors over other technical, economic, and social considerations (Personal Discussion, MOWR: 1996).

4.6.5.1 National Civil Code, 1963 (Muluki Ain)

Muluki Ain is a general code of conduct that guarantees the right of the public to use water to satisfy their various domestic and industrial needs. It prohibits any actions relating to the discharge of water and sewage into the groundwater acquifers. In the Section on Jagga Abad Game Ko Mahal (land development and settlement), it explains the definite codes of conduct for settlement and right of the public to use water for various purposes.

4.6.5.2 Water Resources Act, 1992 (WRA)

WRA provides a basis for utilization and allocation of water based on national preference and priorities. The act has vested the ownership of "all" water resource to the state. Although the ownership remains with the state, for various purposes, water is given to the public for "free." It also provides legislative ground on water right, and priority of water use. Accordingly, drinking water is ranked as the first priority, followed by irrigation, fisheries, hydropower generation, cottage industry, industrial enterprises and mining, navigation, recreation, and other uses. The act is criticized for being drafted as a top-down instrument, which, to some extent, legally deprives general people to use water (Khadka: 1992).

4.6.5.3 Water Resource Regulation, 1994 (WRR)

WRR is a legal explanation of WRA. It provides guidelines – all furnished with needed formats – for effective implementation of the water resources act. It provides detailed information on how the license to use water can be obtained and what specific activities must be considered for its use. However, the regulation does not contain a provision for granting licenses based on water use by volume and follows a point-source consideration. Under point source consideration, no matter how much water is available vis-à-vis demanded from one source, only one individual or a group receives a license to use it.

4.6.5.4 Irrigation Policy, 1993, First Amended 1996 (IP)

Considering the fact that only 30 percent of the total irrigable land area in Nepal receives irrigation, it is imperative that feasible irrigation schemes are identified and developed. It is also essential that the prime role of user farmers is recognized and their adequate participation is sought as the key to increase managerial and operational efficiency of irrigation projects. The IP is designed to recognize these policies of the government. IP is amenable to both the WRA and WRR, and contains a few special regulatory guidelines to involve people in irrigation development, need to internalize their knowledge and encourage an increased ownership of the irrigation projects implemented in the area.

4.6.5.5 Irrigation Policy Implementation Procedure, 1997

The implementation procedure is an itemized, objective and systematic elucidation, explanation, and synthesis of IP and is amenable to WRA and WRR. This procedure is the first legal provision that is translated for the general users.

Box 4.2: Legislation Acts and Regulations: Water Resource Sector in Nepal

A few other legislation, acts and policies, which are directly related to the process of water resource development and management, are enumerated hereunder:

- Private Forest Nationalization Act, 1956
- Forest Protection Act 1956
- Lands Act, 1956 (revised 1965)
- Nepal Industrial Development Corporation Act, 1958
- Aquatic Animals Protection Act, 1961
- Land Survey Act, 1961
- Industrial Enterprises Act, 1962 (revised 1982)
- New Civil Code, 1962
- Forestry Act, 1963
- Irrigation Act, 1963
- Town Development Committee Act, 1964
- Nepal Electricity Act, 1964
- Malaria Eradication Act, 1965
- Contagious Disease Act 1965
- Canal, Electricity and Related Water Resource Act, 1967
- Town Development Plan (Implementation) Act,1970
- National Parks and Wild life Conservation Act, 1973
- Soil Conservation and Watershed Management Act, 1982
- Decentralization Act, 1982
- Natural Calamities Relief Act, 1982
- Nepal Electricity Authority Act, 1983
- International Center for Integrated Mountain Development Act, 1983
- Trekking and River Rafting Act, 1984
- Solid Waste Management and Resource Mobilization Act,1986
- Royal Academy of Science and Technology Act, 1988
- Electricity Rules, 1988
- Village Development Act, 1990
- Municipality Act, 1990
- District Development board Act, 1990
- Constitution of Kingdom of Nepal, 1990
- Pesticides Control Act, 1991.
- Act on Utilization of Public goods, 1991
- Water Resources Act, 1992
- Vehicle and Transport Management Act, 1992
- Industrial Enterprises Act, 1992
- Electricity Act, 1992
- Fixation of Electricity Tariffs Rules, 1993

Source: Various Reports and Documents

4.6.5.6 Nepal Water Supply Corporation Act, 1992

Only 38 percent of the total population in Nepal receive piped water from organized sources (1998). Thus, it is essential that technically, economically, socially and environmentally feasible drinking water projects are identified and implemented. This act equips Nepal Water Supply Corporation with legal authority to develop water supply systems in the municipalities, collect service charges, and maintain sewage systems. This legislation does not cater to the need of water supply in the rural area, unless their boundaries are contiguous to a city's boundary.

4.6.6 Ownership of Water Resources

The WRA has vested "the ownership of water of surface, underground or in whatsoever form available within the country... to the government" (Section 2 (a) and 3, WRA: 1992). People can not use water until they obtain a license, or acquire it by paying a fee to the individual or an organization, which has taken a license to use water. Thus, the question of publici juris in water resources is very strictly defined in Nepal. (Khadka: 1997).

4.6.7 Water Rights

The right to use water must be obtained by acquiring a license from the government. The WRR has made some definite guidelines as to how an individual or an institutionalized association[13] aspiring to survey or use a source can obtain a license for these purposes. The WRR clearly states that "Any person or corporate body, who desires to obtain a license for survey in water resources, shall have to submit an application stating all particulars relating to the proposed project to the District Water Resource Committee (DWRC) [formed as per the rules 8-10 of WRR, 1993].

Box 4. 3: Particulars to be Included in the Application Forms	
• Description of the project, • Map of the project-site (main structures to be shown), • Sources of water and quality of water to be utilized, • Area of water resources to be surveyed,	• Number and types of consumers to be benefited from the project, • Estimated time and total cost for completion of project (including survey and operation), • Other necessary matters (Rules 12-12.1, WRR: 1994).

(Source: HMG: 1994)

Similarly, "any person or corporate body, who desires to obtain a license for utilization of water resources, shall have to submit an application [to DWRC]...stating detail description of the project (including a map of the project-

[13] The regulation has also provided the direction how an informal association can be institutionalized.

site...)" (Rule: 18). The description of the project must include a feasibility report, mode of finance, acquisition or possession of houses and land and analysis of environmental effects, and other necessary matters.

The DWRC after making sure that the rules are totally fulfilled issues – with or without amendments – a license according to the applicant. Rule 22 of WRR explicitly states that "who has obtained license for ...utilization of water resources...shall have the right to use the water resource for the works as mentioned in the license to the extent of water resources of such place and area as specified in the license". The license needs to be renewed before it expires. The license to use water is both saleable and transferable, but the licensees are required to submit an application to DWRC and obtain permission to do so. Although explicitly drafted, the rule appears to be extremely complicated for a general user.

Table 4. 4: License Fee

Types of Utilization of Water Resource	Fee (NRs)
Drinking water and domestic use	100
Irrigation	200
Agricultural use such as animal husbandry and fishery	100
Cottage industry, industrial enterprise and fishery	200
Water transport	500
Entertainment use	500
Other use	500

4.6.8 Government Institutions and Organizations

4.6.8.1 General

Various ministries, departments, and corporations are created under the broad administrative framework of HMG/N to carry out different activities related to water resources in the country. Different legislative bodies are also formed at different levels of the administrative hierarchy to regulate the functions related to WRM and water supplies in the municipality and rural sector. The box 4.3 summarizes the roles and responsibilities of different agencies in Nepal.

4.6.8.2 Central Level

National Planning Commission (NPC)

NPC is an apex body responsible for overall plan formulation, monitoring, and evaluation, and, in association with the partner agencies, holds a direct responsibility for better resource management and development in Nepal. NPC, as a translating body, acts to convert the political will into achievable development policies. It operates as a higher level convergent point, where the political will, national development policies and the need and aspiration of the local level are blended to design projects.

The Commission, in association with the Ministry of Water Resources, collects all WRM plans developed in different districts and formulates the national WRM program. The commission also works as a functionary of the National Development Council, which is a constitutional arrangement and a politico-administrative body responsible for formulating national level policies. It also houses policy-level research, planning, monitoring, and evaluation units to oversee the comprehensive development of the water resource sector. NPC is made responsible to oversee that all major environmental indicators in water development, including maintenance of water quality are adequately followed in the country (NPC/NEPAP: 1994). However, recently the formation of a separate ministry for population and environment has reduced its direct involvement in water quality control. NPC is not concerned with the grass-roots level users, and relies exclusively on the information furnished by the line ministries.

Ministry of Water Resource (MOWR)

MOWR operates on the apex of water resource management ministry's hierarchy. The ministry is responsible for overseeing the all water resources issues, including the observance of riparian laws in the country. It is involved also in screening and awarding hydropower and irrigation projects, and in international riparian issues. MOWR has three most important functions, policy making, coordination and overall monitoring and supervision of WRM activities.

Ministry of Population and Environment (MPE)

MPE is a recently formed ministry under the HMG/N, and oversees the activities that were previously seen by the Population Commission and National Environmental Council. It has recently published an Environmental Guideline, which is designed to make corrective as well as legislative provisions for water quality maintenance. The guideline is the implementation procedure for the National Environmental Policy, 1996. Using proper policy tools, It also tries to create a balance between population and resources that includes water.

Ministry of Health

Ministry of Health bears the responsibility for health awareness, providing medical services and coordinating with the MOWR to set water quality standards and enforce them. It represents the National Committee on Rural Drinking Water Supply and Sanitation Project. It acts as a policy level office, and operates through district hospitals and the Public Health Section in the district.

Box 4.4: Agencies with Water Related Responsibilities		
Agency/Ministry	**Department/Units**	**Responsibility**
National Planning Commission	CCNCR Environment Division	Coordination
Agriculture	Agriculture, Agriculture Marketing Services, Livestock Development and Animal Health, Horticulture	Bio-technology, Land use-Improvement and management, Agri-extension, Fisheries, Agricultural Production, Animal husbandry, Animal feed and fodder, Fruits and vegetable development and promotion
Communication	National News Service, Radio Nepal, Nepal Television (NTV), Gorkhapatra and Rising Nepal	Dissemination of water resources information, awareness creation
Finance		Allocation of funds coordination of foreign aids
Forest	Forest, Soil and Watershed Management, Plant and Forest Research	Forest management, protection and Community forestry Protection of ecosystems, Watershed management, EIA, environment education
Population and Environment		Environmental policy development, coordinate population and carrying capacity of water
Women and Social Welfare		Enforce women's role in water resource management
Health Services	Health Services, Health and Sanitation	Public health and family planning Environmental health, water borne disease control
Housing and Physical Planning	Housing and Physical Planning, Town Planning Boards, .Solid waste Management & Resource Mobilization	Urban planning and development, Sewerage, Sanitation and pollution control Collection recycling and disposal of solid wastes and sanitation improvement
Industry	Industry/cottage and Village Industry	Pollution control; mineral mining and waste disposal enforcement
Land Reform	Land Reform management	Land tenure, land surveying and mapping
Local Development	Regional and District Offices	Integrated rural development, decentralization
Water Resources	Irrigation, Water and Sanitation, Electricity authority, meteorology and Hydrology. Water and Energy Commission	Utilization of surface and ground water, electricity (energy), flood, and river control, meteorology/ hydrological information collection and dissemination policy making and planning.
Works and Transports	Roads	Inland Water Transport

Source: Various Ministries and Departments.

National Agriculture Coordination Committee (NACC)

The NACC is a coordination arrangement that looks after planning, implementation, monitoring, and evaluation of agricultural development activities in the country. The committee is represented by the heads or representatives of the Ministry of Agriculture, Ministry of Water Resources, Department of Agriculture, Department of Irrigation, Department of Livestock Services, Agricultural Development Bank, Agriculture Inputs Corporation, Department of Cooperative Development and National Cooperative Society.

(International) Non Governmental Organization (I/NGO)

Many I/NGOs are involved, as a partner of HMG/N or individually, in water resource development. Their involvement varies from installation of one drinking water tap in a community to larger scale irrigation development and power generation covering larger watershed basins. Generally in I/NGO initiated WRM systems, the contribution of farmers is comparatively less than in government managed systems. This may appear surprising, but most of the I/NGOs still operate as handout providers. However, the functioning of local NGOs can be highly participatory.

Department of Irrigation (DOI)

DOI, also at the central level, but under the Ministry of Water Resource, is the major government department involved in irrigation development of the country. Ever since its establishment in 1953, it has been instituted under different Ministries at different times. The DOI is the central organization with five regional, seventy-five districts, and nearly two dozen project offices. DOI operates through public contacts. However, often such contacts are passively maintained. (IIMI: 1997). The main functions of the department are:

a) to plan, design, and implement major and minor irrigation systems,
b) to oversee the sustained operation, maintenance, and management of the completed systems, and
c) to investigate, utilize, and license the available resources in the country. DOI also plays major role in formulating the government's irrigation policy.
d) In addition, it provides flood protection, principally through the construction of erosion protection works (APROSC/JMA: 1995).

Department of Water Supply (DOWS)

DOWS, also under the Ministry of Water Resources, bears the responsibility to coordinate and manage the national policy and priorities for water supply and sanitation. It mainly functions through Water Supply and Sewerage Board and its branch offices in the major municipalities and through its District offices, I/NGO, and Rural Water Supply and Sanitation Fund Board. The DOWS is the central organization and operates through five regional and 75 district offices. The main functions of the department are:

a) to plan, design, and implement major and minor water supply projects,

b) to oversee the sustained operation, maintenance, and management of the completed systems, and

c) to investigate, utilize, and license the available resources in the country. DOWS also plays a major role in the formulation of drinking water policy.

<u>Water Supply and Sewerage Board (WSSB)</u>

The Water Supply and Sewerage Board is currently working in over 37 districts. Established according to the corporation act of 1971, the board is responsible to ensure the supply of water in adequate quantity to the public.

<u>Nepal Rural Water Supply and Sanitation Fund Board (RWSSFB)</u>

The fund board operates through a modified format designed by the World Bank for JAKPAS project. The board works in association with Support Agencies and Support Organizations to implement small-scale, low-cost and participatory drinking water projects. This project is comparatively more people based than other agencies (ICON: 1993).

4.6.8.3 Regional, District and Local Levels

<u>Regional Directorates (RDs)</u>

Both DOWS and DOI each operate through five regional offices. The main responsibilities shouldered by these directorates are to: a) act as a converging office for the directives from the centre and need from the district and local level offices, b) coordinate different regional level line agency offices, mainly agriculture, and c) supervise irrigation development projects within the region.

<u>District Irrigation Office (DIO)</u>

The DIO is responsible for regular O&M of the irrigation systems of the districts. In many cases, the DIO functions in association with the farmers' organizations. DIO is apparently the most crucial agency and plays an important role for successful implementation of joint management system (JMS) and turnover policies. In districts, where the JMS is under implementation, the DIO is vested with the responsibility of developing the capability of local WUAs and involving them in joint management along with the agency.

<u>District Water Supply Office</u>

The DWSO is responsible for planning, design, implementation and regular O&M of drinking water projects in the district. The DWSO is required to function in association with the water users' organizations. In addition, the office often mobilizes users for system development, tap-stand location, cost-sharing arrangements, hand over, and subsequent supervision of drinking water projects.

District Water Resource Committee (DWRC)

Under the new policy framework, WRA has provisioned that there shall be a DWRC in each district. DWRC issues license in pursuant to section 8 (1) of the WRA to individuals or groups aspiring to use water resources within the country. As can be noted in the box below, users' representation in DWRC is not sought. Apparently, any water resource decisions taken at the district are kept confidential. The minutes of the meetings are not accessible to the public.

Box 4.5: Composition of District Water Resource Committee (DWRC)	
• Chief District Officer- Chairperson • Representative, District Agriculture Development Office- Member • Representative, District Forest Office- Member • Representative, District Drinking Water Office- Member • Representative, District Irrigation Office- Member • Representative, Office of the Electricity Project run by HMG/N in the concerned district- Member	• Representative of the office relating to utilization of Water resources other than 2) to 6)Member • Representative, District Development Committee- Member • Local Development Officer- Member-Secretary • If any work relating to water use concerns more than one district, the joint meeting of DWRC of all concerned districts exercise power on a collective basis.

Water Resources Utilization Inquiry Committee

The WRR has provisioned an inquiry committee to oversee disputes that can arise while using water resources. Again, it can be noticed that the disputes are arbitrated without farmers' or the users' representation. This committee is represented by representatives from Ministry of Water Resources as chairperson, and District Development Committee and Regional Office of the National Planning Commission as members.

District Agriculture Coordination Committee (DACC)

It is a coordinating body at the district level, and assumes the responsibility to increase the production and productivity in the district. The committee is composed of DADO as the Chairperson, and District Irrigation Officer of Irrigation Office, District Manager of Agricultural Inputs Corporation, District Manager of Agricultural Development Bank, and District Cooperative Officer.

District Office (DO)

District Office holds the law enforcement responsibility in the district. The Chief of the District Office acts as the head of the DWRC and oversees issuing of the license for survey and the use of water. In addition, as an enforcement agency, it can bring anyone before justice, who ignores to observe WRA or WRR or the national code of conduct.

Local Development Office (LDO):

LDO acts as the link agency between the local politicians and the government. The district level program – including that for irrigation and drinking water development – gets approval through this politico-administrative body. It also operates as the converging point for the policy and directives going to the grassroots and the need and aspiration going to the centre.

Municipality/Village Development Committee

Municipalities and Village Development Committees (VDC) are the lowest political units in Nepal. A municipality normally denotes a city and VDC, a village. The decentralization policy pursued by the country has increasingly bestowed greater autonomy to municipalities and VDCs. This includes deconcentration of internal resource generation and mobilization authorities. The municipalities and VDCs collect land revenues and in a few cases, the service fees for the utilization of water (Shukla and Sharma: 1995).

4.6.8.4 Water Users' Association (WUA)

WRA has made a provision that enables users to form an association to collectively use water resources. The WRR also provides definite guidelines to form a consumer's group in its rules 3, 4, 5, 6, and 7. To form a group, at least seven persons, selected from among the concerned users, must tender application to the DWRC along with a copy of statute of the group and a fee of Rs. 100. Most of WUAs independently prepare their operating policies. There are, however, a couple of efforts underway to insure consistency in the formation and statute of the committees (NPC: 1994, APROSC: 1997). The IP in its section 2.3 also has provided legal basis for the formation of a WUA in irrigation development schemes/projects (HMG: 1997). It has also clearly stated that at least 20 percent of the total members in any WUA should be women.

WRR has made it clear that the formation of a water users' organization is a prerequisite to implement any projects/schemes for water management and development. In most cases, WUAs are vested responsibility right from the identification to a sustainable O&M of the schemes/projects. Accordingly, WUAs have to be involved in all aspects of survey design, construction, service fee collection, operation and maintenance and conflict resolution. However, such involvement varies from project to project and, much also depends on the dynamism of WUAs in the projects.

4.6.9 Cost Recovery

Legislation on Service Fee

Three policies and legal provisions have laid specific guidelines regarding the service fee. Sections 3 and 4 of WRA clearly states that no person is entitled to use water without obtaining a license from the government, and the licensee is liable to pay a charge or annual fee for utilizing water (HNG/N: 1992). The rules 29, 30, and 31 of WRR have made basic provisions relating to service charge. The regulation states that an annual service fee must be paid to the HMG/N (HMG/N: 1994). The regulation has made provisions to form a three-member Service Charge Fixation Committee (SCFC). It consists of a person nominated by HMG/N as chairperson, a person nominated by HMG/N from among the consumers as member and a person nominated by HMG/N as member. The regulation has granted flexibility to the SCFC to fix procedures for service charge fixation. In small drinking water projects, such service fees are less likely to be implemented. In such projects, the users put some cash up-front to buy small accessories and contribute labor on as and when needed basis. The MWOR reports that the drinking water projects are much more financially resilient than irrigation development projects (IIMI: 1997). However, the collection procedures and rates are still being refined based on the experiences gained from actual practice. So far, there is little or fragmentary information documented regarding service charge collection in Nepal.

Municipal and Industrial Cost Recovery

There is neither a separate policy nor an agency to look after the cost recovery for industrial and municipal use of water. Moreover, construction costs incurred in drinking water supplies in the municipalities are not reimbursable. However, the Water Supply Corporation of HMG/N collects tariffs from the households connected with the facilities. There is no precise record on how the tariffs are fixed and collected, but it is assumed that the costs are based on the actual O&M requirement and a small profit mark-up (IIMI: 1997). The drinking water sector is extensively led by subsidies and charities, but an initial labor contribution or a maximum of 12 percent of total cost sharing is normally practiced all over the country (IIMI: 1997).

4.6.10 Budget Process

The budget processes of DOI and DOWS are complex, as it is done at multi-levels, at all of which different people exercise various authorities. In addition, as DOI and DOWS operate through different administrative structures in different districts, this leads to an intricate chain of processes at various levels. The budget processes of DOWS and DOI are complex also in the sense that these constitute the loans and grants that are directly channeled to different projects, and the HMG/N allocations for irrigation and water supply. The budget of the former is prepared for the entire project duration, presumably with very little involvement of the local people and local level facilitators. These are centrally fixed and consultants hired by the concerned donor carry out most of the budgetary procedures. With a brief review of the progress made by these projects in the previous year, the DOI and DOWS channel the budget for the subsequent year. For the latter, the DIO and DWSO must take a prior approval of respective sectoral programs with the District Development Committee. Such programs are reviewed at the centre and, with or without modifications, the budgets are approved.

Box 4.6: Chronology of Institutional Interventions in Water Resources

1951:	Establishment of Ministry of Forestry.
1952:	Royal Land Commission formed to promote national land reform.
1956:	Enactment of Forest Nationalization Act.
1956:	Commencement of national economic planning with the First five-year Plan (1956:62).
1961:	Enactment of Forest Act.
1965:	Third five-year Plan (1965-70) launched to lay emphasis to increased food production, land reform, forest management, and urban sanitation.
1970:	Fourth five-year Plan (1970-75) formulated, to lay emphasis on the development of special areas of national priority. Regional development planning concepts emerged.
1974:	Department of Soil and Water Conservation established: renamed in 1981 Department of Soil Conservation and Watershed Management (DSCWM).
1975:	Fifth five-year Plan (1975-80) launched with emphasis on land use planning.
1980:	Department of National Parks and Wildlife Conservation set up.
1980:	Sixth five: year Plan (1980-85) commenced with greater consideration to environmental programs.
1980:	National Commission for the Conservation of Natural Resources organized with the objective to coordinate the activities of DSCWM and natural resource management.
1981:	National Commission of Population established (now Population Division under the NPC).
1982:	Environmental Impact Study project initiated to study the environmental consequences (EIA) of selected development projects
1982:	King Mahendra Trust for Nature Conservation (NGO) established with the mandate to promote conservation and management of natural areas and wildlife.
1982:	Nepal Environment Conservation Group (NGO) established.
1982:	Water and Energy Commission established.
1983:	International Centre for Integrated Mountain Development (ICIMOD) founded to address mountain development issues of Hindukush-Himalayas.
1983:	The International Union for the Conservation of Nature and Natural Resources (NGO) established a project office in Nepal to prepare National Conservation Strategy for Nepal.
1985:	Seventh five-year Plan (1985:90) initiated.
1987:	Environment and Resource Conservation Division established within NPC.
1987:	Environment Division established in the Department of Soil Conservation and Watershed Management.
1989:	Panchayat system replaced with a multiparty system, and the interim Government introduced the Municipality Act, District Development Committee Act and Village Development Committee Act. New administrative units given various environmental management responsibilities.
1990:	Council for the Conservation of Natural and Cultural Resources established under the National Planning Commission.

Box 4.6: Chronology of Institutional Interventions in Water Resources	
1990:	Constitution of the Kingdom of Nepal promulgated with a strong commitment to environmental protection. The right to use water bestowed on people
1991:	Environmental Section established in the Department of Irrigation.
1991:	Ministry of Forests and Soil Conservation renamed Ministry of Forests and Environment for greater protection and management of the natural environment.
1992:	Structural modification in Department of Agriculture
1992:	Agro-ecological region concept adopted by the Ministry of Agriculture.
1992:	Schemes prepared under the leadership of the Prime Minister to revitalize the National Conservation Society.
1992:	Nepal Participated in ICWE Conference in Dublin
1992:	Nepal participated in the Rio Summit and endorsed Rio agenda.
1992:	Capital city of Kathmandu recognized as first metropolis in the country.
1992:	Water Resources Act endorsed and accepted in the parliament
1993:	Eighth Plan started with a strong commitment on irrigation and water resource development
1995:	Arun Project Cancelled
1996:	Ministry of Population and Environment Form
1996:	Ministry of Women and Social Welfare Formed
1997:	The Ninth plan launched with strong emphasis on water resource management, development, environmental problem mitigation
1998:	The Ninth Plan's Water and Irrigation Emphasis published

Source: Various Reports, Government Documents, and the headline news cuttings.

4.7 Conclusions

Based the above review the following conclusions have been drawn:

4.7.1 Water is a Finite Resource

Water Right and Water Use License: The WRA provides that "the ownership of water of surface, underground or in whatsoever form available within the country... is vested in the government" (Section 2 (a) and 3, WRA: 1992). The right to use water can be obtained from the government by acquiring a license (Rule 22 of WRR). The license to use water is both saleable and transferable. The public awareness regarding water rights is very limited and confined only to recent projects[14]. There is a provision on licensing procedures; however, the rule is silent on water sharing by volume from the source.

Water Quality Maintenance: No government authority has been made responsible to look after and maintain water quality. The environmental action plan of 1992 and environmental guideline published in 1994 are more or less silent about the quality of water in irrigation canals with some basic discussion of drinking water. However, the national code of conduct (1963), WRA (1992), Solid Waste Management and Resource Mobilization Act, 1987 and WRR (1993) have laid down a few definite guidelines for water quality maintenance.

[14] The awareness of the people toward the acts and regulations has been assessed in chapter 7 of this thesis.

Research have established that despite frequent institutional changes, the changes in the institutional structure has not encourage better effluent management and better utilization of water resources. This was also observed to be economically demanding and detrimental. In perspective, it has been noticed that the changes in the institutional structure do not follow a logically thought out and specified path. The creation of institutions is more influenced by the administrators' and politicians' requirement than the requirement of the general people and, specifically, the requirement of water resources.

__River Basin Management:__ Environmental Action Plan (1994) has provisioned some definite policies for integrated river basin wide management. The issue has remained in constant discussion among policy makers. Nevertheless, no detailed plans have been made yet about river basin management.

__Water Resource Monitoring:__ The WRR has made DWRC responsible for monitoring of water resources in each district. The DWRC is the responsible body to ascertain whether the licenses are properly being used or not. According to the policy, the government will establish a detailed geographic and management information system, which will be updated and institutionalized based on the requirement. The government makes, while evaluating WRM projects, a detailed assessment of changes in IRR, irrigated area and responsibility of WUAs. It has been clearly established that monitoring would be institutionalized and the needed guideline for future program implementation would be made available. However, none of these legal provisions are currently being implemented. Monitoring efforts, on the whole, seem very weak. The problems appear largely in the sources of data collection at the project level, data authenticity, information flow from the project to the centre, data recording and analysis at the centre (IIMI: 1997).

__Water Service Needs:__ Future water requirements are expected to rise consistently in the all WRM projects. Urbanization and industrial activities are increasingly influencing many projects, which, in turn, have complicated the demand-supply situation of water for all purposes. Given increasing competition, more attention is needed to address water service needs.

4.7.2 Institution for Water Resource Development

WUA Formation: WRA avails opportunities to anyone aspiring to use water resources on an institutional basis through WUA, which can be formed and registered locally with DWRC. WRA, WRR, and IP provide a legal basis for the establishment of such WUAs. The binding document and regulation of functioning of an individual WUA would be vested in the organization itself. The WUA would prepare a constitution, which will be amenable to WRA, WRR, WSSBA, RWSSFBA, IP, and others.

__Institutional Framework:__ Various ministries, departments, and corporations have been created under the broad administrative framework of HMG/N to carryout different functions related to water use in the country. Various legislative bodies are also formed at different levels of the government hierarchy, from central to local levels, to regulate the functions related to irrigation and water supplies. Many I/NGOs are also involved, as partner of HMG/N or by themselves, in water resource development.

Institutional Arrangement It is indicative that there are various agencies created at different levels that cater to the issues of water resource utilization, however, a converging institutional framework formed based on organizational consensus in water resource development is lacking. More precisely put, policies and institutions exist, but an overall framework and strategy are not properly developed. It is also indicative that the essence of WRM and various line agencies' roles are yet to be properly interfaced in the policies and subsequently followed in actions. There is a need to develop a common understanding regarding the attainment of the ultimate objective of improved WRM – may it be in the form of increased agricultural outputs or improved health of the rural people.

Coordination: Although there are various institutions created under the HMG/N to operate in the water resource sector at different levels, there does not exist a coordination plan to provide effective support to the general people for the utilization of water resource projects. The National Agriculture Coordination Committee and the National Drinking Water, Health and Sanitation Committee, formed to coordinate planning, implementation, monitoring, and evaluation of water resource development activities in the country, are inactive. The coordination problems are more critical at the districts and at field levels. The District level coordination committees for both drinking water and irrigation are defunct.

DWRC Operation: The role of DWRC is limited largely to issuing licenses to the water users in the districts. There exist many opportunities and need to make these committees active with greater responsibility to regulate the provisions given in various acts and legislation. However, as Chapter 6 presents, the role of DWRC has been ill defined. As the members of the DWRC are civil servants with administrative duties, they are not very concerned with its activities. Seemingly, DWRC appears to be a very confusing arrangement in the water resources sector. The envisaged coordination appears to be severely constrained by the debate of what authorities to relinquish and how much to relinquish (Guthman: 1997).

4.7.3 Women's Role in Water

It is evident from the review that apart from a small provision in WRR to involve 20 percent women in water development system, there are no legal provisions for women's role in WRM. Recently, a few noticeable attempts have been made, including creation of Women Farmers' Division in Ministry of Agriculture and inception of a project on Women in WRM by WECS.

4.7.4 Water is an Economic Resource

Service Fee Collection: There are concrete policies and legal provisions that have laid specific guidelines regarding service fees, both ISF and Drinking Water Fee. The IP, 1996 in its article 2.6 and WSSB and RWSSFB have provided detailed guidelines on service fee collection. The charges are presumed to meet the O&M costs of the irrigation systems and the real value of water. Unless the projects are operated and managed by the agencies, WUAs are fully authorized to fix service rates, collection, and utilization. However, the collection procedures and rates are still being refined based on the experiences gained from actual practices. For most of the rural water supply projects, the service charge is collected in the beginning inclusive of a small O&M fund. Experience shows that the collection of ISF and the charges collected up-front, in general, are comparatively lower than the required minimum O&M cost.

4.7.5 Capacity Assessment

As can be sensed from the review presented in this chapter, a clearly thought-out program, and strategies to include users in the planning, design, implementation and O&M of WRM activities is lacking in Nepal. In addition, even when a provision is made, the concept of people's involvement is taken as an obligatory and coercive component rather than a partnership-building initiative. Most striking of all is that the capacity of the people and their real potentialities have been ignored in water management initiatives.

Creation of WUAs, implementing programs through women are a few, but very important milestones in WRM sector in Nepal. However, It appears that the involvement of people in WRM is an administrative necessity rather than a self-induced process of cost and responsibility sharing. Inadvertently, this has led to the emergence of a distinctly visible hiatus in the planning process (IIMI: 1997). All of the new WRM approaches have strong participatory components in them. Yet, none of the efforts is homegrown or seeks to internalize the existing knowledge of the people. Most efforts resort in designing a separate participatory component that is often alien to the socioeconomic and environmental set-up of the concerned community/area (Ives and Messerli: 1989, Jodha: 1990a, IIMI: 1997).

CHAPTER FIVE

; INTEGRATING THE SOFT AND HARD SCIENCES: METHODOLOGICAL OVERVIEW

"There is no magic way of organizing or conducting research. (At best, research outcomes are not fully predictable.) Whether water resources research be conducted in groups, by individual scientist, or along narrowly defined disciplinary lines, the skill, intuition, and dedication of the researcher are major determinants in the success of the effort" (Long and Field: 1974:12)

5.1 Background

Chapters 2 and 3 of this research addressed that any water resource management (WRM) research must be able to gather right information, and should involve major stakeholders in the analytical framework. Similarly, these chapters argued that all analysis techniques should be based on an iterative process, and the findings must be in a constant knowledge of the subjects of the research, so that subjective judgments or chances of it can be avoided to their best. The design of this research has tried to accommodate all of these understandings. First, it has depended on local-level stakeholders – primarily watershed residents – to generate, analyze, and synthesize all information. Second, all analyses presented here evolved out of different forms of interactions between the researcher and stakeholders. Third, both the hard and soft analysis techniques have been applied using a multi-actors and multi-tool methodical framework.

5.1.1 Objective of the Chapter

The main objective of this chapter is to present the research methodology used in the thesis. Specifically the objectives of this chapter are:

- to justify the use of multiple methods, tools and analysis techniques.
- to provide the concept, approach, and steps involved in the assessment of actions, attitudes, and preferences.

5.2 Study Strategies

5.2.1 Study Assumptions

Unlike conventional research, this thesis was not started with any fixed hypotheses to prove or to disprove, because pre-hypothesizing could have suppressed the creativity, and increased the rigidity of the research. Similarly, hypothesizing could have limited the opportunity for an in-depth participatory analysis. In addition, hypothesizing could also have constrained the use of Participatory Rural Appraisal[15] (PRA), which appreciates the formulation of hypotheses by discussing the given context of the research with the real beneficiaries (Chambers: 1997). This concept in PRA is based on cybernetics, which is defined as "*a set of ideas about the dependency of any systems on the flow of information, especially information about differences between the ideal and actual*" (Grandstaff et al.: 1987:8). Thus, until the actual is discussed, formulation of specific hypotheses could distort the research. The study, however, formulated a few assumptions based on the conceived objectives. These assumptions were formed as broad negative explications, because it has been argued earlier that the *elements of sustainability can be better isolated if the study is initiated by addressing the context of unsustainability*.

1. People's actions do not support better management of water resources, indicating that their water resource activities are unsustainable.
   - People disregard environmental considerations in day-to-day utilization of water in the community. The waste management and water management can not be differentiated, as both are nonexistent.
   - People do not make adjustments and they are unwilling to accept tradeoffs or socioeconomic changes.
   - Community water management is an "as-it-occurs" process. The water resources are often unplanned and are entirely nature dependent. Communities do not organize themselves to better performance.
   - WRM endeavors—if they occur—are gender sensitive. Normally, men are involved more than their social counterpart, women. The management of water is viewed as men's responsibility.
   - Water is managed as a free good and no economic value is placed on it. As laws of economics would explain, as a free good the water is managed inefficiently.
   - The management of water is characterized by widespread ignorance and little ingenuity can be traced that can be utilized for designing better water management efforts.
2. People do not support the WRM principle goals and their general outlook on water is similar.
3. People can not prioritize water resources activities, as they are not aware of what is required.

5.2.2 Integration of Hard and Soft Sciences

Ives and Messerli (1987) and Hewitt (1988) have given some insights into a few desirable conditions to conduct research in the Himalaya. Some of the relevant points are discussed in the bulleted text below:

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[15] PRA is also known as Participatory Interactive Development (PID) or Participatory Learning and Action (PLA). Although PID or PLA reflect latest contextual modification in participatory research, the abbreviation PRA is used in this thesis due to its popularity. (*Chambers, R. (1997) Whose Words Really Counts (Putting the first last), Intermediate Technology Publication, UK.*)

- The authors argued that while conducting research "plural problem definitions and plural solution definitions" are properly realized. This is a very valid argument, however, this researcher argues that there are numerous solutions available to the scientific community, but the context of problem are relatively less known and may never be fully understandable. In this token, a research may fall into the *trap of problem scenario generation*. Thus, it is essential that only those problems, categorically pointed out by the concerned stakeholders, be taken into consideration. Similarly, the problem definition may not be applicable in the context of capacity assessment research.
- As problems in the Himalaya are heterogeneous and characterized by non-linear behavior to evolve appropriate management options, all existing capabilities should be appropriately taken into consideration. The authors claim justifies the involvement of major actors in the study design.
- There also exit a need to properly define the resource characteristics of Himalayan water. It is essential that (as discussed in detail in Chapter 3) water is defined based on the human-resource interaction, which is situated and unique for the Himalaya.
- The authors argued that clients' (Non-paying members) actions, attitudes, and preferences are properly identified. However, this research argues that all concerned stakeholders' (paying as well as non-paying) actions, attitudes, and preferences needs to be identified. A research in the Himalaya should not be limited to either clients or facilitators' point of view, but it should be able to put both groups in a single platform so that all issues could be discussed.
- The authors argued that a usable synthesis of hard and soft science is essential to conduct studies in the Himalaya. This researcher fully supports this assertion. An extensive discussion on the significance to merge two streams of sciences is provided in a latter section of this chapter.
- The author fully agrees with the authors that the room for homegrown wisdom is made. However, as the research noted in Chapter 3, mostly the use of such homegrown wisdom is confined to study "successes" rather than "failures." It is argued here that it requires a deliberate commitment to study from both the perspectives
- The researcher agrees with the authors that flexible research, those providing enough ground for contextual modifications, is conducted.

The discussion presented in above paragraphs reassert the argument presented in Chapter 2 that it is essential to integrate the following in the context of the research: a) *Himalayan development and WRM*, b) *successes and failures of previous approaches*, and c) *physical and social aspects of resource and capacity assessment*. It is also argued here that the integration of these aspects requires a new thinking and analytical capability. The research argues that such integration must be based on an inductive approach, where Himalayan WRM as explored as a situated phenomena.

Hollings (1995:13) has argued in favour of a similar approach while making his case for the adaptive approach to management. However, as it has been discussed earlier, the purpose of this thesis is not to prove or falsify any particular management approach. The researcher does not wish to black-box this research as that subscribing to the "science of whole or science of part." Yet, in broader context, the strategies adopted in this research may appear closer to the "science of integration of parts." The research was started with the notion to welcome surprises and regarded that the Himalayan water resource system may appear as a moving target. Admittedly, no matter how rigorously it is tried, unless the people in the small watershed involve fully and consider themselves as an integral part of the process, the knowledge of the system remains incomplete. Any resemblance of the approach of this research and Hollings' adaptive approach to management is merely coincidental, not least of which is the fact that the inductive approach, concept of a fluid society, and reliance on people's knowledge are a few of the emerging contexts where the science is currently paying attention.

This also leads to the argument of whether quantitative or qualitative analysis is more appropriate for WRM works (Woods: 1995). Admittedly, there are benefits to both subjective and objective analysis. While the former helps to consolidate knowledge based on consciousness or perception, the latter helps to consolidate knowledge that is quantifiable or measurable (Bookchin: 1990). However, it needs to be understood that the qualification and quantification of a set of variables are only the starting point of a scientific investigation. Conversely, it is much more important to concentrate in the process of how such qualification and quantification could be synthesized to build logical understanding (G. Young, Personal Communication: 1998). *Understandably, the quantity of data, may it be objective or subjective, is considerably less important than their reliability, relevance and usability.*

5.2.3 Multi-actor and Multi-approach Research

WRM research is a complex process. Therefore, it warrants the use of a combination of tools, involve many actors, and generate data covering a spectrum of human and physical variables. It is more strongly felt in the Himalaya, where the complexity of WRM research requires it to be carefully integrated with the mountain specificities (Jodha: 1991). The lack of such integration can lead to the continuation of range finding exercises, use of a particular perspective (physical or human), and thematic coverage (irrigation or drinking water, etc.) in WRM research frameworks (Ives and Messerli: 1987, Jodha: 1991, Chalise: 1994). Methodology adopted in this research acknowledges these limitations (see Chapter 2).

Box 5.1: Distinction between Hard and Soft Science
The hard science is considered as those dealing with natural substances, while the soft science deals with human beings. Hard science is substantive while the soft science is operative. While the soft science includes disciplines like law, economics, geography, regional planning, the hard science includes climatology, meteorology, physics, chemistry, geology, geomorphology, etc. The sciences, however, can be interpreted differently according to their application (Singh: 1992).

Integration of science and use of multiple tools in WRM is increasing. Burgenmeier (1993) observed the need to include more directly the social, political, legal aspects and environmental concerns in WRM. He argued that the exclusion of soft elements often results in wrong decisions. Thus, inclusion of soft elements is essential and it requires subjective knowledge based on experience, intuition, and common sense. Similarly, Cowater et al. (1994) argued that water being a physical resource, using only social perspective in its analysis might be misleading. In this sense, the problems in water resources must be seen as a systems problem where aspects of physical as well as socioeconomic behavior are complex, unpredictable, and always multiple.

However, as Chambers (1978, 1997) argued, the research agenda for WRM is more inclined to the priorities, skills and concerns of professionals involved, than the priorities of the people or the outcome. Chambers posited "...generally, true that research priorities are generated less by the situation of rural people than by the preoccupation of professionals" (Chambers: 1978:390). Thus, the outcomes of WRM research are often "micro-myopic [and neglects the water resource system, which is]...an obsession with one small scene to the neglect of its surroundings" (Chambers: 1978: 391). In the same context, Myers (1991) strongly stated that the hydrologic investigations remain incomplete if they are not adequately integrated with the water utilization of the local people (Myers: 1991). Saaty forwarded his interpretation as:

> *"No theoretical consideration of scales of measurement in the social sciences is likely to be as practical and implementable as one which derives from those habits and activities of people which make a scale likely and useful in that area." (Saaty: 1973: 21)*

As an answer to Saaty's concern, Chambers posited that WRM research is incomplete unless it satisfies: "working with and learning from rural people, holistic appraisal, opportunity orientation, creative lateral thinking (without being cramped by disciplinary rigor), and due assessment of practicability" (Chambers: 1978: 393-394). As an extension to Chambers' work, this researcher believes that people not only possess skills to provide information but also a strong analytical and synthesizing ability.

Hatley and Thompson (1985: 370) presented that the "principle of reciprocity" is required in WRM research. The authors argued that the blending of science and technologies could bring the essence of reciprocity. The authors contended that culture and natural resources are the two sides of the research, and they must be harmonized. A similar sentiment is articulated in the Rio Agenda (1992). Chapter 35.11 of the agenda presents that:

> *"...the key objective of the sciences should be to improve and increase the fundamental understanding of the linkages between human and natural environmental systems and improve or integrate the analytical and predictive tools required to understand better the environmental and development processes by conducting research to integrate physical, economic and social sciences in order to understand better the impacts of economic and social behavior on all aspects of the environment and of environmental degradation."*

In this token, Bhattarai (1997) conducted a study based on Analytical Hierarchy Process (AHP) to identify the most appropriate scale of hydropower projects for Nepal, and found that due to scanty availability of data, multi-criteria, and multi-approach methods are suitable for studying WRM in Nepal. He also argued that such research must also involve actors with diverse WRM preference and objectives. Thus, it is argued here that both beneficiaries and those who plan, design, and implement WRM activities must be included in the research design. Attention is also increasing to divide the users based on their social strata and gender (Gale: 1992, Neupane: 1993, Neupane and Young: 1997). These studies reason that the societies are very stratified and exclusion of any strata can only provide fragmented understanding. Considering the general socioeconomic situation that characterizes the Himalaya, the ultimate clients of any program of sustainable WRM are astonishingly diverse, and *"interrelationships between all the actors of economic and political power flow are remarkably complex"* (Thompson and Warburton: 1985: 121).

This review demonstrates that research in WRM originates from two extremes. From one stream, scientists seem to be concerned with the integration of social and hydro-engineering sciences and their methods of research. Similarly, from the second stream, the demand-supply and temporal-spatial relationships of water, and their interrelationship are taken as the main agenda for integration. Falkenmark (1995) argued that multi-aspect research involving both demand and supply side is essential to study changes in micro-scale water cycles (Fig 2.2). She also argued that both time and space considerations are needed to master water resource use and distribution. Thus, natural and social sciences become the indispensable parts of successful application (Falkenmark et al.: 1980:10).

In the same context, the analysis for capacity assessment must focus on the interaction between slow and fast phenomena, essentially by relating the focus of the research with long-term changes in situated variables. Equally, there exists a need to acknowledge that the problems are fundamentally cross-scale in both space and time. Therefore, the research not only should be multidisciplinary but also cross-scale along temporal and spatial axes. This thesis recognizes the need and applicability for such bases, which is reflected in its design and analyses.

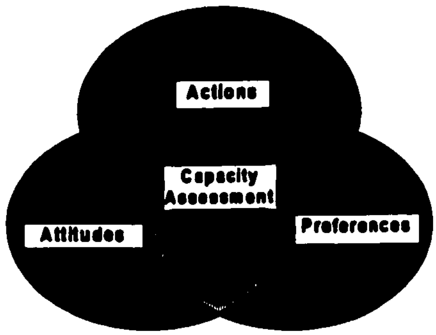
5.3 Research Method

5.3.1 Basic Approach

This research was conceived with a broad assumption that the people's capacity in WRM can be studied by examining small watershed level water use practices and, in that, by understanding the various adjustments and accepted tradeoffs. However, following a detailed discussion with the small watershed community, attitudinal and preference analyses were also included in the research design. Box 5.2 provides the small watershed community's response on capacity assessment.

Box 5.2: Perception on Capacity Assessment
The community indicated that the true assessment of their capacity would require detailed assessment and analysis of **Kama or Karya and Jankari** (Action and Awareness), **Bichar** (Attitude or thinking) and **Chahana** (Preferences). (Participatory Analysis: 1995-7)

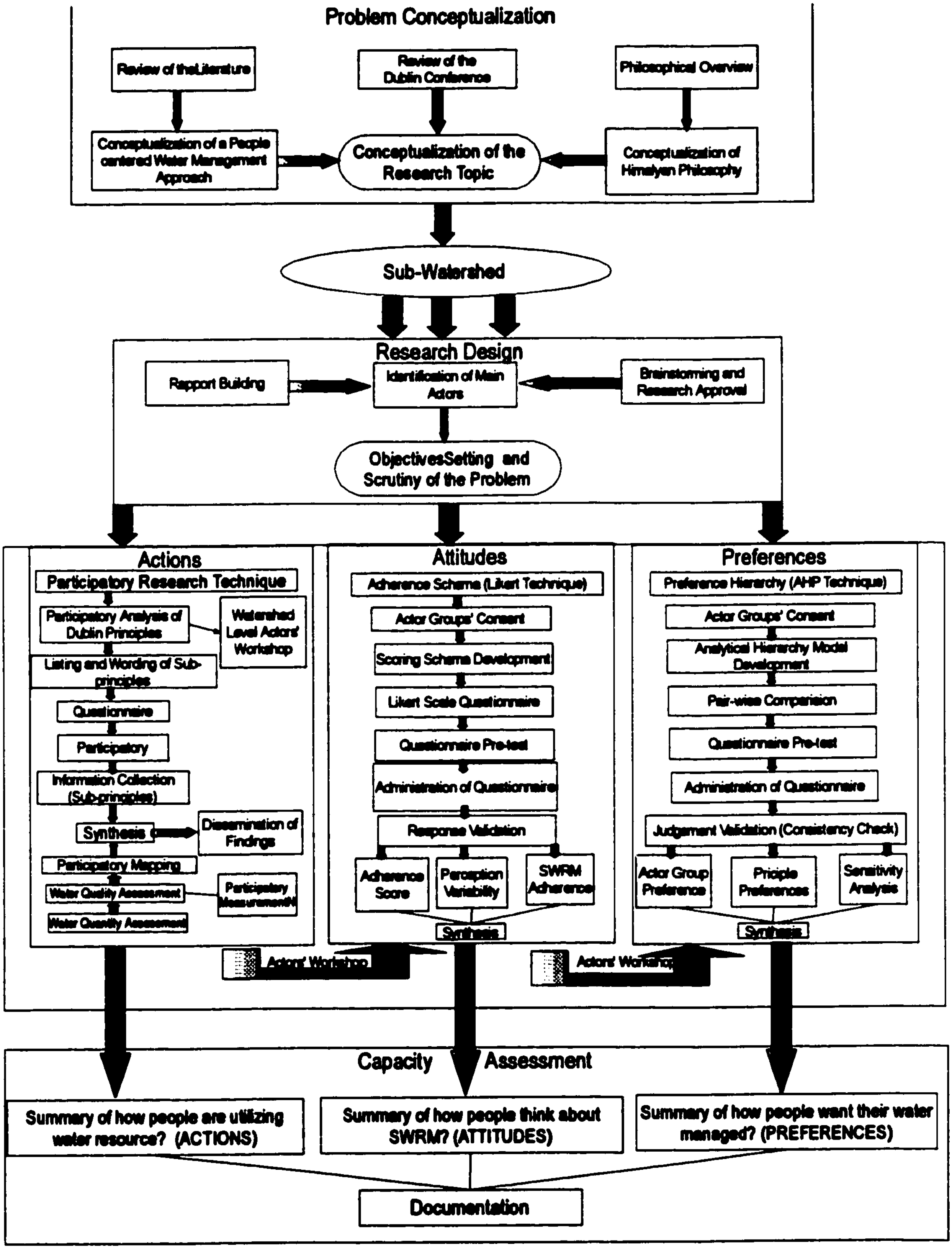
Fig 5.1: Capacity Assessment in Perspective



The research has comprehensively adopted the Dublin principles, but other broader contexts of WRM have also been used in the thesis. Such broad concepts include: sustainable WRM, equity, and social justice as the modality to internalize people's knowledge in WRM (Mitchell: 1989, Barbier: 1987, Gale: 1992, Rio Summit: 1992, Woods: 1995, Neupane and Young: 1997). Figure 5.2 presents the detailed design of the research.

This research has attempted to investigate the actions, attitudes, and preferences of major grass-roots level stakeholders in WRM. Through the action assessment, it attempts to provide an insight into activities that distinctly demonstrate their knowledge or ignorance in various aspects of WRM. These activities have been carefully drawn based on the four principles outlined by the Dublin Conference (Box: 2.14). It also renders an opportunity to analyze the Dublin Principles and generate community's understanding on issues relating to the principles.

Fig 5.2: The Detail Design of the Research



The attitudinal assessment attempts to understand the major stakeholders' adherence toward different WRM principles, sub-principles, and sustainable WRM (Gale: 1992, Neupane: 1993, Neupane and Young: 1997). It has also helped to identify the degree of perception variability existing among involved actors. Similarly, the preference assessment attempts to substantiate the perception variability, and provides the priority of the most critical activities felt suitable or desired by the selected stakeholders.

Box 5.3: Key Elements of the Methodology	
• Refinement of the concept of capacity assessment i WRM and logical analysis to identify the majo components within it. • Identification of the major actors responsible for WR in the small watershed • Adoption of the four principles of sustainable WR (IWCE: 1992) as the main platform for the thesis • Participatory analysis of the principles.	• Identification of the sub-principles in the context of small watershed. • Identification of major actions and awareness that supported or contradicted with the sub-principles • Identification of the degree of adherence of different actors toward sub-principle and principle goals • Identification of preference of different actors toward the WRM goals.

5.3.2 Thematic Coverage

The thematic coverage of the study is limited to drinking water and irrigation; however, the entire water resource system is represented in the analysis. The research has focused exclusively on surface water. It has been discussed earlier that this research does not represent the time of extreme stress.

5.3.3 Multi-tool Approach

This research is based on a combination of techniques. These techniques include Participatory Research Technique (PRT), Likert method of attitude quantification and analysis, and Analytical Hierarchy Process (AHP) approach.

5.3.4 Study Area[16]

This research was carried cut in a small watershed area of the Gerkhu River[17], situated in the Middle Mountain of central Nepal.

5.3.5 Field Work

Box 5.4 summarizes the context and theme of exploration in three seasons.

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[16] A detailed description of study area has been presented in Chapter 6.

[17] Hereinafter, the term, *Gerkhu Khola*, or ***small watershed*** has been used to refer to the selected watershed area. Khola in Nepali language means a small River.

Box 5.4: The Field Seasons, Themes of Exploration and Achievement	
Field Work	Themes of Exploration and Achievement
Season I (Summer 1995)	Selection of the research area, narrowing down of the problem, consolidate the research question and formulate the preliminary design of the research, rapport building, obtaining research authorization, synthesis of action, attitude and preference as important components of capacity assessment and become aquatinted with the area.
Season II (Summer 1996)	Participatory rural appraisal, identification of the major actors, detailed action assessment, demand and supply-side observation, measurements and quality analyses of water, taking detailed account of water use, discussion concerning the most important indicators of sustainable water use (collaborative principle analysis), synthesis of sub-principles of sustainable WRM, sharing of the findings, identify the limitation of action analysis
Season III (Summer, Spring 1997)	Consolidation of the findings of the second season, attitudinal analysis, perception variability tests, sharing the findings, AHP model formulation, preference assessment, sharing of the information, final synthesis

5.3.6 Secondary Data Collection

The conceptual basis of this research was developed through an extensive review of the literature on water resource problems, uses and management, capacity assessment, capacity building, and Himalayan resource management and development (Fig.: 5.2). Thus, secondary information was crucial to synthesize the problems and available solutions. Secondary information was collected by reviewing previously published reports, documents, journals, books, official records, on-line documents, dissertations and theses, UN archives, and selected gopher domains and internet web-sites.

5.3.7 Primary Data Collection

A combination of techniques was used to collect primary information. Such techniques included Participatory Research Techniques (PRT), questionnaire survey, direct observation, and measurements. The research extensively relied on group discussions held with selected key-informants and volunteers, and general group meetings involving all stakeholder groups. At the central level, the researcher met a few government officials and asked them to clarify some policy issues pertaining to capacity assessment.

Equally, the study took extreme precaution while generating – through PRA and other techniques – and using data, since the availability and quality could affect the output. In overall, the data were generated by using causal, judgmental and extrapolative methods. However, information generated through all methods was discussed for their reliability in group-meetings.

5.3.8 Justification for Participatory Rural Appraisal (PRA)

"...[PRA is a process] that employs a range of methods, tools and techniques specifically selected to enhance the understanding of rural conditions, with particular emphasis on tapping the knowledge of local inhabitants..." (Grandstaff et al.: 1987:6).

The researcher argues that there exists a strong theoretical similarity between PRA's core principles and important components of WRM (Chambers: 1997, Humble: 1995, Mason: 1994). While arguing the integration of hard and the soft approaches, the researcher argued that the process of research is much more important than quantification and qualification of any variable. The argument is based on the conviction that a flawless research process could maximize the utility of tools and techniques adopted in the research, on the other hand, the effectiveness of tools for quantification and qualification alone would not provide a condition for best results. However, the mutual dependency among the two can not be avoided. The same statement can be used to justify the use of PRA in this research. PRA concentrates more on the collection process than specific variables (Chambers: 1997). In this context, PRA argues for optimal ignorance, which signifies it is better not to know what is not worth knowing, and appropriate imprecision, which signifies that precision of data is not desired as long as it adequately represent the existing situation (Chambers: 1987).

The review indicated that the use of PRA in resource management studies is rapidly increasing. Carson (1987) successfully integrated aerial photography technique with PRA in a remote hill of Nepal. Conway (1987) conducted a detailed agroecology survey of Northern Pakistan using PRA technique (1987). Pinney (1991) successfully integrated the Geographic Information Systems (GIS) and PRA for land planning and natural resource management in Sub-Saharan West Africa. Wickham (1993) and Kindon (1993) used PRA techniques to assess the indigenous knowledge of Balinese farmers. Both studies concluded PRA as a useful good tool in studies that attempts to internalize local people's knowledge in external management approaches. Many watershed management studies have integrated PRA with hydrological research (Montgomery et al: 1995, DANIDA: 1997). In Nepal this technique has been used very successfully in irrigation management (ICON: 1993c), drinking water project development (JAKPAS: 1994), watershed condition analysis (APROSC: 1997), etc.

5.3.9 Selection of Actor Groups

"Capacity assessment should involve the key stakeholders – those who can influence (both negatively and positively) the results of a proposed intervention, and those affected by the outcome. Stakeholders could include formal and informal decision-makers, beneficiaries, oversight bodies, managers, technicians, and other government staff involved in the effective functioning of the systems and organizations. They can also include members of the private sector, as well as the public sector (shareholders, for instance). These actors could be directly affected (those who stand to benefit or lose the most) or indirectly affected by the tasks involved. The involvement of direct stakeholders should receive first priority. (Source: http://magnet.undp.org/cdrb/CAPMET~1.HTM: 1994)"

The stakeholder analysis in the small watershed area initially led to the identification of a total of nine actor groups. The analysis was based on the UNDP guideline (Box: 5.5) However, during the group meeting, four actor groups – middle farmers, academic sector (teachers and researchers), private sector and policy level – were dropped. The community, who was made responsible for the identification of the key stakeholders, reasoned that these actor groups do not fit into the framework of local-level WRM. It was later realized that the identification of individuals belonging to these actor groups would be impossible (Bhattarai: 1997).

Box 5.5: Questions To Help Identify Stakeholders	
• Who influences policy and decisions? • Who could contribute resources of any kind that can help better management? • Whom the management would affect (positively or negatively)? • Who has no "voice," for whom special efforts may be needed? • Who are the representatives of those likely to be affected?	• Who are the task managers? • Who is likely to be mobilized for or against what is intended? • Who can make the task outcome more effective through their participation or less effective by their non-participation or outright opposition? • Whose behavior has to change for the effort to succeed?
(Source: http://magnet.undp.org/cdrb/CAPMET~1.HTM)	

Considering the possibility of faulty identification of the people engaged in the farming and non-farming sectors, and identification of already separated members of the family, as part of the household, due attention was essential. The researcher resorted to the users, who identified the individuals belonging to different groups. The major stakeholder groups identified are presented and defined in Box 5.6.

Box 5.6: Actor Groups	
Actor Group	Identification Criteria
Small farmer	Members of watershed community, who were involved in agricultural activities as their basic source of livelihood, and possessed < 0.5090 ha of land*
Large Farmer	Members of watershed community, who were involved in agricultural activities as their basic source of livelihood, and possessed > 0.5090 ha of land*
Off-farm Workers	People involved in activities which are not agricultural that generated monetary return
Women	Women, especially from women headed households or those who received permission to participate from their husbands or parents.
Local-level staff	Extension agents and officers of offices with distinct programs in water resource, Members of DWRC # working at the district level.
NGO Workers	Members of the local NGO, implementation staff and officers of I/NGO operating within the district but having directly or indirect program related to water within Gerkhu Khola.

*NPC Classification, regardless of land-type or productivity # See chapter 4 or 6

5.3.10 Sample Design

The research was based on both the sampling and selection of respondents. For the action analysis, the respondents were sampled only from among the small watershed community. In order to represent the entire small watershed area in the analysis it was divided into upstream, midstream, and downstream areas. The samples were drawn by using a multistage, stratified random sampling method.

Box 5.7: Involvement of Actor Groups in Various Analysis			
Actor Group	Actions	Attitudes	Preferences
Small Farmers	✔	✔	✔
Large Farmers	✔	✔	✔
Off-farm Workers	✔	✔	✔
Women	✔	✔	✔
Local-level Staff	NA	✔	✔
NGO Workers	NA	✔	✔

NA Not Applicable

For attitudinal and preference analyses, the respondents were asked to volunteer themselves from among the actor groups. This was very effective, because the total number of persons volunteering were more than the required number of 15 in each group. Box 5.7 provides the cross-sectional involvement of actor groups in different analyses. In order to reduce sampling bias in attitudinal and preference analyses, the respondents were selected from among the sampled respondent in action analysis. Due to repeated group works required for these analyses, the availability of the respondents was taken as the main criterion for selection. Except for occasional refreshments, no incentives were given to the respondents to participate in the study.

Sampling Method

The sampling design for action analysis was based on the population census of Nepal (CBS: 1991). The average income of the households was taken as the basis for sampling and the level of error was permitted at 10 percent. The following formula was used to calculate the sample size.

$$n = \frac{(Z\frac{S}{ex})^2}{1 + \frac{(Z\frac{S}{ex})^2}{N}}$$

Where, n = required size of the sample

S = standard deviation of income of the district

Z = Value of the normal curve at 10 percent level of error

ex = error permitted in the study (10 %)

N = Total Households in the district

Based on the calculation and rounding up, the total number of respondents for action assessment was identified at 120. For attitudinal and preference assessments, the sample size was maintained at 15 for each of the identified actor groups. Thus, in the three types of analyses, a total of 300 individuals were interviewed. Box 5.8 provides the total number of respondents in different actor groups selected for analyses.

Box 5.8: Respondent Numbers by Actor Groups for Different Analysis

Actor Group	Action Analysis	Attitude Analysis	Preference Analysis	Total
Small Farmers	43	15	15	73
Large Farmers	27	15	15	57
Off-farm Workers	27	15	15	57
Women	23	15	15	53
NGO Workers	NA	15	15	30
Local Level Implementers	NA	15	15	30
Total	120	90	90	300

NA Not Applicable

5.3.11 Questionnaire

Separate questionnaires were prepared for each type of analysis (Samples provided in the annex). The questionnaire for action assessment was provided with closed questions. Similarly, for attitudinal and preference analyses, the questionnaires were prepared with standardized scales. The respondents were asked to select a particular point on the attitudinal scale (based on Likert technique), or preference scale (based on AHP). The questionnaire prepared for all analyses contained questions based on various principles and sub-principles of ICWE

(1992). Before the interviews, pretests were conducted for all types of questionnaires. The pretests were augmented with detailed discussions with the stakeholders and necessary modifications in the questionnaires.

The questionnaires prepared for all three types of assessment had to be very carefully designed based on the Dublin principles and the sub-principles identified at the small watershed. The most difficult task was to phrase these questions in a language that would not be too difficult for the actors to understand. These questions had to be reformulated in a way that would reflect the rural situation of Nepal. However, in certain cases, owing to the multidimensional interlinkages of the principles, phrasing of a question became very difficult. In order to solve these problems, the questions were phrased to reflect the general water use activities in the small watershed; or a long funnel of the question were designed, probably at the cost of data rigor[18].

5.4 Actions Assessment

- The action assessment was based on participant observation, PRA, and semi-structured questionnaire survey. In order to establish proper rapport with the inhabitants of the basin and understand the basin characteristics, initial preparation was essential. In order to acquire preliminary knowledge about the small watershed, information related to WRM was collected from district level offices in Nuwakot.
- A participatory mapping technique was initially used to prepare a detailed map of the small watershed, emphasizing all rivers, channels, springs, irrigation canals, drinking water systems and waste disposal systems.
- All the actor groups were identified and were briefed about the purpose of the research. The Dublin principles were brought to the attention of the small watershed community[19]. The participatory analysis of the Dublin principles resulted into 12 sub-principles, three for each principle of sustainable WRM.
- The sampling process and PRA were used to appraise detailed physical and socioeconomic situation of the small watershed.
- Checklists and formats for detailed water use study at the household level were prepared, and a detailed data collection was carried out.
- Information was collected on issues related to use of water, awareness of supply and management of supply during the monsoon season. Besides, a detailed account of methods, such as, water harvesting to conserve water, was taken. The physical characteristics of major sources, waste management during the monsoon, incidence of water-related disease with their possible causes and extent, consciousness about the quality of water and uses of water by quality were also studied. Similarly, information was also collected on the tradeoffs and adjustments, agricultural patterns (low water requirement variety, change in planting

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[18] A *funnel of a question* is a set of arguments or supporting questions briefed or asked to elaborate and clarify the context of a main question.

[19] The process is dealt in detail in Chapter 7.

time, change in the cropping pattern), use of the stored water for productive purposes, use of river water and technologies applied or used. Participatory approach was used to collect samples for the Biophysical and chemical analysis of water samples.

- The information obtained was analyzed by using descriptive statistics and qualitative techniques. The qualitative analyses included critical documentation of environmental, social and economic implications of water use processes. To the extent possible, the human-water use system was placed in the context of physical processes to critically identify the ingenuity and ignorance of the people. Subjective analysis also helped develop a logical backing for the design of the attitudinal and preference assessments.

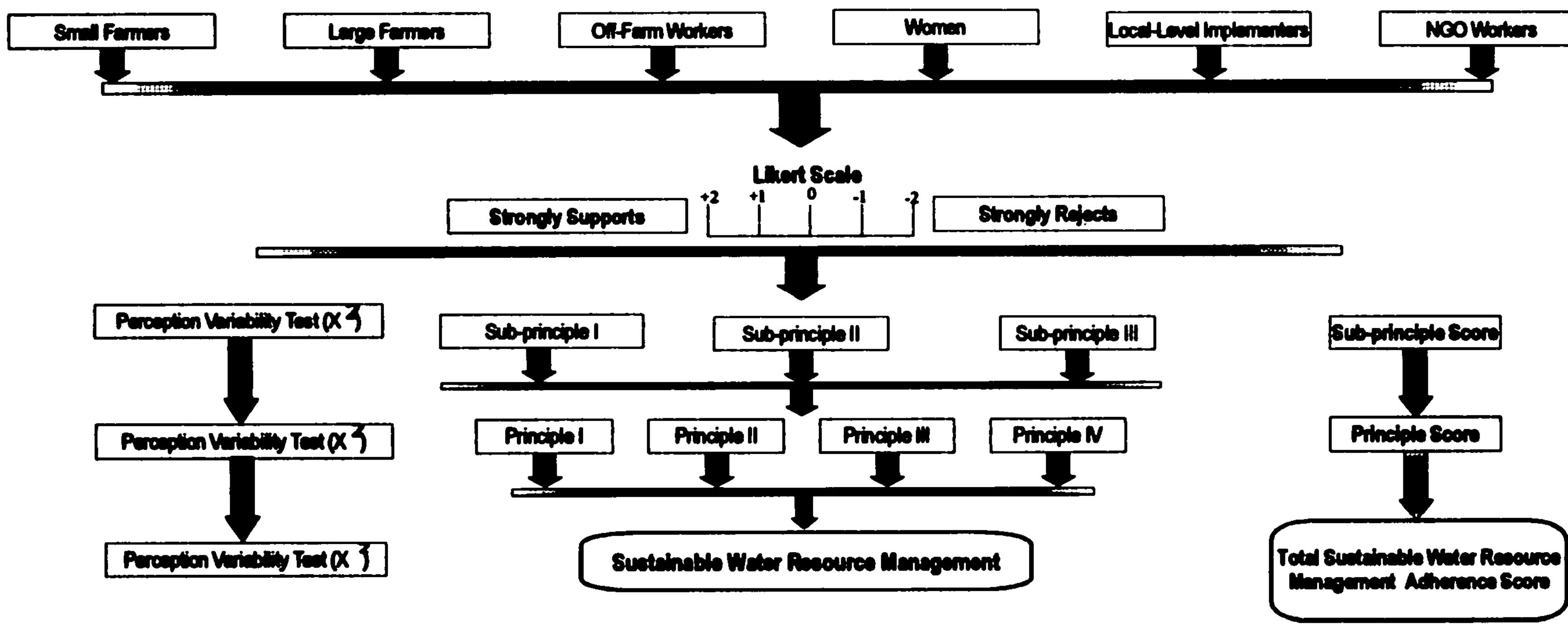
5.5 Attitudinal Assessment

One of the major concerns of WRM lies in the people's willingness to accept changes that any new management approach would propose (UNEP: 1988, Gale: 1992, Neupane and Young: 1997). The degree to which the people support such changes depends, among others, on prior knowledge about consequences, and their attitudinal preparedness to support the departure from existing practices. Careful assessment of attitudes could demonstrate the existence or non-existence of such preparedness.

Attitudinal research is gaining popularity in WRM (Kranzer: 1988, UNEP: 1988). This cuts across the developed and developing countries and, so far, such results have been very useful to implement, or to explore various issues concerning WRM programs. A study conducted in the eastern USA used attitudinal personal interviews with key informants in selected communities to ascertain perceptions of the groundwater resource, and attitudes to contamination and protection of drinking water supplies. The study performed subjective content analysis and concluded that a strong linkage exists between the source protection, the interaction of hydrogeologic characteristics, and the local perception of those characteristics. (Powell: 1991).

Kranzer (1988) attempted to integrate the socioeconomic and psychodynamic variables to study the residential water conservation behavior and identified the important variables that are influential under crisis. He concluded that WRM suffers from the analytic separation of the behavior of the users and the local-level agents. He posited that the psychodynamic (static and dynamic consideration for WRM) factors are most important in predicting and assessing conservation behavior.

Fig 5.5: Likert Scale Scoring Schema



$$\sum_{i \to 1}^{n} X_i = P_i$$

P I + P II + P III + P IV = Score SWRM

Where X... are the sub-principle scores; PI, PII, P III and P IV are the cumulative principle score; and SWRM is the total adheerence score

5.5.1 Steps Involved in Attitudinal Assessment

- Sharing of the results of the action assessment demanded the assessment of detailed attitudes of the actor groups toward WRM principles and sub-principles. This requirement was shared with the actor groups. The idea was adequately accepted. In a separate group meeting, the adherence model used by Neupane and Young (1997) in Daraundi River was shared, and later accepted with a few modifications. It was also agreed that sub-principles derived through action assessment would be used as the basis for attitudinal assessment.
- Attitudinal assessment questionnaire was prepared. Each question had a five-point scale (+2 to -2).
- A meeting of all members was considered important. The meeting was also used to explain the scale used to collect data and the mode of analysis.
- As an extra precaution and to assure the validity of the judgments, the questionnaires were reintroduced to the same respondents at an interval of two weeks. An additional perception validation was considered appropriate, which was done by using a judgment validation test. The test involved asking the individual's opinion about the conduct and utility of the research and immediate random readminstration of some of the questions.
- In order to avoid sampling bias, each respondent was requested to avoid discussing his/her answer with anyone else. In addition, the questionnaire administration was done as discreetly as possible (Fig: 5.3).

Theory Behind Likert Scale Analysis

The theory behind Likert scale analysis is unique but equally simple. It helped to quantify the attitudes of the individuals toward the specific conditions of WRM (Likert 1967, Gale: 1992, Cooley and Lohnes: 1992, Neupane and Young: 1997). The quantified scores are then compared with each other using statistical methods.

Analysis

The analyses of the attitudinal data involved two major steps. Firstly, it involved a process to find out the attitudinal adherence score – the extent to which different actor groups accepted or rejected different sub-principles. Secondly, it involved a process to find out the extent to which the perception varied among different actor groups. The obtained responses were analyzed by scoring + (plus) 2 to + 1 for each adherence and - (minus) 1 to -2 for each antithetical response (Box 5.9). The neutral response was given a 0 score. The five point scale is very popular among natural resource managers (Gale: 1992) and has been successfully used in WRM (Neupane and Young: 1997).

The adherence scores for all actor groups were separately entered into an Excel worksheet. An Excel Macro was written to add all adherence/antithetical responses and then to normalize the scores to a percentage (100) figure. The normalization was essential to improve the consistency of scores and to make them mathematically comparable.

Thus, the scores of each sub-principle ranged between -100 and +100 (adherence score). In the same manner, the scores of each of the four principles become the sum of the four associated principles (minimum - 400, maximum + 400). Respondents' total adherence values – Sustainable WRM Score – thus become the summation of the scores obtained for four principles.

Box 5.9: Ranking of Content for Each Principle.	
Score	**Content**
-2	The response is antithetical to the sub-principle.
-1	Aspects of the response imply that it would work against the sub-principle, which is not explicitly addressed.
0	The response has the potential to work for or against the sub-principle, which is not explicitly addressed, or it has neutral potential for affecting the sub-principle, which is not explicitly addressed.
+1	Aspects of the response imply that it would adhere to the sub-principle, which is not explicitly addressed.
+2	The response explicitly supports the sub-principle.

Source: Modified after Gale 1991:230, and Neupane and Young: 1997

The mathematical explanation of the above discussion can be written as:

$$F = F_s1 + F_s2 + F_s3$$
$$P = Ps1 + Ps2 + Ps3$$
$$W = Ws1 + Ws2 + Ws3$$
$$E = Es1 + Es2 + Es3$$

Where:

F is the total score of the principle I: Finiteness of Water

P is the total score of the principle II: Participatory and User's Involvement

W is the total score of the principle III: Women's Role in Water

E is the total score of the principle IV: Economic Value of water

Fs, Ps, Ws, Es... are the sub-principle scores of the respective principles

The total adherence score for SWRM = F+P+W+E

Box 5.10 summarizes the schema of final computation.

Box 5.10: Schema of Final Score Computation			
Principles	Total Score Obtained	Range	Adherence Score (%)
I	F	300	(F/ 300) * 100
II	P	300	(P/ 300) * 100
III	W	300	(W/ 300) * 100
IV	E	300	(E/ 300) * 100
Total	SWRM	400	(SWRM/400) * 100

As for the perception variability test is concerned, it was observed that χ^2 test of the scores obtained by different actor groups would suffice. The (I XK) method of χ^2 test was found most appropriate for this purpose.

Formula to Calculate χ^2 l × k Method (McNemar: 1969:245-66)

Columns	Col A	Col B	Col C	Col D	Col E
Groups	I	II	$A_i + B_i$	B_i) A_i+B_i	B^2_i) A_i+B_i
A	A1	B1			
B	A2	B2			
C	.	.			
D	.	.			
	$\sum A_i = A_t$	$\sum B_i = B_t$	N	$\sum B_i$) (A_i+B_i)	$\sum B^2_i$)(A_i+B_i)

The formula is given by: $\chi^2 = N^2 * (A_t+B_t) [\Sigma B^2_i) (A_i+B_i) - \Sigma B^2_t) (A_t+B_t)]$

Where: A, B, C,... are the categories of positive or negative explications under various sub-principles

N is the number of total responses

The research modified a model developed by Gale (1992), and Neupane and Young (1997) for perception variability comparison and used it to compare the perceptions of different actor groups (Box 5.11). The model hypothesizes that *if the raw scores of the two actor groups were statistically similar, it will imply that their perception and inclination toward the WRM sub-principle are similar.*

Box 5.11 Model for Analysis of Perception Variability					
Actor Groups	Large Farmers	Off-farm Workers	Women	Local-level Implementers	NGO Workers
Small Farmers	R/A:H_o	R/A:H_o	R/A:H_o	R/A:H_o	R/A:H_o
Large Farmers	X	R/A:H_o	R/A:H_o	R/A:H_o	R/A:H_o
Off-farm Workers		X	R/A:H_o	R/A:H_o	R/A:H_o
Women			X	R/A:H_o	R/A:H_o
Local Level Implementers				X	R/A:H_o

H_o: There is no significant difference among actor groups with respect to WRM preferences, indicating that they have a similar outlook. R: Reject Hypothesis, A: Accept Hypothesis

5.6 Preference Assessment

"All activities can not be implemented." This statement is perhaps one of the most used statements in current WRM discussions. However, there is a dearth of a systematic attempt or a design methodology to properly demonstrate how activities could be best prioritized to reflect the preferences of all major stakeholders involved in implementing WRM programs/projects. In reality, often, the programs come as a bundle and they are implemented as per the design rather than the preference of stakeholders (Nieto et al.: 1997, Abaza: 1993). However, it must be appreciated that chances of success of programs can dramatically improve if they can be matched with the preference of the stakeholders. More precisely, activities planned for a community must incorporate and reflect the concerned stakeholders' priority choices. Logically, preferring and prioritizing are also an integral part of capacity, i.e.: capacity to prioritize an implementation approach and specific activities.

This fact was further consolidated when the villagers expressed that the assessment of actions and attitude are capable only to describe the present and an ideal situation. However, these would fail to present a set of activities most desired by the people. In this context, Saaty and Kearns (1985:17) contended " ... complex problems of choice require information, organization of thought, and the use of logic, intuition, and experience." Consequently, the research decided to assess the preference of the major stakeholders.

The most difficult point to embark in the analysis was the choice of a proven methodology. The research initially thought about using fuzzy programming technique to find the preference of people. However, it was later dropped because it would leave very little opportunity for the stakeholders to participate in the analysis. The second choice of the thesis was Multi-Attribute Utility Theory (MAUT). The usefulness of MAUT is studied by many (Saaty: 1980, Simonovic: 1996, Bhattarai: 1997). It offers potentiality to structure main theme, sub-theme and to diagnose the nature and extent of internal value controversy, which is a needed input for option invention. Following discussions held at various academic institutions[20], it was decided that an approach based on Analytical Hierarchy process (AHP) technique, would be used for preference assessment. The use of AHP has been appreciated in the situations where sufficient data and a reliable database are often unavailable. Assessment of preference is analogous to this situation. As Saaty (1980) stated:

> *"Most people decide today with "seat of the pants" judgments or by mathematical models based on unverifiable assumptions that draw conclusions without adequate validation. Typically, individuals make these choices on a reactive and frequently unplanned basis with little forethought of how the decisions tie together to form a single integrated plan. The entire process of deciding what, when, and whether to do certain tasks is the focus of priority setting."*

AHP relies entirely on value judgment. It is less mathematically demanding and can be applied where people have little or absolutely no mathematical knowledge. It is a tool that assigns quantitative values to qualitative judgments

[20] This issue was discussed with concerned experts in IIASA, Austria and at the department of applied economics at Wolongong University in Australia. Considering the nature of the issue, it was suggested that use of MAUT and any tool developed within it (ELECTRE, MAHP or AHP) as most applicable in the context of the research (1996 and 1997).

and makes them comparable with one another (Bhattarai: 1997). AHP produces functional value of the utility-function rather than the function itself with the involvement of various actors and with due consideration of relative importance of their concerns. AHP also provides a potentiality of integration with the PRA. Use of this technique, however, warranted very careful planning and patience. Extreme care was necessary to use a pair-wise prioritization questionnaire and avoid researcher's subjective judgment.

Box 5.12: Analytical Hierarchy Process
The Analytical Hierarchy Process (AHP) uses subjective judgment for structuring and solving multi-person, multi-criterion and multi-time period problems, Structuring problems hierarchically allows for the identification of multiple actors and interests while resulting in prioritization of impacts and/or preferences through pair-wise comparisons by those who have a first hand knowledge to the system. The AHP allows for a margin of inconsistency (or intransitivity) of preferences and is equally suitable for scenario construction and policy selection. The technique draws upon the human ability to conceptualize problems as sets or systems of interdependent factors while simultaneously decomposing the problems in terms of those factors, which are perceived to have the highest priorities. The Analytic Hierarchy Process is a powerful and comprehensive methodology that provides the ability to incorporate both qualitative and quantitative factors in the decision making process. The AHP uses a hierarchical model comprised of a goal, criteria, several levels of sub-criteria, and alternatives for each problem or decision. The AHP's flexible and efficient hierarchic framework guides the decision making process. Because all parts of the hierarchy are interrelated, it is easy to see how a change in one factor will affect the other factors. By laying out decisions in this format, many types of data can easily be incorporated, differences in levels of performance can be accommodate, tradeoffs among things that look different can be identified. (Adopted from: Saaty, T.L (1980), The Analytical Hierarchy Process, New York: McGraw Hill, Saaty and Kearns: 1995 and Expert Choice 9.5 Help Manual: 1998)

Theory of Analytical Hierarchy Process (AHP)

The AHP is based on a few axiomatic foundations (Saaty: 1986).

- The reciprocal property that is basic in making paired comparisons
- Homogeneity that is characteristic of people's ability for making paired comparisons among things that are not too dissimilar with respect to a common property and, hence, need for arranging them within an order preserving hierarchy
- Dependence of a lower level on the adjacent level.
- The idea that an outcome can only reflect expectations when the latter are well represented in the hierarchy.

From a set of pair-wise comparison matrices, a set of local priorities are derived, which express the relative impact of a set of elements on an element in the level immediately above. This can be best done by using basic matrix algebra of Eigen vector calculation. Eigen vector can be computed by taking the geometric mean (by multiplying the elements in each row and taking their nth root where n is the number of elements). These values are then normalized to unity by dividing each entry by the sum of all entries. When this is performed for each column then these are averaged across the rows. These solutions not only provide the priority rank but also the relative intensity of choice of one alternative to the other (Saaty and Kearns: 1985, Saaty and Alexander: 1989).

The AHP is the estimation of priority weights of a set of criteria or alternatives from a square matrix of pair-wise comparison $A = [a_{ij}]$, which is positive and if the paired comparison judgment is perfectly consistent it is reciprocal, i.e. $a_{ij} = 1/a_{ji}$ for $ij = 1,2,3,\ldots n$

The final normalized weight of its i-th factor, w_i is given by

$$\boxed{w_i = a_{ij}\left(\sum_{k \to 1}^{n} a_{kj}\right) \qquad \forall\, i = 1,2,3,\ldots n.}$$

In the real life judgment, an error is likely occurrence. The suggested Eigen value method computes w as the principal right Eigen value of the matrix A, or w satisfies the following system of n linear equations:

$Aw = \lambda \max w_i$ Where $\lambda \max$ is the maximum Eigen value of A.

This is to say that:

$$\boxed{w_i = \frac{\sum_{j \to 1}^{n} a_{ij} w_j}{\lambda \max} \qquad \forall\, i = 1,2,3,\ldots n.}$$

The natural measure of inconsistency or deviation from consistency, called consistency index (CI) is defined as:

$$CI = \frac{\lambda_{max} - n}{n - 1}$$

The consistency index of a randomly generated reciprocal matrix from scale 1 to 9, with reciprocal forced, for each size matrix called random index (RI) is presented in table below,

Box 5.13: Random Index (RI)										
Matrix Order	1	2	3	4	5	6	7	8	9	10
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

Source: Saaty, T. L. (1985: 34)

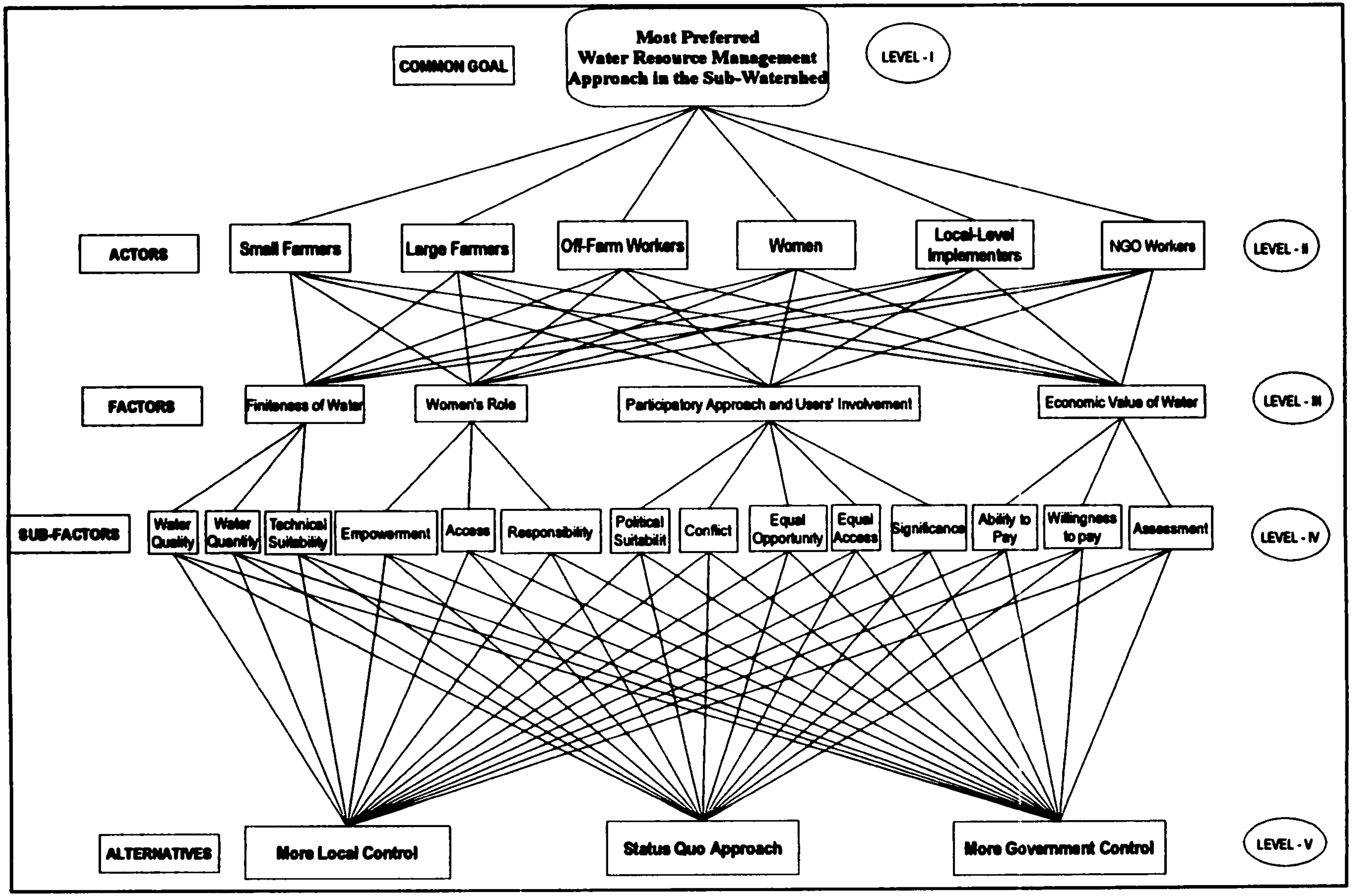
The consistency ratio is defined as the ratio of CI to RI for the same order of matrices, i.e. CR = CI / RI. A value of CR < 0.01 is typically considered as an acceptable limit.

Box: 5.14: Description of AHP Scale		
Intensity of Importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Weak importance of one over another	Experience and judgment slightly favor one activity over another
5	Essential or strong importance	Experience and judgment strongly favor one activity over another
7	Demonstrated importance	An activity is strongly favored and its dominance demonstrated in practice
9	Absolute importance	The evidence favoring one activity over another is of the highest possible order of affirmation
2,4,6,8	Intermediate values between adjacent scale values	When compromise is needed

(Saaty: 1980)

The other task intrinsic to the AHP is the synthesis of the judgments throughout the hierarchy and computation of the overall priorities of the alternatives with respect to the major objective. As Saaty and Kerns stated it "priorities are synthesized from the second level down by multiplying the local priority (matrix cell value) by the priority of their corresponding criterion in the level above and adding them for each element in a level according to the criteria it affect" (1985: 34). The pair-wise comparison is simply the assignment of comparative value according to Table 5.14 in a respective matrix cells.

Fig 5.6: The Model for Preference Assessment (Analytical Hierarchy Process)



5.6.1 The AHP Levels

Design of a hierarchical model to address a decision -making problem was relatively easy compared to the process involved in conceptualizing the entire model with the people. It was essential that this problem be properly addressed before drawing the hierarchy model. Thus, there was more art involved in this process than science. However, relevant reference was essential. The literature survey resulted that there are hardly any hierarchical models available in the water resource sector (Bhattarai: 1997). This study is perhaps a new avenue that AHP has ventured (See AHP newsgroup AHP@hermes.circ.gwu.edu or http:// www.expertchoice.com).

The Objectives

The objective for this study is primarily concerned with the identification of the most appropriate WRM approach in the small watershed area by synthesizing the priority response given by the major stakeholder groups. It aimed to identify the most suitable implementation modality in WRM.

The Actors

The second level in the hierarchical model constitutes various actors having direct influences in the decision-making and management but conflicting preferences. For simplicity, the same actor groups identified for the attitudinal analysis were used in the study. Box 5.5 provides a general description of actor groups and the justification for their selection.

Main factors and Sub-factors

The third and fourth level of the model contains the activities that are essential in WRM. The factors are the rephrased statements based on the Dublin principles. Box 5.15 summarizes the factors and sub-factors according to their objective functions.

Development Alternatives

In the last and fifth node of the model, three alternatives identified through participatory analysis are provided. The essence of the new choice is to identify, whether the water resource planning should continue as it is now, the users should take a greater control of the water resource in the area, or the government should take a greater control.

Box 5.15: Factors, Sub-Factors, Statement Objectives, and Objective Functions			
Factor	**Sub-factor**	**Program objectives**	**Objective Function**
Finiteness of Water	Water Quality	To improve the quality of water or measures to restore it in the area	Maximize
	Water quantity	To increase the total quantity available of water both by improving access and increasing supply	Increase Availability
	Technical Suitability	To improve the suitability of the package that the farmers can handle easily	More appropriate
Participatory Approach and Users' Involvement	Political Suitability	To design with least political interference	Maximize
	Equal opportunity	To increase the opportunity to plan, manage and use	Maximize
	Equal Access	To increase the access to the fare share and also in the local level planning	Maximize
	Conflict	To reduce conflict	Minimize
	Significance	To increase the image of watershed, better recognition at the district level bureaucracy	Maximize
Women's Role	Empowerment	To provide more power to women through educational measures, training etc.	Maximize
	Access	To improve access of women in planning, water use, implementation	Maximize
	Responsibility	To provide women with more responsibility	Maximize
Economic Value of Water	Ability to pay	To implement program by duly understanding the ability to pay, enforce progressive charge	Maximize
	Willingness to pay	To proper scrutiny of who are willing to pay implementing programs based on nonsubstractability and nonexcludability	Maximize
	Assessment	To institute a process that can better assess who needs to pay how much and how much modality may be slowly introduced	Maximize

5.6.2 The Steps Involved in Preference Analysis

The specific activities performed to assess preferences are provided in the bulleted list below.

- In order to seek the consent of the actors before the design of the hierarchical goal for preference assessment, it was duly shared.
- A few volunteers were requested from among the actor groups. Extensive discussions were held with the volunteers of the actor groups to identify the goal and major alternatives for WRM in the area (Box: 5.15). The goal (what is the final aim) and alternatives (what are the best approaches to realize the goal) were quickly

derived because there are similar approaches being proposed and implemented in the area (DANIDA: 1996). Similarly, the goal and alternatives were critically analyzed to coincided with the national goal and broad policy framework of WRM in the country. This consideration was needed primarily to make the assessment process and its outcomes compatible to the national water resource policies.

- The subsequent step was to identify factors and sub-factors that were in conformity with the Dublin Principles. This was performed by enlisting all projects and activities planned by the Ministry of Water Resources in the country's Ninth Plan. The concise list was then grouped under the four principles of Dublin. From the other end, the selected members of the actor groups were asked to prepare a list of the major programs and activities that the people wanted to have them implemented in the area. The two lists were then collectively processed to delete the repetitions. Another round of meeting narrowed the list into single sub-factors. The sub-factors were then renamed and put under the factor. While doing so, distinct relationships between factors and sub-factors were properly evaluated. Considering this ,the hierarchical tree was prepared (Fig. 5.4)
- A pair-wise comparison questionnaire was prepared.
- An actor group meeting was called to pretest the pair-wise comparison questionnaire. This venue was also used to explain the relative comparison scores. The process was later observed as very difficult in a few actor groups. This necessitated the development of a new technique for questionnaire administration. Finally, it was decided to use a pie-diagram (provided in Expert Choice Software 9.5). This technique is also in conformity with the methodology of PRA.
- As not all respondents were present at the meeting, this required making individual explanation to all respondents prior to the administration of the questionnaire.
- As an extra precaution, the questionnaires were reintroduced to the same respondents at an interval of two weeks.
- Some judgment validation was considered appropriate, which was done by readministrating questions.

5.6.3 Processing and Reporting

The processing of completed questionnaire and the pie charts was done by using Excel and Expert Choice Pro 9.5 for windows (Box: 5. 16). An Excel Macro using visual basic was developed to analyze the individual information. The individual preference scores were then bulked separately for each actor group using the geometric mean. The calculated values of geometric means for all actors were linked to Expert Choice 9.5 and a detailed analysis was performed separately for individual judgment, actor groups' preferences of factors and sub-factors, and analysis of the most preferred approach to WRM. Toward this end, a sensitivity analysis was performed by changing the weight or influence of key actors.

Box 5.16: Expert Choice Software

Expert Choice software is a multi-criteria decision support tool based on the Analytic Hierarchy Process (AHP). The AHP is a powerful and comprehensive methodology for making decisions using both measured data and judgments from the decision maker(s).

It offers a systematic framework where the elements of the problem in a hierarchy, judgments, and derived priorities for action can be entered. It allows breaking down of a decision into smaller parts, proceeding from the goal to criteria to sub-criteria and so on down to the alternatives of action. In making the judgments the elements of the problem are looked at in isolation: one element compared against another with respect to a parent element. Simple pair-wise comparison judgments throughout the hierarchy then allow to derive the priorities of the elements. Expert Choice then synthesizes all the judgments into a unified whole in which the group alternatives are clearly prioritized from best to worst.

(Modified After Expert Choice Review: 1998)

5.7 Conclusion

The iterative process adopted in the research design was based on the integration of the hard and soft sciences (Box 5.1). It was based on PRA, participant observation, Likert analysis and AHP based analysis. The overall data collection and analysis then became as provided in the list below:

Box 5.17: Data Collection and Analysis Schema

Overall Goal: **WRM must be sustainable and satisfies all the principle and sub-principle criteria to benefit population.**

Principle I: **Fresh Water is a finite and vulnerable resource, essential to sustain life, development, and the environment**

a) Actions (demonstrated through both real practice and awareness):
   - i) Aware about, and care about to the water resource set-up in the area
   - ii) Use of efficient practices
   - iii) Adjustment with the fluctuation in water quantity,
   - iv) Regards to other resources when using water
   - v) Activity carried out to improve the water Quality

b) Attitudes (based on the inclination):
   - i) Water is the center to all resources and, in that, its availability depends on the resource structure necessitating that the unsubstitutability of water is duly realized.
   - ii) Quality of water affects the total availability and, in that, it must be recognized that if deteriorated it is only partly reversible.
   - iii) Finiteness of water is not technologically dependent but, on the appropriate technology that the immediate users can locally manage, necessitating that the limits to technology are duly realized.

c) Preference (demonstrated through the relative importance of activities on):
   - i) Water Quality

ii) Water Quantity

iii) Technical Suitability

Principle II Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels

a) Actions (demonstrated through both real practice and awareness):

i) Collective works done

ii) Involvement in the present planning structure

iii) Involvement in the present budget preparation structure

iv) Legal responsibilities followed

v) Right to water is duly followed and shown appreciation to others' rights.

b) Attitudes (based on the inclination):

i) Knowledge about the current planning structure is uniformly available to all and, in that, all have been given an equal opportunity to contribute

ii) Continuous participation is key to the success of WRM programs.

iii) Equity and transparency, especially for cost sharing and allocating access, are adequately maintained in all WRM initiatives.

c) Preference (demonstrated through the relative importance of activities on):

i) Political Suitability

ii) Equal Access

iii) Equal Opportunity

iv) Conflict

v) Significance

Principle: III Women play a central part in the provision, management, and safeguarding of water

a) Actions (demonstrated through both real practice and awareness):

i) Due consideration to the time devoted by women in collecting water

ii) Degree of help given to the women

iii) Women allowed participating in WRM initiatives

iv) Women's participation in training and other activities and comparison with men

v) Comparison between two water projects constructed by male and female group (efficiency, cleanliness, system performance, and upkeep)

b) Attitudes (based on the inclination toward):

i) Realization that women are being over-burdened in terms of water resources use and management.

ii) Women should have equal access in Decision Making and Planning and should receive greater responsibilities in WRM.

iii) Empowering women to participate in all levels of water resources programs.

c) Preference (demonstrated through the relative importance of activities on):

i) More Responsibility to Women

ii) Empowerment of Women

iii) Giving more Access to Women

Principle IV Water has an economic value in all its competing uses and should be recognized as an economic good

a) Actions (demonstrated through both real practice and awareness):

i) Realization of wage and opportunity lost (total number and their causes)

ii) Investment in water resource development

iii) Contribution in WRM

iv) Personal initiative

v) Appreciation and value of time saved by using different practices

vi) Use of water for productive purposes

b) Attitudes (based on the inclination):

i) Water must be treated as an economic good having an economic value.

ii) Equity in distribution and cost sharing is essential and, in that, a participatory mode of assessment of true value of water and contribution is essential.

iii) Progressive system of cost sharing based on the amount of use and total waste disposal is essential.

c) Preference (demonstrated through the relative importance of activities on):

i) Willingness to Pay

ii) Ability to pay

iii) Need for Better Assessment

PART II

The Case Study, Syntheses and Conclusions

CHAPTER SIX

GERKHU KHOLA WATERSHED: THE STUDY AREA

'Any ecosystems no matter how resilient, can be pushed to a 'point of no return' or more exactly, to a threshold beyond which limiting factors become so severely operative that recovery, in periods meaningful in the human time scale, becomes impossible.' (Raymond et al.: 1973:48)

6.1 Background

This research selected a small watershed (definition provided in Chapter 1), *Gerkhu Khola* in the middle hills of Nepal Himalaya. The researcher's familiarity of the area and its relative nearness to Kathmandu were important bases for selecting the are for detailed study.

6.1.1 Objectives of the Chapter

This chapter introduces the area where this research was conducted. The chapter summarizes the social, economic and environmental setting of the studied watershed; and critically examines the organizational and institutional setup and their interactions with the people living in the watershed. The main objectives of this chapter are as follows:

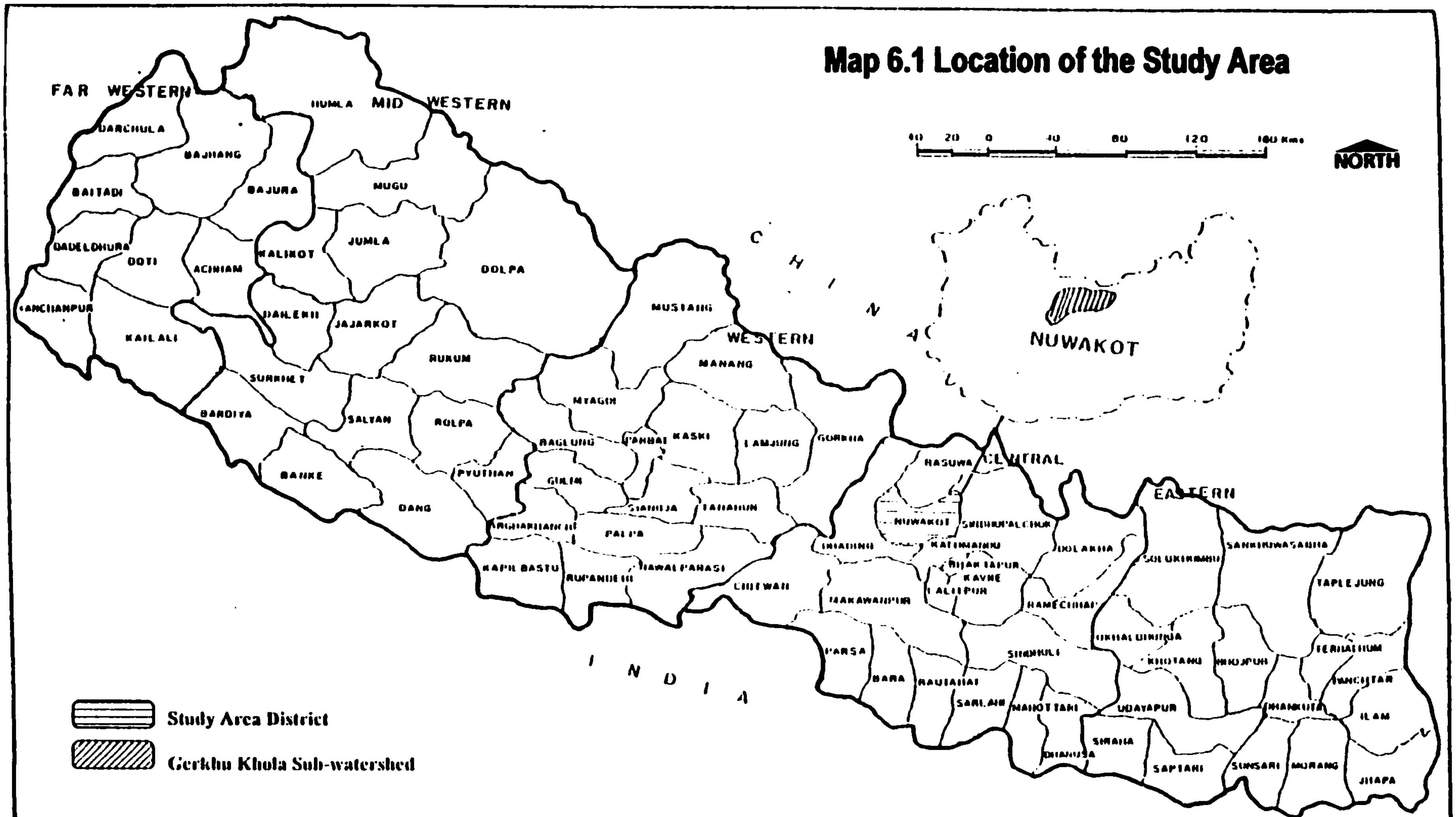
- to introduce the demographic structure and socioeconomic setup of Gerkhu Khola Watershed
- to introduce the established organizations and institutions in the area
- to briefly describe the level of development in the watershed
- to introduce the general setting of the problems.

6.2 Physical Setting

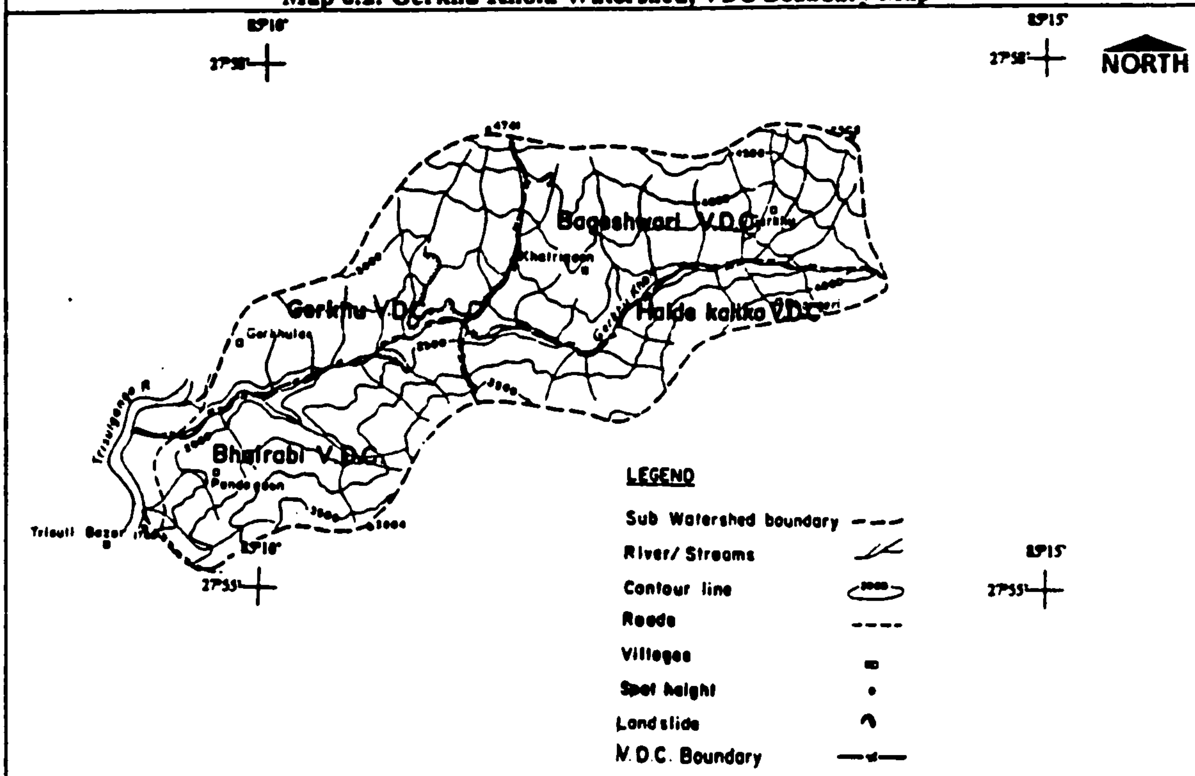
Gerkhu Khola Watershed is a small watershed situated in Nuwakot District, approximately 90-100 km northwest of Kathmandu (Map 6.1). The selected watershed is spread over an area of about 19.11 sq. km, which is approximately 1/60 part of the total area of Nuwakot district (LRMP: 1984, Field Verification: 1995). The area is located 3.7-km northeast of Trishuli Bazaar and 10 km from the District Headquarter, Bidur.

Administratively, the area extends north-south in the Central Developmental Region. Physiographically, the area is situated in the middle Himalaya (Lesser Himalayas). Geographical coordinates of the small watershed are between 27°55' to 27° 57' latitude and 85°9' to 85° 14' longitude. The area is bordered by Fhalangu watershed in the North, Chokade Danda, and Bageswori VDC in the East and South, and Trishuli River in the West (Map 6.2).

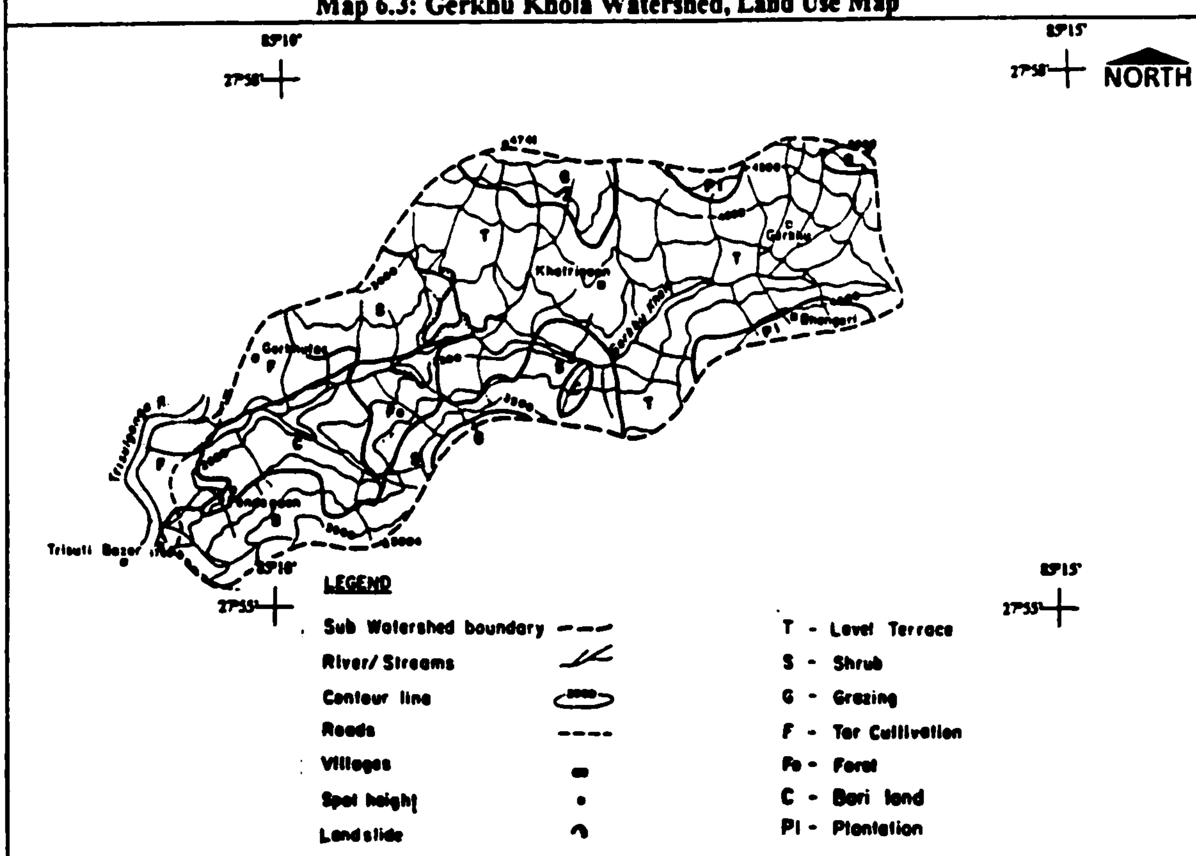
Map 6.1 Location of the Study Area



Map 6.2: Gerkhu Khola Watershed, VDC Boundary Map

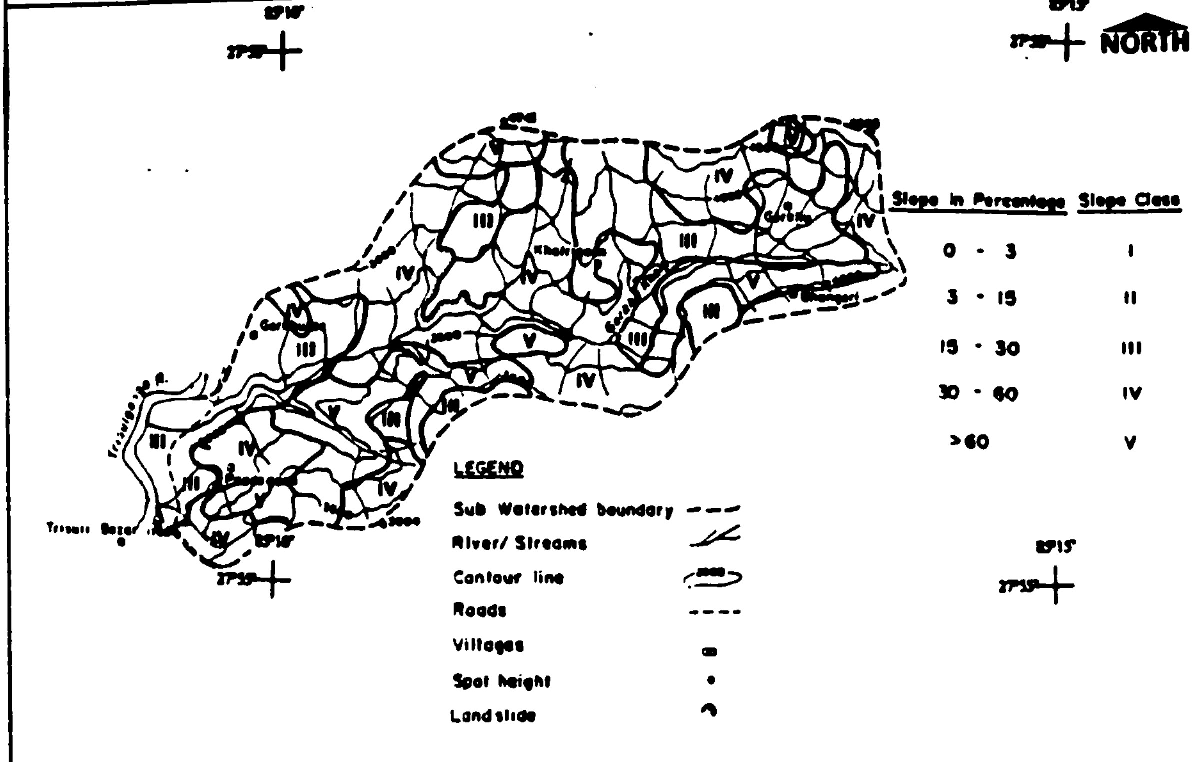


Map 6.3: Gerkhu Khola Watershed, Land Use Map

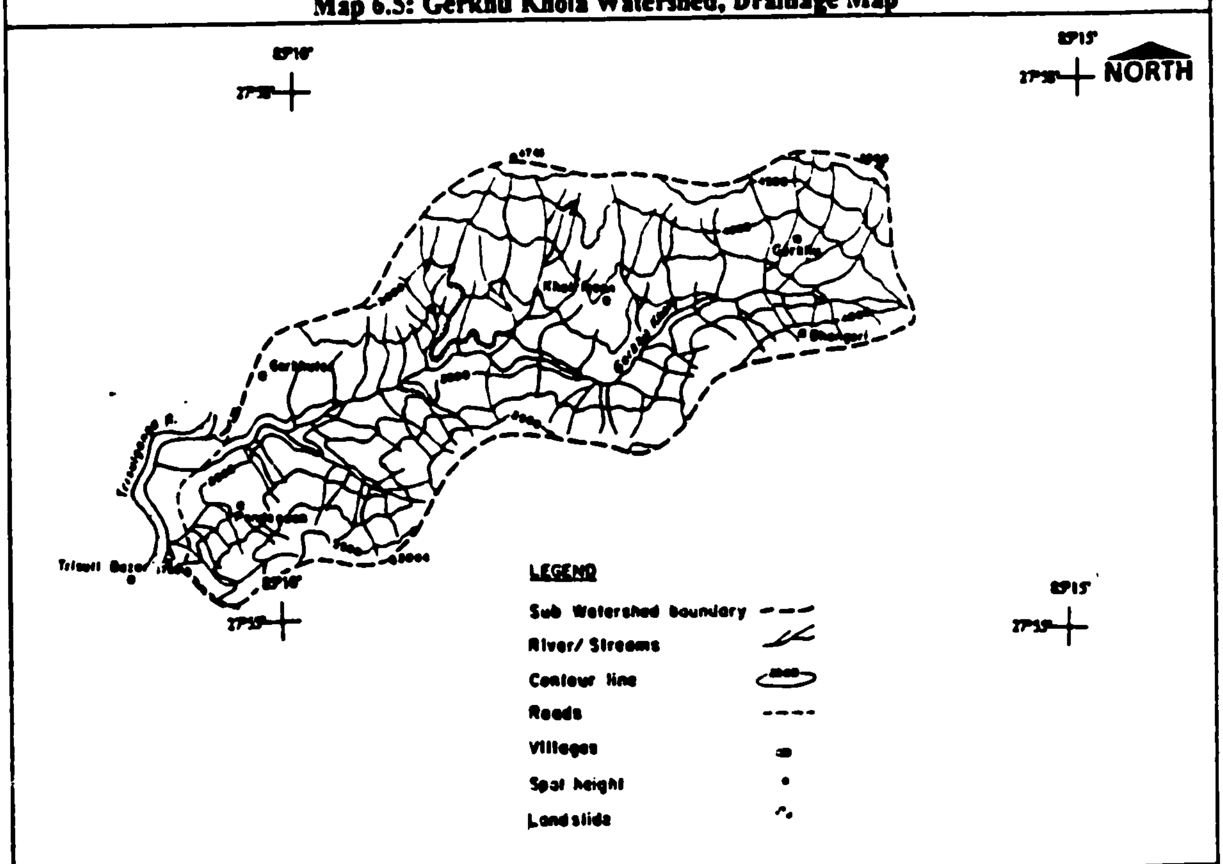


Source: Ministry of Forest and Soil Conservation: 1997

Map 6.4: Gerkhu Khola Watershed, Slope Map

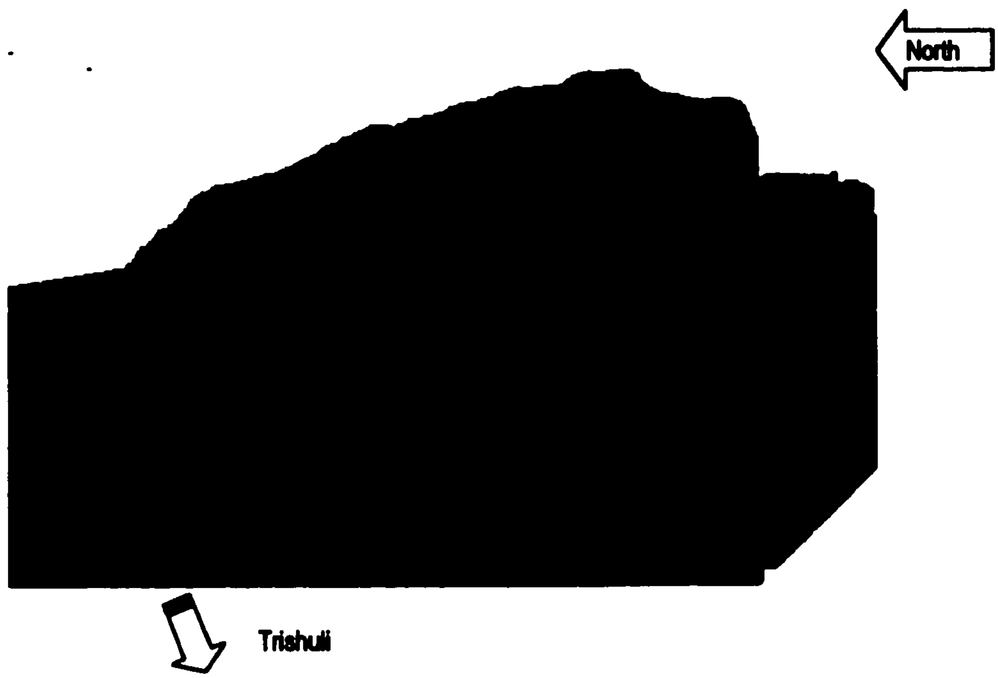


Map 6.5: Gerkhu Khola Watershed, Drainage Map



Source: Ministry of Forest and Soil Conservation: 1997

Map 6.6: Digital Elevation map: Gerkhu Khola Sub-watershed



View from the Headworks of Trishuli Hydropower Project (Colony)

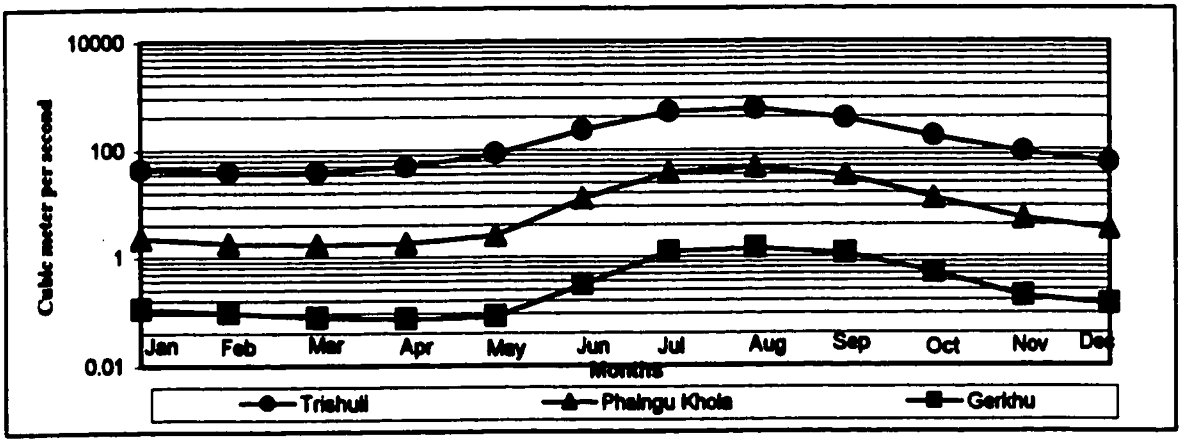
View From Tupche (Kaule) Danda

The elevation of the area extends from 535 to 1678 meters. The lowest point is at the snout of Gerkhu Khola, which is also the southwestern end of the watershed. The highest point separates the watershed with Fhalangu Watershed. The complicated topographical features of the small watershed area are presented with the help of a digital elevation model (DEM) (Map 6.6)

6.2.1 River System

Gerkhu Khola watershed area is identified with reference to three rivers – the Trishuli, Fhalangu, and Gerkhu Khola. All rivers have distinctive socioeconomic importance to the community. The Gerkhu Khola and Fhalangu are small rivers and they feed into the Trishuli, which is a major tributary to Narayani River system (Sharma: 1972). Figure 6.1 provides comparative discharge data for the three rivers (DHM: 1993).

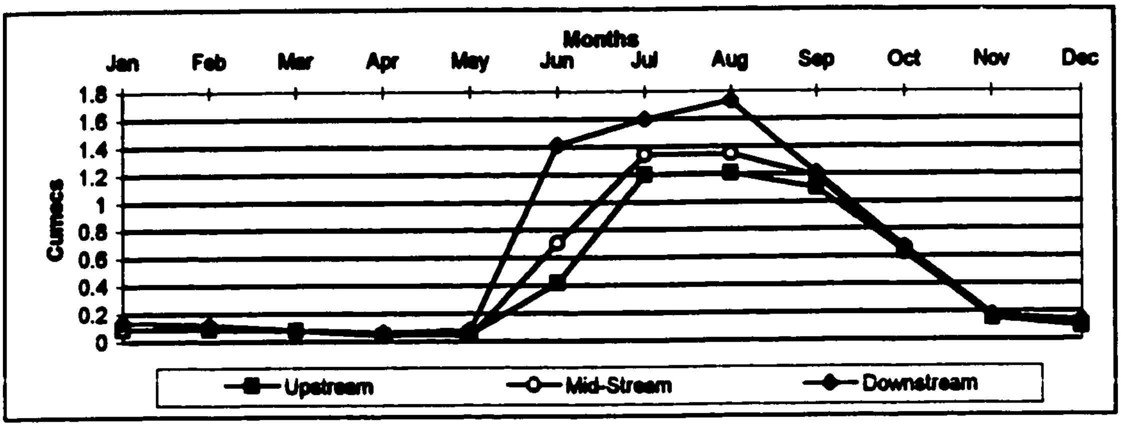
Fig. 6.1: Mean Monthly Discharge of Major Rivers 1971-1996



Source: DHM: 1993

The Gerkhu River originates in ward-number 7 of Bageswori VDC. The mean monthly discharge as recorded during the fieldwork, for upstream, mid-stream and downstream reaches of Gerkhu Khola is shown in figure 6.2 (Field Survey: 1995-7).Fhalangu watershed area borders Gerkhu Watershed to the North. The Trishuli originates as Langtang River from a glacier in Langtang Himal at the Sino-Nepal border. This river flows 41 miles along the East to west drop of Langtang Himal before joining with Bhote Khola at Syabrubesi (Sharma: 1972). The river then flows southwards and joins with Trishuli Khola originating from Gosain Kunda at Betrawati before entering the Nuwakot district. The sub-basin area under study is situated along the southwestward sloping stretch in Nuwakot District.

Fig. 6.2: Gerkhu Khola Watershed: Discharge Measurement Data



Source: Field Survey: 1995-7.

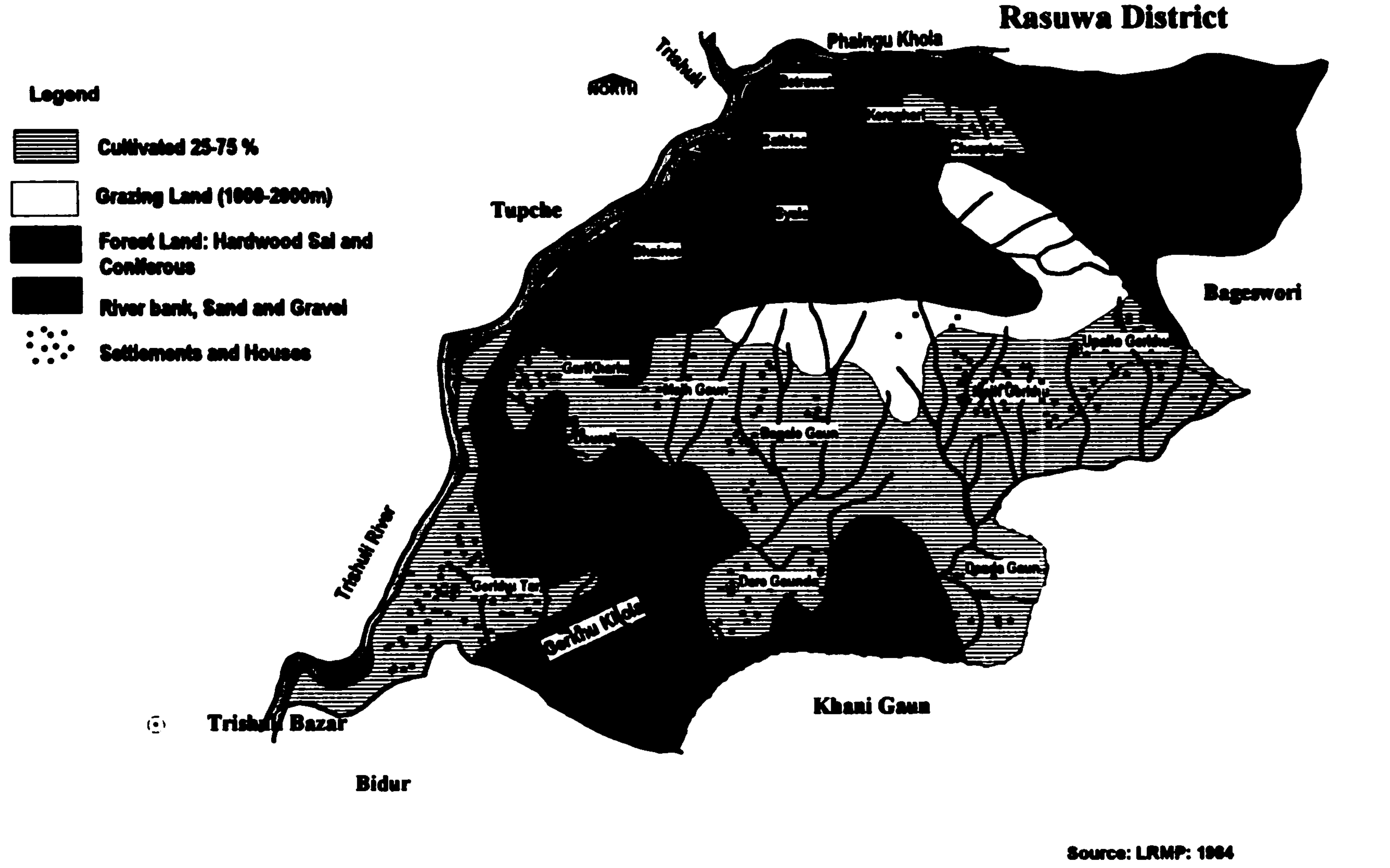
Table 6.1: Slope Class of Gerkhu Khola Watershed

Slope Class	Slope %	Area (ha)	Coverage %
I	0-3	-	-
II	3-15	-	-
III	15-30	600	31.4
IV	30-60	918	48.0
V	> 60	393	20.6
Total		1911	100

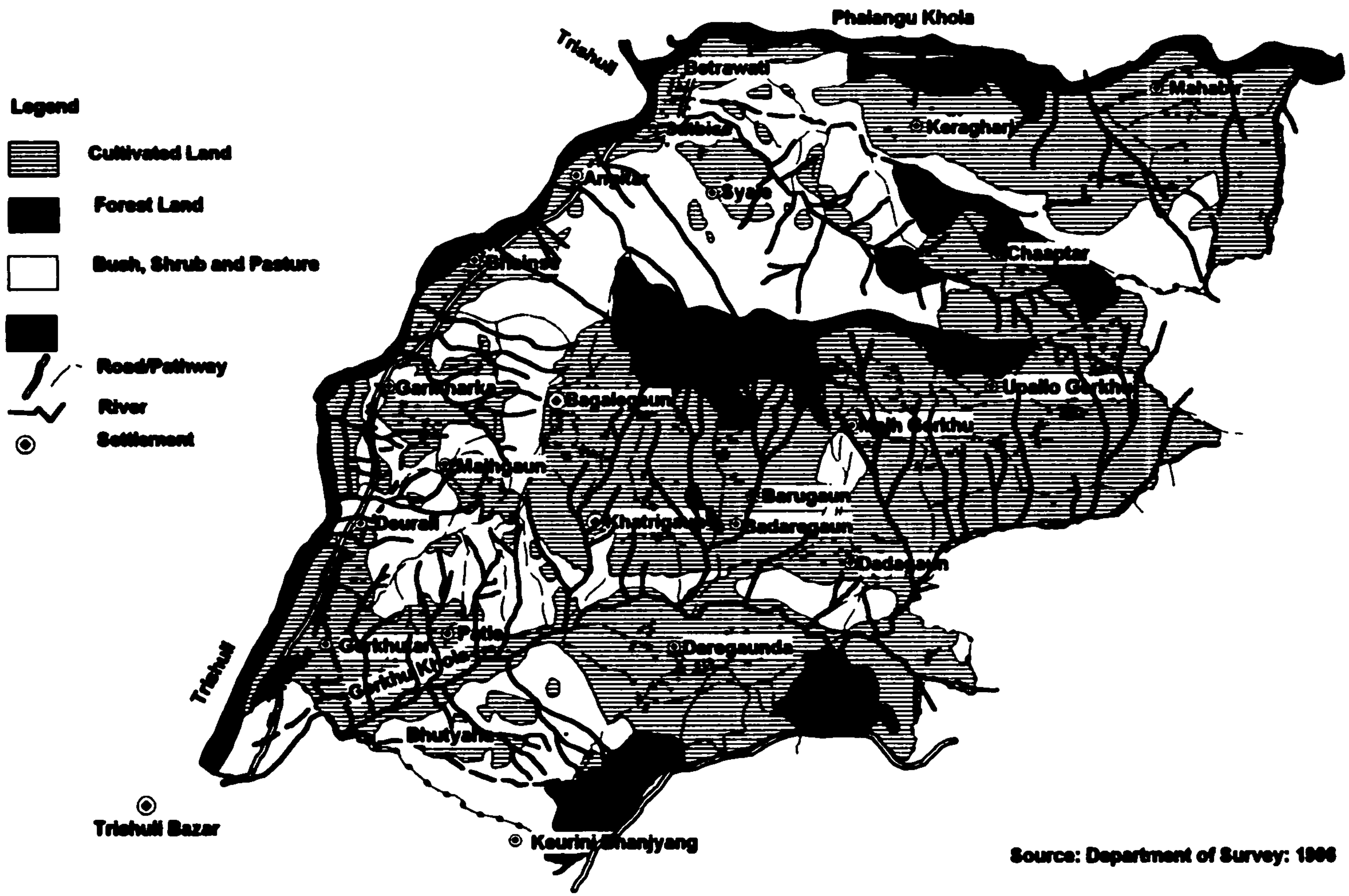
Ref: Map 6.4, Source: Ministry of Survey: 1997

Five minor rivulets, Ghatte Khola, Betang Khola, Dhobi Khola, Guhe Khola and Kapre Khola, drain the watershed. They are. The drainage density of the area is over 90 percent (Map 6.5). In the upstream areas, Gerkhu Khola flows in a small gully. However, in the middle and downstream area flood plains can be seen. The average width of flood plain is 20-40 meters, however, at certain areas, especially toward the southern end of the watershed, it is over 160 meters (Field Observation: 1995-7). Across the flood plains, the river appears randomly braided and meandering. The alluvial deposit along the river is extensively cultivated. The landscape of the small watershed grades from barren mountains with little or no top soils in the North to generally lower-altitude but high relief terraces southwards. However, the landscape around the Gerkhu Khola does not change much. The local relief throughout the region is high, and slopes all across the small watershed are over 10-25° (Field Observation: 1995-7). About 20 percent of the total watershed area has 15 percent slope (Map 6.4, Table 6.1). The rest of the area is steep to very steep sloping with narrow terraces built for cultivation or for grazing.

Map 6.7: Landuse Map of Gerkhu: 1984



Map 6.8: Land Use Map of Gerkhu: 1996

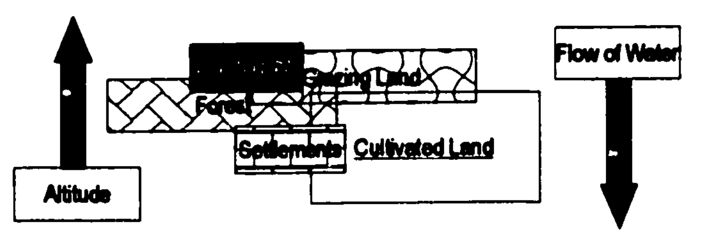


Source: Department of Survey: 1996

6.3 Climate

Even within a small area of 19.11 sq. km, the climate in the watershed area ranges from tropical to temperate, as the altitude increases toward the North. On the same day (May 27, 1996), the temperature varied by 13°c in two reference points less than 9-km apart (Pedometer Reading: 1996). While the temperature at Gerkhu Tar recorded 37°c, the temperature at Chokade Danda was 24°c. The annual temperature of the nearest two stations, Trishuli Aquaculture farm and Panchsaya Khola Sheep Farm at Bhalche, for 1971-1992, is 21°c (DHM: 1993). The mean annual temperature of the selected sub-basin varies from a low of 1.6° c in the north to a high of 28° c in the South (DHM: 1997). The researcher tried to produce first-hand data on temperature and rainfall but some of the equipment in one of the temporary stations was stolen, and the plan had to be abandoned.

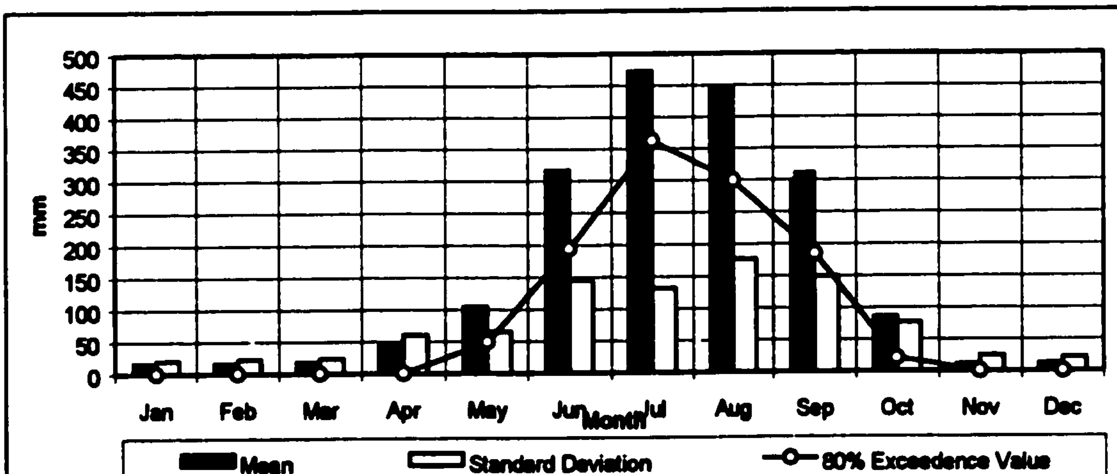
Fig. 6.3: Hydrological Relationship between the Landforms



Note: The dark colour signifies the precipitation in the form of snow. The arrows indicate altitude and direction of flow of water

(After Young, G. (1997) Invitee Lecturer Series, CRRC, WLU)

Fig 6.4: Mean, Standard Deviation, and Exceedence Limit of Precipitation (Gerkhu Khola)



Source: DHM: 1993

Annual precipitation in the selected sub-basin totals approximately 1850 - 1900 mm and the mean deviant is about 22 percent (DHM: 1997). In the North, the winter rain sometimes falls in the form of snow, but this trace amount does not contribute significantly to the total run-off (DHM: 1997). The figure 6.3presents that the area receives precipitation both in the form of rainfall and snow and there exists a distinct hydrological relationship between different landform in the area The distribution of rainfall varies in both temporal and spatial terms in the basin. About 75 percent of the total precipitation occur during the monsoon season in the small watershed.

6.3.1 Soil and Vegetation

The Gerkhu Khola lies within the meta-sediment zone (DANIDA: 1996), which is composed of thick sediment of limestone, quartzite, slate, sandstone and black and green phyllites (Ohta et al.: 1973). The area generally has a very low infiltration rate and the silt content of the soil is very high. Soil depths vary and the topsoil along the hills is relatively thinner. However, the deposits on the flood plains, according to the villagers, gain depth after every rainfall or flash flood. This implies that annual topsoil loss in the area is very high. A UBC/ICIMOD project in the Jhiku Khola, which is a neighboring small watershed, is currently developing a model of sediment transportation and top soil erosion, however, the findings of this project are neither comprehensible nor comparable to this small watershed conditions (Box: 4.1) (*http://www.idrc.org.sg/cbnrm/nepal/pantc.htm.*). Some of the hydrological variation, especially the total discharge and the usability of water are directly related to the topsoil loss (Participatory Estimates: 1995-7). The watershed community attributes the decline in the agricultural production to this phenomenon. However, during the fieldwork, spanning three seasons, *the researcher did not record any direct signs of human disturbance that could be related to the topsoil degradation.* The topsoil erosion, however, demonstrated a distinct effect on the shifting of the river. Visibly, the right-bank along the flow of the river expanded by 12 cm during 1995-7.

6.3.2 Landuse

Out of the total area in the selected sub-basin, 70 percent is under direct productive and residential use, which comprises approximately 80 percent cultivated and 20 per cent non-cultivated uses. The present population pressure, expressed as a ratio of people per hectare of cultivated land, is about 9:1 (Participatory Estimate: 1996). Similarly, 8 percent land is reported to be under forest (participatory Estimates: 1997). There has been a large-scale encroachment during the past by illegal settlers (Table 6.2).

MapInfo was used to analyze the landuse changes, in a part of the small watershed area, during 1984 and 1996. It is comparable from Maps 6.7 and 6.8 that there has been a significant change in the landuse practices. The most conspicuous change can be observed in the total area under natural forest. In the southwestern part of the watershed, some forest can be seen. The bush, pasture, and shrub patches can be seen at different places, which are the reminiscent of the forest area. The south-central area is covered with 10-20 percent of natural forest. Similarly, a few forest patches are emerging in the central area due to extensive reforestation and conservation efforts. Especially the crown density of the patch over Gerkhu Tar has increased by almost 30 percent. The rest of the forest pockets are semi-managed and produce perhaps half of their potential capacity. Cultivation and grazing are practiced on almost 50-75 percent of the land and, although there are a few small landslides, the catchment area is relatively stable with few gullies or visible landslides. The gullying is more common in grazing and terraced lands. Various ethno-ecological measures can be seen used to avoid such problems, but some of the ecological problems appear to need some external support. Water and land are the two resources available to the people in the watershed to embark on their development.

Table 6. 2: Landuse Pattern – Gerkhu Khola

Land Use	Area (ha)	Percentage
Khet Land (Lowland)	870	45.5
Bari Land (Upland)	174	9.1
Terrace Cultivation	131	6.9
Forest land	159	8.3
Shrubs	449	23.5
Grazing Land	128	6.7
Total	1911	100

Source: Participatory Estimate: 1996

6.4 Socioeconomic Setting[21]

6.4.1 Demographic Description

The total population of Gerkhu Khola is about 7176, which is divided in 1249 households (PDDP/UNDP: 1997). An analysis of 120 randomly sampled households revealed that the population is divided into 51.4 percent males and 48.7 percent females. Extrapolation of the district level statistics reveals that the annual rate of population growth during 1971 and 1981 was 2.9 percent per annum, while that for 1981 to 1991 was 0.9 percent (CBS: 1998). Joint family, sharing the same household, is one of the common characteristics of the area. Irrespective of the reaches, the total male population is higher than females. The average family size is reported to be 6-8 persons. A mild positive correlation is observed between the reaches of the Gerkhu flowing downstream and the size of the household.

People of varied ethnic background inhabit the area. The main ethnic groups living in the area are Brahmin and Kshetris, who also are the higher caste people. Tamang is the second largest ethnic group in the area. The occupational (scheduled) castes constitute 9 percent of the total residents in the small watershed. The population in the area differs slightly in terms of spoken language. Languages of both Tibetan and Indo-Aryan origin are spoken in the

[21] The Analysis presented here has been based upon the indicators of development as outlined by Adelman and Morris (1968).

area. However, due to the education system and increasing use of the Nepali language, the minor languages are slowly disappearing, although peculiar vernaculars and special accents still persist (Field Survey: 1995-7).

Table 6. 3:General Demographic Characteristics of Gerkhu Khola Watershed				
Particulars	**Upstream**	**Mid-stream**	**Downstream**	**Total (Average)**
Sampled Households	45	40	35	120
Total Population	302	308	277	887
Population Male	161 (53 %)	162 (52.5%)	142 (51%)	465 (52.4)
Population Female	141 (47%)	146 (47.5 %)	135 (49 %)	422 (47.6)
Average HH* size	6.71	7.40	7.90	(7.39)
Ethnic Group (Percentage of Population)				
Brahmins/Kshetris	32	27	24	(70)
Tamangs	7	10	6	(19.3)
Occupational Caste	4	3	4	(9.2)
Others#	2	-	1	(2.5)

Source: Participatory Estimates: 1995-7, * Household, # Giri, Shrestha, Awasthi etc (Figures in parentheses are %)

Sixty-seven percent of the people in the small watershed are within the economically active age group. The economic active group has been defined as people belonging to age group 11-60, assuming that this group economically contribute toward the total household income. About 74 percent of the economically active population are engaged in agriculture. The figures for involvement in off-farm activities and unemployment are positively correlated along the southwestern slope (Table 6.4). Lack of other employment opportunities in the area is evident. Due to a mounting work force per hectare of arable land, underemployment or disguised unemployment is widespread phenomena. The educated population in the small watershed is also affected by the problems of underemployment and unemployment. Due to the unavailability of job opportunities and the degradation of productive assets, large-scale short or longer-term migration (1-2 per household) is reported among the youths to Kathmandu and other productive areas in the country. It is observed that more than one person per household migrated for short or longer-term. Stagnated economic activity was cited as the main reason for such migration. However, education and medical treatment were also reported as main reasons for migration (Participatory Estimates: 1995-7).

Table 6. 4: Population Characteristics in Gerkhu Khola Watershed				
Particular	**Upstream**	**Midstream**	**Downstream**	**Total**
Economically Active Population Percentage	62	71	66	67
% Eco Active Population. Engaged in Agriculture	82	75	62	74
% Pop. Engaged in Off-farm Employment	5	11	20	15
% Total Unemployment of Economically Active Population	13	14	18	16

Source: Participatory Estimates: 1995-7

Considering the suggestion given by the villagers, the level of literacy is counted only for the persons over 5 years. Similarly, individuals who could not read or write in the local language are categorized as illiterate. Out of the total, 32 percent of the population is illiterate, constituting 23 percent male and 77 percent female (Table: 6.5).

Table 6. 5: Educational Status in Gerkhu Khola		
Particular	**Male %**	**Female %**
Illiterate	23	77
General literate	44	17
High-School	20	4
Above High-School	3	2

Source: Participatory Estimates: 1995-7

6.4.2 Land Holding

The local economy is almost exclusively based on agriculture, which employs more than 65 percent of the households in the sub-basin (Participatory Estimates: 1995-7). Inequality in income is pervasive; the Gini coefficient – as measure of disparity – is 0.42 (PDDP/UNDP: 1997). The distribution of land holding is more skewed and the Gini coefficient of this variable was 0.51 (APROSC: 1994). The distribution of land in the selected watershed (Table 6.6), however, is less skewed than the district figures (Participatory Estimates: 1995-7).

Fig 6.5: Land Ownership by Type of Land

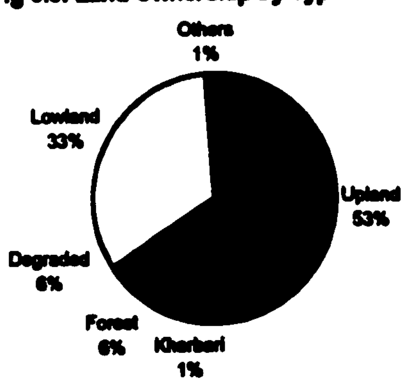


Table 6. 6: Land Holding		
Categories	Ownership ha.	% Population
Land less	0	2
Small	0.01 - 0.5	40
Medium	0.5 - 1.0	37
Large	1.0 - 5.0	19
	> 5.0	2

(Participatory Estimates: 1995-7)

The average holding in the area is 0.95 hectare per household. The average land holding for upstream, midstream and downstream areas is 0.96, 0.94, and 0.92 ha, respectively. There is no significant difference between the land ownership in different reaches of the rivers. However, the ownership by lowland and upland varies along the river slope. From upstream to downstream, the percentage of lowland in the total holding increases gradually, and it decreases for the upland case. The renting out of land is significantly higher in the lower reaches when compared to the upstream areas. However, the recent policy adopted by the government, which recognizes "the tiller of land as owner" has put this variable into the category of sensitive information. It was reported in the group discussion that about 33 percent of the land in the downstream area is rented out. It was also observed that most of the renting-in farmers were from the upstream areas.

Land sharing among sons through inheritance adversely affects the production process in the area. Terrace farming is a common feature in the study area, and holding is divided into small parcels. Along the riverbank, however, the land extends in an extensively cultivated, single long southwestward sloping stretch. It was also reported that the farm size of the people living in the downstream area is gradually diminishing, while that of the people living in the upstream area is increasing. Such increase and/or decrease are reported by as much as 42 percent of the households (Participatory Estimates: 1995-7). The appreciation in the land value, disintegration of joint family, availability of water and off-farm income opportunities, etc., are cited as the main reasons for selling or buying land. Similarly, the increased economic activities in the downstream area have downgraded agriculture as less profitable option.

6.4.3 Agriculture

The cropping intensity (CI) of the area is 182. CI is a measure of the extent of land utilization and it is calculated as the ratio of area of land in crops to total area of agricultural land times 100 (APROSC/JMA: 1995). If a farmer transplants paddy in entire area and wheat in ¾ of his holding and keeps the rest of the land as fallow, the CI would be 1.75/1 *100 = 175. It was, however, observed that in some parts of the area having assured irrigation, normally developed and operated by an individual or a group of farmers that the cropping intensity can be increased to up to 300 (Participatory Estimates: 1995-7). The yield rates are moderate in comparison to the average yield rates in similar terrain elsewhere.

Table 6.7: Crop Rotations in the Area		
No of Crops	**Low land**	**Upland**
1	Paddy – Fallow	Barley – Fallow, Potato – Fallow, Millet – Fallow, Maize/Soya
2	Paddy-Fallow-Paddy, Paddy-Wheat-Fallow, Paddy-Fallow-Maize, Upland Paddy –Mustard	Maize-Millet-Fallow, Maize-Pulses-Fallow, Maize-Oilseed-Fallow, Upland Paddy-Pulses-Fallow, Upland Paddy-Oilseed-Fallow, Upland Paddy-Maize-Fallow
3	Potato-Maize-Paddy Wheat-Paddy-Early Paddy Wheat-Maize-Paddy	Maize-Millet-Potato (homestead area) Upland Paddy -wheat-maize

Source: Field Survey: 1995-7

6.4.4 Livestock

Livestock is an indispensable component of the sub-basin ecosystem. The livestock inventory in the watershed area is provided in table 6.8. The grazing density of the area for the entire small watershed is about 10 livestock units[22] per hectare of grazing land. Most households let their livestock free-range. The area around the water sources is normally used as grazing land.

Table 6. 8: Average Number of Livestock Holding									
Livestock	Upstream		Midstream		Downstream		Watershed		Total
Breed	Local	Improved	Local	Improved	Local	Improved	Local	Improved	Livestock
Cattle	2.30	...	2.53	0.06	3.08	...	2.54	...	2.59
Buffalo	2.30	-	1.78	0.29	1.45	0.52	2.01	...	2.25
Goat	2.76	...	2.23	0.06	1.78	...	2.30	...	2.35
Pig	...	-	...	...	-	-	...	...	...
Total	7.66	...	6.62	0.51	6.31	0.62	6.92	...	7.27

Source: Participatory Estimates: 1995-7, The figures are number of heads.

6.4.5 Urbanization and Industrialization

The extent of urbanization is slow, as within the two neighboring districts only one officially recognized urban area exists. Similarly, the extent of industrialization is also very slow. However, the hydropower project and increasing tourism along the north-south corridor have attracted a few manufacturing industries at the district headquarters and

[22] ONE LU is equivalent to 0.9 buffalo, 0.8 cow and 0.4 sheep or goat (APROSC: 1994)

along the Kathmandu-Rasuwa highway. The entrepreneurship development program of the government agencies and NGOs appear to make some notable efforts, yet these do not yield the desired results as proper financing and support services are inadequate. However, a sizable proportion of the community depends on off-farm employment.

Telecommunications facilities exist only in Betrawati and Bidur-Trishuli areas. As the electrical-line runs along the highway, the electrification is limited to this "ribbon" area. Despite nearness to the Trishuli-Devighat Hydroelectricity project, electricity is available only to 40 percent of the people living in the watershed area.

6.4.6 Social Indicators

The small watershed is characterized by a vast social and cultural pluralism. The houses of the lower caste people are normally found on outskirts of villages. These people are very difficult to be persuaded to be involved in any developmental work. Even in this study, the representation of people belonging to this caste group is negligible. These people have very low social-esteem, a high intolerance, and an apathetic outlook for outsiders, but a strong sense of allegiance to the people living in the villages. Often the participation of these people depended on the voice of their so-called masters. Despite several attempts, the study could only involve three people belonging to this group in small-farmers and off-farm workers' category. The local apprenticeship of blacksmiths and cobblers go by children learning from parents within the caste-bound customary roles.

Because of the population concentration in the lower area of the small watershed, the education facilities are also established in this area. There are two colleges located within a few hours of walk from the area. Besides, there are 3 higher-secondary schools and 10 other categories of schools present in or in the walking distance of the small watershed. Although the summary of the education facilities and proximity to Kathmandu provide a positive impression, the bulk of the local population is illiterate.

There is one basic health service unit within the watershed area. However, the majority preferred to go to Trishuli Bazaar to receive health services. The crude fertility rate of the area stood at 4.3 per cent during 1981; however, as the out-migration is very high the real population growth rate is 2.9 percent per annum (Participatory Estimates: 1995-7).

6.5 Institutions and Organizations

This section elaborates on the characteristics and functions of existing institutions and organizations.

6.5.1 Locally Evolved Institutions

Although people reported the existence of many local institutions, functioning almost entirely through internal command with limited external demand, most of them are either no longer in operation or are slowly being abandoned. The institutions which were abandoned and having a distinctive relationship with WRM in the area included: Mana-Pathi Satne system (traditional barter system of labor, water and other resources abandoned due to the integration of the local economy with the national economy), and Panch system (local arbitration system on water resources and other disputes abandoned due to the political influence in arbitration). However, there are still some locally evolved institutions operating in the area.

6.5.1.1 Perma System

The Perma System is an institutionalized exchange of labor among villagers to meet their requirements during the peak season, thus easing shortage of labor. This practice follows a mutual agreement based on a definite rotation according to the moisture content of the soil and other cultivation activities. In the local language, this process is referred as "Jatra Jane or Mela Jane." This practice is also used for canal maintenance and for voluntary labor contribution to make water-related structures. Men, women, and children all participate in Jatra or Mela. Such gatherings are also used for social purposes, and to take important community-related decision. Participation in Perma is less common among members of higher social status. These households often employ lower income families as wage labourers or keep Hali. This is characterized by a unique patron-client relationship existing within the society. While the lower income group receives wages for their work, the decisions– despite being taken in the absence of the higher income group – often favor the higher income households (Participatory Estimates: 1995-7). However, this practice is slowly being abandoned in the area. The large farmers are little affected by this, but the small farmers suffer serious labor shortage during the peak seasons.

6.5.1.2 Aama Samuha (Mothers' Organization)

It is group of women within the watershed united together for the development of the village. The group is currently active in forest management, water, health, and sanitation. The group is also observed to be focusing on the gambling and drinking problems within the watershed area. They have filed a petition with the District Office and are willing to make the small watershed area liquor and gambling free (Field Survey: 1995-7).

6.5.2 Local Institutions with Some degree of External Supports

These are locally evolved institutions, which have now been integrated with the external systems. Some of these still operate as traditional institutions.

6.5.2.1 Water Users' Association (WUA)

There are six formal and informal WUAs in the Gerkhu Khola Watershed. Five of these were formed on behest of the government and NGOs when drinking water or irrigation systems were proposed or built in the area. The sixth one is locally evolved (Field Survey: 1995-7). Currently, only three of them are in operation. One of them was recently formed and it is entirely represented by women. The recently formed committee has prepared a written set of rules to operate their system. Other committees function without any written agenda. (Field Survey: 1995-7). WUAs ensure that the drinking water systems are functioning properly, and arbitrate small water use conflicts occurring in the area.

Similarly, during paddy season, farmers get together and, as a group, collectively tap Gerkhu Khola for irrigation purposes. These groups cease to operate when the irrigation is no longer required or immediately after the monsoon begins. These informal groups also help solve disputes among the group members. Apart from arbitration in such conflicts, these also regulate the use of irrigation water among the users. These groups are informal and lack any written form of agenda for operation. The efforts are underway to assign some of the canal maintenance work to a local NGO. The NGO will be responsible for coordination and supervision of such works.

6.5.2.2 Conservation/Consumer Societies

Conservation/Consumer Societies conserve natural resources through local participation. Its function is to ease government dependency in forest, water, and watershed conservation. Recently, DANIDA has initiated a watershed management program in the area and they plan to create community development committees to implement various watershed management activities (DANIDA: 1997). There are a total of six community forestry groups with over five hundred members in the watershed area. The total area of forest handed over to the farmers adds up to 280 hectares (District Forestry Office, Nuwakot 1996).

6.5.3 External Organizations

The existing organizations are operated and managed by the outsiders with limited or sometimes no participation of the local community. These may or may not be situated within the small watershed boundary, but assume a distinct role in WRM within Gerkhu Khola.

6.5.3.1 General

As the selected watershed falls within the broader administrative structure of the district, the District Development Committee (DDC) oversees all development activities inside the watershed. The DDC operates both as a political and administrative body (Chapter 4). The Local Development Officer, the chief, also serves as the member secretary for the District Water Resource Committee (DWRC) (Chapter 4). The research attempted to assess the functioning of the DWRC. However, it was not possible because no one in the DWRC could tell anything about its functions or its activities in the past few years of operation. Due to some unknown reasons, the access to the DWRC minutes was also denied. Interestingly, some of the members were not even aware about the existence of, or their membership to this legal body.

Similarly, the District Water Resources Inquiry Committee (DWRIC) and the District Agriculture Coordination Committee (DACC) are also defunct. There were altogether three major water resources disputes in the area that required external arbitration. All of these cases are being looked after by the District Court, as opposed to the DWRIC (See Chapter 4). Similarly, the DACC has not held a meeting in the last three years. This committee is very vital to the implementation of the Ninth plan in the country.

6.5.3.2 Agriculture

There is one Agricultural Service Centre (ASC) located in Falate within the selected sub-basin that provides agricultural extension support. The District Agriculture Development Office coordinates the ASC's work. This center is equipped with a few small agricultural implements that farmers can borrow by paying a nominal service charge. This center provides extension services on irrigation management.

6.5.3.3 Irrigation

The District Irrigation Office (DIO), located in Bidur, oversees the irrigation development activities within the watershed area. The office is staffed with one Senior Engineer, two Assistant Engineers, seven Overseers, and a number of clerical staff. The Office has been mandated to take charge of all projects initiated by the DDC and those sanctioned through various bilateral and multilateral agencies. So far, this office has surveyed the prospects of developing permanent irrigation systems in the area for over 10 times (Participatory Estimates: 1995-7). However, neither a detailed plan has yet been produced nor have any new programs been implemented in the area. The studies have established that any irrigation development activity in Gerkhu Khola would not be sufficient for the entire small watershed. In addition, the effort to harness water of Fhalangu or Trishuli Khola for irrigation would not be feasible (UDA: 1988)

The Agricultural Development Bank provides a subsidy of up to 95 percent to any group of farmers aspiring to develop an irrigation project on collective basis. The remaining five- percent amount must be borne by the users as a loan and subsequently repay it at an interest rate of 16 percent. The project proposed by the villagers, however, must be technically and financially feasible. Being a bank, its selection criteria are strongly enforced. Often, the bank collaborates with the DIO while implementing irrigation projects.

6.5.3.4 Drinking Water

The district is served by a District Drinking Water and Sanitation Office (DWSO) located at Bidur. The office has a mandate to plan, contract, build, train and hand the system over to the beneficiaries. The office is staffed with one Senior Engineer, Two Assistant Engineers, Six Overseers, One Technician, and a few clerical staff. The office also handles all the drinking water and sanitation projects in the district. The VDCs, however, can have their own program and can externally hire all required technical staff. Interesting as it may sound, the DWSO reported to have lost a significant number of drinking water projects to NGOs and the Rural Water Supply and Sanitation Fund Board (RWSSFP). Both NGOs and the RWSSFP operate with their own agenda and their requirement for initiation of drinking water projects is different and more effective than the DWSO. It has developed three drinking water projects in the small watershed and is currently assessing the feasibility for 2 new systems.

6.5.3.5 Local NGOs

There are over 35 bilateral donors, INGOs, and NGOs working in the district (Box 6.1). The majority of these I/NGOs have "some" program(s) implemented in the district. Indirectly, all of these programs are supposedly helping the small watershed area. Most of these are formally registered with the District Office. The list provided in the box is not exhaustive. It is observed that anyone can come and work in the district as a nationally registered NGO. There is no proper record keeping systems or NGO coordination office in the District.

Box 6.2: List of Donors, INGOs and Local NGOs	
Donor/NGO	**Sector**
Agriculture Research and Extension	World Bank
Drinking Water	(RWSSDFB), UNDP,WHO, UNFPA, Water Aid, OXFAM, Nepal Red Cross
Livestock Development Project	ASDB
Community Forestry	ASDB, UNFPA, Australian Development Assistance, GVS
Health, Family Planning	UNICEF, UNFPA, USAID, Australian Development Assistance, Save the Children/USA, Marry Kohl Foundation, Nepal Children's Organization, Nepal Red Cross, CARRIER
Watershed Management, Forestry	FAO-UNDP, DANIDA, FINNIDA
Women Development	UNICEF, Manushi, Eco-Himal
Education	USAID, Australian Development Assistance, PACT, OXFAM, South Asia Partnership, CERED, CARRIER
Fisheries	Japanese/JICA, JOVC
Participatory District Development, social mobilization	UNDP, Save the Children/USA, LUTHERAN WORLD
Irrigation	SNV, ASDB
Cultural Heritage	France-Nepal Cultural Club
Child Development	Nepal Children's Organization

Source: District Office, Nuwakot: 1997. A list of abbreviations and acronyms is provided in the appendix.

Box 6.2: Name. Location, Objective and Performance Rating of Locally Evolved NGOs

Name	Objectives	Performance Rating
Gerkhutar Yuba Club, Gerkhutar, Gerkhu VDC, Ward No. 3, Nuwakot (Estd. 1984)	Saving mobilization; sports, traditions and culture; skill development training for women; resource management; primary health; adult education	Satisfactory; collaborative effort is effective
Suryodaya Social Club, Gerkhutar, Gerkhu VDC, Ward No. 3, Nuwakot (Estd. 1990)	Saving mobilization; sports, traditions and culture; skill development training for women; resource management; primary health; adult education	Satisfactory; collaborative effort is effective
Laligurans Social Welfare Club, Bitlab, Gerkhu, W.N. 5, (Estd. 1996)	Population and environment; community facilitation; forestry; local resource mobilization; adult education	Recently established, the users' review could not be collected
Bageswori Yuva Club, Chokade, W.N. 4 (Estd. 1991)	- (defunct)	NA

Source: Participatory Analysis: 1995-7

Besides four locally evolved NGOs are operating in the area, Box 6.2 summarizes their name location, objectives and performance as observed by the people in the area. Evidently, none of the locally evolved NGOs are currently involved in WRM. However, all NGOs have been assured to be included in the DANIDA initiated watershed management project in the area. In that front, all of the NGO members demonstrated a very high enthusiasm.

6.6 Major Problems in the Area

Accessibility is pointed out as the main bottleneck for development programs within the area. Lack of transportation networks, deteriorating conditions of the trails and roads and inadequate government attention are the prime factors that aggravate the existing problems in a number of ways. These factors also undermine the major development initiatives that are in place. Persistence of social norms, values, and vast illiteracy has corroborated low self-esteem among the people, thus causing perpetual underdevelopment.

A high level of out-migration prevails, indicating a growing degree of life sustenance problems related particularly to food, shelter, health, and production. The migration is often the aftermath of the cumulative effect of lack of income opportunity, and socio-cultural problems. Despite large-scale out-migration, currently about 8 persons depend for their livelihood on each hectare of cultivable land. Lack of replenishment of soil nutrients has arrested the crop yields. Consequently, the per capita consumption of food has declined to 74 percent of the total requirement[23]. It is observed that only 7 percent of the total household could produce enough food for the whole year. For over 92 percent of the total inhabitants in the area, the produced food is sufficient only for up to six months (PDDP/UNDP: 1997). The people in the watershed adopt different ways to cope with this insufficiency. Out of the total food deficient households, 32 percent reported to work as wage/agricultural laborer, 23 percent sell their assets, 25 percent borrow money from different sources, and the rest resort to seasonal migration to support their families (Participatory Estimates: 1995-7).

The total income per household for the entire watershed is Rs. 28,572 per household. The per capita income of up, mid and downstream residents are NRs. 3772, 3323 and 4105, respectively (C$ 1 = NRs. 42). These figures do not include the price of the commodity consumed and bartered internally or among the neighbors. The farmers discussed the different items to record their true income in about two group discussion but in both they failed to reach a consensus on value of such consumption or transactions. The main items included in the reported figures are sales of

[23] The food sufficiency was calculated on the basis of total calorie required per person per year and the total caloric value of the total production in the area (APROSC: 1994).

agricultural produce, livestock product, income from cottage industry, wage or salary, occupational income and pension, trade or business, and asset sales.

Likewise, the watershed has yet to witness any growth in non-agricultural activities needed to help relieve pressure on the agricultural sector. The real unemployment is as high as 16 percent of the total economically active population. However, the underemployment is as high as 50-55 percent (Field Survey: 1995-7). Often, the off-farm earnings of the agricultural poor are comparable to or less than their on-farm earnings, which is an incentive to not work (Field Survey: 1995-7). The infant mortality rate, as of 1987, was 180 and the child mortality rate was 208 per thousand. Chronic under-nutrition affects up to 80 percent of the children (CBS: 1993). The group discussions held at various levels justified these figures.

6.7 Conclusions

There is an urgent need to rethink the process of development in the watershed. It is very apparent that the locally evolved institutions are slowly withering away, or are being ignored by the villagers. The most striking example can be noticed at the irrigation canal maintenance. During the survey period, the farmer's collective way of irrigation management was being handed over to the Suryodaya Social Club, which is a locally evolved NGO.

However, a critical thinking of this issue would generate multiple interpretations to this observation. It could be the villagers' way of evolution, if the fundamentals of adaptive management are taken into consideration (Hollings: 1995). It could be the villagers' way of institutional adjustment in order to become more responsive (Abaza: 1994). Similarly, it could be the pressure of modernization (Asafu Adjaye: 1996), or it could be a desire for change expressed by the small watershed community (Blaire: 1996, Desai: 1996). Similarly, it could be the recent pressure of the DANIDA funded project in the area, which has a modus operandi that only allows villagers to receive support through NGOs (DANIDA: 1997). The most credible explanation is the latter. However, the resource structure and management strategies of the villagers are definitely changing. This departure may appear as unsustainable to many, or it may appear as a unique way of adjustment. Any one of these it may be, any effort of WRM in the area must take a careful consideration of these changes characterized by existing sustainable or unsustainable processes, and the ingenuity or ignorance of the people.

CHAPTER SEVEN
UNDERSTANDING ACTIONS

"There is no opportunity for either the questions or the answers in this "citadel of expertise," to be influenced let alone decided by those whose lives are most directly dependent upon mountain lands. An apt description of these mainstream studies is "technocratic" in the broad sense. They presuppose a style of work requiring technical procedures and language worked out by specialized professionals in well-established fields. They usually articulate closely with professional organizations... Without doubt, this is the prevailing style of scientific endeavor today. In its home situations, it has developed powerful and persuasive ordering of knowledge. It is no coincidence that the particular technocratic views that predominate today emanate from the most powerful and wealthy states. Yet it surely takes not great wisdom to expect that these formations of enquiry will channel study into a particular view of "the facts," or "relevance" and acceptable results." (Kenneth Hewitt: 1989: 23)

7.1 Background

It is described in the preceding chapter that a unique socioeconomic and physical set-up characterizes the Gerkhu Khola watershed. Inasmuch as the area appears to be comparable to other small watersheds along the middle mountain belt, both physical, human systems and their interactions are different and difficult to be generalized (Ives and Messerli: 1987). Such situated interrelationships, within the human-physical system, are characterized by a set of rules that is socially and culturally defined (Lovelace and Rambo: 1986). These rules are shaped by the way in which human beings define their roles and actions (Kama or Karya) toward water.

Apparently, as these social laws are mostly unwritten, their observance depends on the physical set-up, and the concerned community's social, economic, and environmental understanding related to water (Baland and Platteau: 1996). The researcher posits that people's capacity for WRM is reflected in the way they observe these unwritten laws. Conversely, capacity assessment becomes a process to explore what are these laws, and to what extent and how unwritten, but socially defined rules are being observed by the people (Hopkins: 1997). Such assessment can provide benefits at two distinct levels. First, it can provide a useful basis to identify the existing realities of water use. Second, it can help to define a ground for comparison and compatibility assessment of external WRM decisions with such local conventions. Arguably, if found incompatible, such external attempts can be easily tailored or modified to make them fitting to the local situation.

7.1.1 Objectives of the Chapter

This chapter examines the capacity that can be observed in the actions and practices of water use in the area. The main objectives of this chapter are:

- to present the outcome of participatory analysis of Dublin Principles
- to discuss major activities that support or reject principles of sustainable WRM (ICWE: 1992).
- to summarize the realities associated with WRM in the small watershed.

7.1.2 Process

The action analysis was crucial both as an entry point and an icebreaker to the study. Equally, it was helpful to substantiate the need for attitudinal and preference analyses. Initially it was believed that a structured survey based on four principles of Dublin supported by Participatory Rural Appraisal (PRA) would provide the needed bases to assess actions, attitudes, and the preferences of the people in the area[24]. However, when this preconceived idea was shared with the villagers, it required partial modification in the research design, which includes a participatory analysis of Dublin Principles.

Although most of the description given in this chapter is based on the participatory research, in order to apply different statistical techniques, a sample of 120 households was randomly selected. The description of different actor groups and the sampling method is presented in Chapter 5. The sample survey also provided an opportunity to investigate the demographic and socioeconomic situation, which is presented in Chapter 6. In order to provide the representation of entire watershed, samples were chosen from up, mid and downstream reaches of the Gerkhu Khola. Box 7.1 provides the total number of samples collected from different reaches, and villages/hamlets within the small watershed area.

The division of small watershed into up, mid and a downstream reach was done based on DANIDA's classification (DANIDA: 1997). The total number of respondents belonging to the small farmers' group is higher, because other groups were not present in some of the hamlets. Only 23 women could be sampled because the number of women-headed households are very few within the area. Moreover, many women, although sampled, were not given permission to participate in a detailed interview by their relatives and parents. However, they were allowed to attend group meetings. All the information collected in the field was processed immediately and the results were shared

[24] It was initially phrased as the assessment of balance, tradeoffs, and adjustments.

with the community members. Any unsubstantiated and invalid questionnaires were discarded or readministrated. Consequently, six questionnaires, out of 120, required readminstration.

Box 7.1: Total Number of Samples Across the River-Reach and Administrative Area			
River Reach	**Village**	**Ward Number, VDC**	**Sample Size**
Upstream	Regmitar	7, Bageswori	8
	Hile	7, Bageswori	7
	Ange	7, Bageswori	7
	Upallo Gerkhu	2, Gerkhu	13
	Nepal Tole	2, Gerkhu	5
	Tharitole	2, Gerkhu	5
Total			45
Midstream	Bitlab	5, Gerkhu	27
	Chinne	7, Gerkhu	6
	Daregaunda	7, Gerkhu	7
Total			40
Downstream	Gerkhutar	3, Gerkhu	26
	Keurini	1, Bidur Municipality	9
Total			35
Grand Total			120

7.2 Participatory Analysis of Dublin Principles

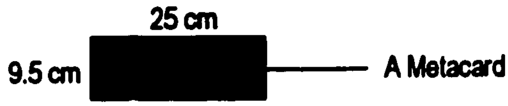
7.2.1 Approaching the Analysis

The participatory analysis of the Dublin Principles was approached in several rounds of group discussions. Unfortunately, early meetings were very poorly attended. However, these meetings were used as a platform to disseminate the objectives of the research and the concept of sustainable WRM. Apparently, such introductions were not very new to the community, as a DANIDA sponsored project was doing something similar in the area during early 1996. To increase the credibility of the research in the small watershed, an assistant female sociologist was hired from the area. Her mobilization dramatically improved the community's response, concentration, and seriousness toward the research. The steps followed in the analysis are provided in Box 7. 2. Metacard method (Box: 7.3) was used to analyze Dublin Principles. The sub-principles thus generated, guided the entire research.

Box 7.2: Steps Involved in Participatory Analysis of Dublin Principles		
Steps	**Activity**	**Process and Outcomes**
1.	Initial discussion to inform about Participatory Analysis	The research was partially accepted by the community. The basis of sustainable WRM conveyed to the people
2.	Female sociologist was hired	The credibility of the research improved. The people became responsive
3.	Second round of meeting was called	The research was discussed in detail. Actor groups were divided and the purpose of such grouping was explained to the people
4.	Brainstorming exercises	The participating individuals were distributed color-coded Metacards and asked to write their impression on the way water should be managed in their area. Actor groups listed their opinion on WRM. The cards were collected and all the color-coded cards were kept separately.
5.	Revisit the households	The sociologist was asked to randomly visit the discussants to evaluate their level of participation in the exercise. With a limited exception, all the discussants had adequately participated in the group discussions.
6.	Selected actor group members/researcher/ Sociologist meeting	A few volunteers were then called from the participating households. Twelve volunteers agreed to participate to help group all the collected responses under specific principles. The grouped responses were carefully analyzed for any repetitions, discarding them whenever found. All responses were summarized and grouped under Dublin Principles
7.	Group discussion	The final grouping was followed by another community meeting. The meeting was very well attended and all of the summarized statements were unanimously agreed, with a limited number of questions or suggestions.
8.	Separate actor group meeting	Discussion of the meeting conclusions. All questions and suggestions were duly incorporated in the broad statements.
9.	Selected actors/researcher meeting	Phrasing and rephrasing of sub-principles (rather than rewording or remodifying of the principles per se, the meeting decided to elaborate the principles by adding sub-principles)
10.	Group Discussion	Discussion of the sub-principles and arriving at a consensus
11.	Validation of agreement	Adherence Analysis (presented in Chapter 8)

Box 7.3: Metacard Method[25]

Metacards are small 9.5 X 25-cm cards of different colors that are given to the respondents in a group. The respondent may choose to draw a diagram or write a few words on the topic of discussion, however, one card must only hold one idea. The color provides the basis to write/draw similar ideas in the card of one particular color. Often illiterate persons seek help of a literate person. This thesis had taken the help of schoolchildren, who could stay in the group, but would not be able to influence the discussion. (Ashe, J (1979) Assessing Rural Needs: A manual for Practitioners, VITA, Mt. Rainier, USA. Carruthers, I. and Chambers, R. eds. (1981) Special Issue on Rapid Rural Appraisal. Agricultural Administration, 8 -6.)



Box 7.4 provides the sub-principles as analyzed, and phrased in the small watershed. The statements provided are translated from Nepali; however, effort has been made to preserve the essence of Nepali definitions.

Principle I

The community felt that if water sustained their life, it should be regarded as central to all other resources (Ka. *Pani afai euta shrot ho tara yasko upalabdhata le aru shrot haru ko upalabdhata lai pravabit gareko hunchha*). Here the phrase, "*centered to all resources*" refers to the place of water in the overall resource set-up and the emphasis on the dependence of the usability of other resource on water. Secondly, as the quality and quantity of water are interrelated issues, the community felt the need to draft a separate sub-principle to attest the qualitative significance in the finiteness of water (*Kha. Pani ko Suddhata ra Pani ko Upalabdhata ek aapas ma bhar parne kura hun, Pani ko suddhata bigriema, tyaslai jstako testai banauna sakidaina*). They also strongly felt that water, if degraded, is difficult to reverse to its original quality. This sub-principle led to the issue of technology and its limitation, and it was drafted as a separate sub-principle under first principle (*Ga. Pani ko upplabdh matra ra suddhata prabidhi tarika ma bhar pardachha. Tara sabai prabidhi proyog ma lyauna upaukta bhane hudaina*). The technological suitability meant to the community as a set of technological measures that is accessible, affordable, and locally manageable.

[25] This thesis relied largely on this method of data collection. It is easy and helps in preparing unstructured reports quickly and efficiently. This method is broadly in use, especially in resource conservation and development projects. For example: Drinking Water Project Planning with rural women (JAKPAS: 1995), Forestry Assessment (APROSC: 1995), and irrigation development (ICON: 1993, 1994, 1995, IIMI: 1997)

Box 7.4: Principles and Sub-principles of Sustainable WRM	
Principles	**Sub-Principles**
Fresh Water is a finite and vulnerable resource, essential to sustain life, development and the environment	• *Water is the central to all other resources and, in that, its availability depends on the structure of other resources.* • *Quality of water affects the total availability and, in that, it must be recognized that if deteriorated it is only partly reversible.* • *Technological suitability is the key to the finiteness of water. Awareness about the appropriate technology is essential.*
Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels	• *Knowledge about the current planning structure should be uniformly available to all and, in that, all have been given an equal opportunity to contribute.* • *Continuous participation is a key to the success of WRM programs.* • *Equity and transparency, especially for cost sharing and allocating access, must be adequately maintained in all WRM initiatives.*
Women play a central part in the provision, management and safeguarding of water	• *It must be recognized that the Women are over burdened in terms of water resources use and management.* • *Women should have equal access in decision-making and planning, and should receive greater responsibilities in WRM.* • *Empowerment of Women is essential to enable them to participate in all levels of WRM programs*
Water has an economic value in all its competing uses and should be recognized as an economic good	• *Water must be treated as an important good having an economic value recognizable and understandable to both the providers and receivers.* • *Equity in distribution and cost sharing is essential and, in that, a participatory mode of assessment of true value of water and value of contribution is essential.* • *A progressive system of cost sharing based on the amount of use and total waste disposal is essential.*

(Participatory Analysis: 1995-7)

Principle II

Under this principle, the villagers felt that an extent to which a user would participate in WRM is often determined by his/her understanding and knowledge of the existing planning process that is pertinent to the area (*Ka. Jalshrot sambandhi karyakram, yojana banaune kramama sabai ko sahabhagita ra pahuncha hunu pardachha*). The second aspect was unanimously agreed and it covered the argument that a continuous participation in WRM programs is essential for any WRM program to succeed (*Kha. ni sambidhi kriyakalap ma sabiko nirantar sahayag awasyak hunchha*). The third important point considered under this principle wss the need to maintain equity and transparency in all WRM programs (*Ga. Pani ko yojana banaunda ra tiniharuko karyanwayan garda, pardarshita ra bandfand garda* *sabilai pugne hunu pardachha).* The people strongly believed that often their reduced interest and participation are due to the lack of transparency and equity structure in the proposed programs or activities.

Principle III

The synthesis provided that the community had a straightforward answer toward the third principle. They felt that once the women's role in water resource was properly recognized, it would automatically resolve all issues that surround it *(Ka. Mahila le pani sambandhi karyaharuma puryaeko yogdan ko kadar garnu pardachha)*. The community also emphasized the need for the empowerment of women to enable them to better plan and manage water *(Kha. Mahila lai pani sambandhi karyakram ma bhag lina sakchham banaunu pardachha)*. The other aspect emphasized by the people includes increasing the roles of women in WRM planning and decision making *(Ga. Mahila ko sahabhagita yojana banaune ra tarjuma garne karya haru me badaunu parne awasyakta chha)*.

Principle IV

The community strongly felt that water should be regarded as an important good having an economic value. However, they annexed this assertion with statement that its value must be agreeable both to the users and to those who assess its value (*Ka. Pani euta Mulyawav vastu ho ra yasko mulya .nirdharn garna awasyaka pani chha, tara so mulya upabhokta ra sambandhit nikaya duai lai manya hunu pardachha)*. The community indicated that the economic value of water could be realized only when equity is maintained in cost and benefit sharing. *(Kha. Lagat mulya ra upayog ma sabai ko barabar ko sahabhagita hunu pardachha)*. The community also perceived that a progressive system of cost sharing based on the use of water and generated affluence must be maintained (*Ga. Pani ko mulya nirdharan garda proyog ko matra ra pradushan gareko matra bichar garna atyantai awasyak hunchha)*.

7.3 Water Supply, Demand and Balance in Gerkhu Khola

The researcher adopted a conventional approach to analyze the water resource condition in the area. Accordingly, all available water related information was collected from the district-level offices to prepare a tentative supply-side situation in the small watershed. Similarly, to prepare the demand-side situation, all demand requests and feasibility studies conducted in the past were gathered. While there was some information available on the supply-side, very scanty information could be collected on the demand-side. *This is indicative of the fact that most of the efforts currently underway in the small watershed area are supply driven.*

7.3.1 Water Supply Structure

The information collected from government offices provided that the water supply structure (refers to the natural sources of water and their possible use as supply sources) of the area is characterized by extreme degree of variability, fluctuation, and uncertainty. Accounts of such fluctuations and variability are presented in Chapter 6. The secondary information synthesized to 37 sources, excluding Gerkhu Khola, which could be potentially used for drinking water and small-scale irrigation.

7.3.1.1 Quantity and Quality of Water

The community contradicted with the secondary information synthesis and suggested that only 27 sources, as against 34, are feasibly exploitable. In order to reevaluate this assertion, all the sources were visited and their respective discharges were measured during July of 1996. The researcher found that, *as provided by the community*, only 27 sources had enough discharge [over 0.1 (liters per second) lps] to put into any form of productive uses. The physical analysis of water provided that the total discharge, measured during the month of July, ranged from 0.11 to 10 lps.

Tables 7.2 and 7.3 indicate that, based on the present population count, the physical availability of water exceeds 890 liters per person per day (lppd)[26]. If the data for the Gerkhu Khola is excluded, the total quantity reduces to 470 lppd. Even if the total quantity is considered against issues like, placement of the sources, available technology, and financial ability, the available water quantity exceeds all standard criteria to satisfy the need of the community[27]. However, if the available water is put through a qualitative scrutiny, the availability drastically decreases to less than 12 lppd.

The biochemical analyses were carried out of all sources and the obtained results were compared with the water quality indicators given by WHO (1984), Ministry of National health and Welfare of Canada (1989) and US Environmental Protection agency (1992) (Table 7.1).

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[26] The fluctuation of water is duly considered in the figure and the discharge of Gerkhu River is included.

[27] The social minimum of water according to WHO standard is 40 lppd (WHO: 1984)

Table: 7.1: Drinking water Standards			
Aspects \ Agency	WHO (1984)	Canada (1989)	EPA, USA (1992)
Microbiological			
Total Coliform /100 ml	0	0	0
Particulate matter			
Turbidity (NTU*)	<1-5	<1-5	1
Pollution Indicators			
pH Range	6.5-8.5	6.5-8.5	6.5-8.5
Hardness	500	500	-
Aesthetic Indicator			
Color (color indicator)	Hazen (15)	Hazen (15)	Hazen (15)
Odor (threshold)	-	Inoffensive	3
Inorganic			
Aluminum (mg/l)	0.2		0.2
Iron (mg/l)	0.3	0.3	0.3
Chloride (mg/l)	250	250	250
Sodium (mg/l)	400	500	250
*NTU Nephelometric turbidity unit			

Source: WHO (1984), USEPA (1992), Minister of National Health and Welfare (1989)

The taste and smell of water were satisfactory in only one source. The sanitary condition around the water supply sources was generally unsatisfactory. The color of water varied from hazen (Color Indicator) to murky-reddish. Throughout the monsoon, the water carried a strong taste and smell (Field Survey: 1996-7). The analysis also indicated that the turbidity of water – a measure for the dissolved particulate matter – were slightly higher in all cased than the allowed limit of 5 NTU. This high value could have been due to the effect of an early monsoon rain. However, the values for inorganic pollutants were within the allowable limits in all sources. The biological analysis indicated 20 sources having an average of 7.2 e-coli in every 100 ml of water (Field Survey: 1995-7).

Table 7.2: Physical Analysis of Available Sources

SN	Name of the Source	Type	Location	Discharge (July) lps	Present Use	Possible Use	Color	Sanitary Condition	Taste and Smell
1	Tirtire Dhara	X	Gerkhutar Dil	0.77	None	D	Hazen	a, d, f, g	Slight Sulphur Smell
2	Kunako Dhara Muhan	X	Deurali Siran	0.23	B	D	Hazen	a,d,g,h	Leafy green taste and smell
3	Lete ko Dhara	X	Naya Gaon	0.36	B	C	Hazen	c, g	Leafy green taste and smell
4	Patle Khola	X	Chilaune Feda Muhan	1.2	C	C	Murky	b, c	Normal Green Taste
5	Patle Siran	X	Patle Pakha	0.76	A	C	Hazen	b, c	Normal Green Taste
6	Patle Khet ko Muhan	X	Patle Khet	0.86	A	C	Murky	a, b, c, d	NA
7	Patle Khola- Puchhar	Y	Patle	0.52	A	C	Murky	a, b, c, d, g	NA
8	Archale Khola	X	Bhainse (Archale)	10	C	C	Murky	a, b, e, d, g	Sulphur smell
9	Thati Khola	X	Bhainse	0.62	B	D	Hazen	a, d, f, g	NA
10	Dans Khola Puchhar	X	Bhainse	2	A	C	Murky	c, g, h	Normal Green Taste
11	Niglini Khola	X	Angitar	4	A	C	Murky	c, g, f, g	Leafy green taste and smell
12	Gairikharka Puchhar	X	Saur Khola	0.27	B	D	Hazen	c, g, f, g	Leafy green taste and smell
13	Rittha Bote' Dhara,	X	Ratomato Tole	0.32	B	D	Murky	a, c, f, g, h	Green taste and smell
14	Saune Pani Danda	X	Saune Pani, Pipal Danda	0.11	B	D	Hazen	a, b, c, , e, f, g	NA
15	Gairikharka Kalomato Tole	X	Raikar Dhara	0.31	B	D	Hazen	a, c, g	Green taste with smell
16	Gairikharka Chhanga Khola	X	Changga Khola	1.12	A	C	Hazen	c, g	Green taste with smell

Contd. On next page

Table 7.2: Physical Analysis of Available Sources

SN	Name of the Source	Type	Location	Discharge (July) lps	Present Use	Possible Use	Color	Sanitary Condition	Taste and Smell
17	Dans Khola	X	Gairikharka Pallo Dando	1.07	A	C	Hazen	a, d, f, g	Strong So2 smell
18	Amara ko Bot Mune' Dhara	X	Bitlab	1.1	B	C	Murky	c, g	Normal Green Taste
19	Baskote Kuwa	Y	Bitlab	0.2	C*	C	Murky	a, c, e, f, h	NA
20	Bitlab Siran Ko Kuwa	Y	Bitlab	0.3	C*	C	Murky	a, c, e, f, g, h	NA
21	Pallo Gogane	X	Gogane	0.4	B	D	Hazen	a, c, e, f, h	NA
22	Wallo Gogane	X	Gogane	0.19	B	D	Hazen	c, g	Normal Green Taste
23	Daudare Khola Siran	X	Daudare Khola	0.38	B	D	Hazen	c, g	Normal Green Taste
24	Boxe Khola Siran	X	Bitlab	0.275	B	D	Hazen	c, g	Normal Green Taste
25	Jaluke Gairi	X	Bitlab	2	A	C	Murky	a, d , f, g	Green taste and smell
26	Boxe Khola Mul	X	Bitlab	0.44	B	D	Hazen	c, g	Normal Green Taste
27	Keurini Khola	X	Bhutyaha	2.2	A	C	Murky	c, g	Normal Green Taste

Type: X = Spring, Y= Well

Use: A = Monsoon Drinking and Irrigation, Dry = Drinking, B = Livestock and Drinking, C = Drinking, Water and Irrigation, D = Drinking Water, * = Doubtful , low discharge recorded, however the people in the sub-watershed find it possible

Contaminants: a = Animal dung, b = fern, c = humus, d = other wed, e = human waste, f = Snail, g= algae h = leeches

Participatory Analysis: 1996

Table 7.3: Summarized Bio-chemical Analysis of the Sources									
SN	Name of the Source	Turbidity NTU	Water pH	Aluminum mg/l	Iron mg/l	Sodium mg/l	Chlorides Mg/l	Hardness CaCO3 mg/l	Ecoli/ 100 ml
1	Tirtire Dhara	8.00	7.80	0.12	0.38	220.00	255	520	13
2	Kunako Dhara Muhan	6.00	7.50	0.08	0.40	235.00	223	510	5
3	Lete ko Dhara	7.00	7.20	0.13	0.40	200.00	243	500	3
4	Patle Khola	9.00	8.10	0.17	0.43	200.00	211	490	7
5	Patle Siran	10.00	7.50	0.14	0.32	220.00	224	490	2
6	Patle Khet ko Muhan	6.00	7.30	0.11	0.30	240.00	237	510	5
7	Patle Khola- Puchhar	7.00	7.40	0.14	0.30	250.00	271	470	12
8	Archale Khola	4.00	7.20	0.10	0.24	220.00	213	480	
9	Thati Khola	5.00	7.60	0.12	0.20	250.00	219	490	9
10	Dans Khola Puchhar	6.00	7.20	0.14	0.15	190.00	228	500	2
11	Niglini Khola	6.00	7.30	0.15	0.15	200.00	245	450	5
12	Gairikharka Puchhar	5.00	7.20	0.08	0.20	210.00	238	420	3
13	Rittha Bote' Dhara, Gairi	9.00	7.30	0.17	0.42	225.00	241	460	4
14	Saune Pani Danda	4.00	6.90	0.18	0.30	170.00	257	420	17
15	Gairikharka Kalomato Tole	5.00	7.40	0.20	0.21	160.00	243	460	
16	Gairikharka Chhanga Khola	3.00	8.00	0.12	0.16	130.00	251	420	
17	Dans Khola	4.00	7.90	0.11	0.17	120.00	232	400	2
18	Amara ko Bot Mune' Dhara	8.00	7.90	0.16	0.22	110.00	243	460	
19	Baskote Kuwa	7.00	6.90	0.23	0.09	230.00	232	430	15
20	Bitlab Siran Ko Kuwa	8.00	6.80	0.15	0.12	220.00	235	450	20
21	Pallo Gogane	5.00	7.80	0.21	0.31	190.00	265	460	11
22	Wallo Gogane	5.00	7.60	0.16	0.22	190.00	246	420	
23	Daudare Khola Siran	3.00	7.40	0.10	0.12	190.00	245	400	
24	Boxe Khola Siran	4.00	7.70	0.10	0.15	150.00	212	450	1
25	Jaluke Gairi	9.00	7.60	0.12	0.17	160.00	222	460	7
26	Boxe Khola Mul	5.00	7.90	0.12	0.16	170.00	221	450	1
27	Keurini Khola	7.00	7.20	0.14	0.18	175.00	210	480	

Source: Lab Report of Enpho, Nepal: 1996

7.3.2 Landuse Changes During 1984-1997

The landuse pattern of the small watershed has significantly changed over the past 23 years. A comparison of landuse maps of 1984 and 1996 (LRMP: 1984, Department of Survey: 1997) using MapInfo shows that the forest area in the small watershed has shrunk by as much as 27 percent (Maps 6.7 and 6.8). During the same period, about seven new settlements have emerged in the area[28] and the watershed's interactions with the urban area have tremendously increased. It is described in detail in Chapter 6 that the tourism and other economic activities have increased in the area, which has made agriculture as a less a profitable option.

Similarly, the cropping pattern has changed from a traditional-rainfed based to irrigation-dependent. Consequently, the structure of food and eating habits has also changed from rice and millet to rice and wheat. Many small trails and paths have emerged and, in virtually all of the small watershed area, human actions and interactions have increased. Consequently, the dynamics of the supply-side of water have been seriously distorted in the area (Participatory Analysis: 1995-7).

7.3.3 Supply Sources

7.3.3.1 Sources of Drinking Water

On the whole, 36.4 percent of the total population used tap water for drinking at the end of 1997 (Table: 7.4), one percent used irrigation channels and seven percent used traditional drinking water taps (*Dhunge Dhara*). Similarly, a river or stream was used by about 13 percent and the remaining population used a well or a spring. Out of those respondents, who were currently using tap-water, two third received support to develop drinking water systems from governmental, I/NGOs or bilateral sources. The rest developed their systems by mobilizing internally generated resources. The average annual availability of tap water ranged from 5.8 to 11 months. Normally, when the taps dries up, the households rely on other alternative natural sources. The tap-household ratios for the up, mid and downstream reaches of the river are presented in Table 7.4.

[28] The sub-watershed community disagreed and reported that those settlements, considered new by the government, were present in the area but they were only recently given an administrative recognition. Administrative recognition is the process of surveying and providing land title certificates to recognize the formal ownership (Muluki Ain: 1964).

Table 7. 4: Percentage Distribution of Primary Drinking Water Sources				
	Upstream	Midstream	Downstream	Average
Tap-water	26.7	42.5	40.0	36.4
Irrigation channel	0.0	0.0	2.9	1.0
Traditional drinking water taps (*Dhunge Dhara*)	11.1	10.0	0.0	7.0
River or Stream	8.9	12.5	17.1	12.8
Well/Spring	53.3	35.0	40.0	42.8
Total	100.0	100.0	100.0	100.0

(Participatory Estimates: 1995-7)

Seemingly, for every 14-15 households only one tap was available. The distance from the centre of the villages to the tap-stand vary considerably in the up, mid and downstream reaches of the river. The average distance for the whole small watershed was about 193 meters. All of these taps drew water from separate sources. It was reported that only two drinking water systems has been developed in the past five years (Participatory Estimates: 1995-7). However, the community perceived that the tap-water supply situation would change after a DANIDA funded project begins full operation.

Table 7. 5: Tap-Household Ratio, distance and Average Months of Use of Tap Water				
Attribute	Upstream	Midstream	Downstream	Gerkhu Khola
Tap-Household Ratio	1:14.1	1:19.2	1:10.2	1:14.5
Average Distance (pedometer reading) meters	113	276	190	193
Average Months of Use	6.5	5.8	11.0	7.8

(Participatory Estimates: 1995-7)

7.3.3.2 Irrigation Sources

It is described in Chapter 6 that agriculture is the economic mainstay in the small watershed. Despite this, the area did not have any formally initiated irrigation facilities. However, farmers used a number of locally evolved technologies to deal with the irrigation needs. As these techniques reflect on the farmers' response to uncertain and variable water resource conditions, they are described in a latter section of this chapter. A number of feasibility studies have been conducted in the area, however, none of them were implementable. As table 7.6 suggests, there are a few temporary irrigation structures built, managed, and operated individually or through a group.

Table7. 6: Temporary Irrigation Canals in the Area

Temporary Earthen Structures	Upstream	Midstream	Downstream	Total
Individually Constructed	2	3	1	6
Collectively Constructed by 2-5 households	5	4	7	16
Collectively Constructed by ≥ 6 households	1	2	3	5

(Participatory Estimates: 1995-7, Field Survey: 1995-7)

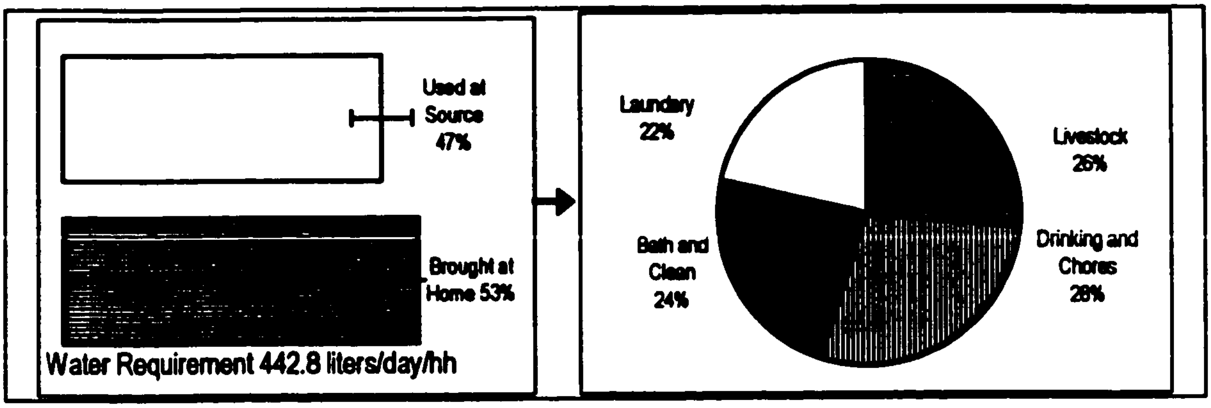
7.3.4 Water Demand Structure

The water demand structure in a given area can be calculated by adding up the area's collective demand for irrigation, drinking water, cleanliness, sanitation and others (Biswas: 1994). The total irrigation demand in the area is estimated at 3 cm per hectare per day during April - July (Late Paddy Season), 2 cm per hectare per day during October - December (Wheat Season), and 2 cm per hectare per day during February - March (Early Paddy Season) (UDA: 1988, Luna Consultancy: 1990). *The discussion with the villagers, however, provided a sense that the irrigation requirement varies in the area, and it normally depends on the local farmers' preference on the kind of crops to be planted.* A rough estimation provided a range of requirement between 4 to 5.5 cm per hectare per day during late Paddy Season, and 3 cm during Early Paddy and Wheat Seasons.

It was possible, however, to more accurately estimate the water requirement for household purposes. The average water use by the households is slightly below 450 lppd (Figure 7.1). This calculates to a per capita figure of 65 lppd. *This figure is 25 liters higher than the WHO (1984) recommendation of 40 lppd and may be used as a basis to implement future projects in the middle Himalaya.* It was also reported that 53 percent of the total water is brought home and the rest is used at the source.

Out of the total quantity, 28 percent of the total water is used for drinking and household chores. Similarly, about 22, 24 and 26 percent is used respectively for laundry, bathing, cleanliness, and livestock raising. Reportedly, out of the total quantity brought home, as much as 60 percent is used for livestock purposes and the remaining amount for drinking and chores. *Thus, it is essential to realize that the freshwater need for livestock raising is a more important issue to the community than the demand for drinking water.* The importance given to the freshwater need of livestock could be attributed to the fact that it contributes as much as 37 percent to the annual household income (Participatory Estimates: 1995-7).

Fig. 7.1: Proportion of Water Quantity Used at Home and at Source, and Quantity Used by Activity



(Participatory Estimates: 1995-7)

7.3.4.1 Present Use of the sources

Contrary to the reports provided by the District Offices, out of the 37 sources, 26 were currently in productive uses (Table 7.2). The only unused source was located on a private property at Gerkhu Tar Dil. The area is fenced and not accessible to the people. As Table 7.2 suggests, at present the sources are being used for drinking, livestock rearing, and irrigation or in combination (columns on present and future use). *This observation gives a sense on the problems related to the formal database in the district. It also suggests that little opportunity is now remaining for supply-side management in the area.*

7.3.4.2 Use of Water and Income Structure

The findings revealed that *there exists a positive correlation between the income of households and the quantity of water used.* As Table 7.7 presents, the quantity of water use fluctuated by as much as 300 percent for the household with more than NRs. 75,000 of annual income compared to those with less than or equal to NRs. 25,000. Interestingly, the relationship does not change if the figure is extrapolated to reflect per capita income vis-à-vis quantity of water. Similarly, the average distance between the tap-stand is also considerably shorter for the people with a higher income (mostly Large Farmers) compared to those with lower incomes. *In future studies, accessibility to tap-water, and quantity of water used may be adopted as a viable and more accurate indicator to classify households into different strata.*

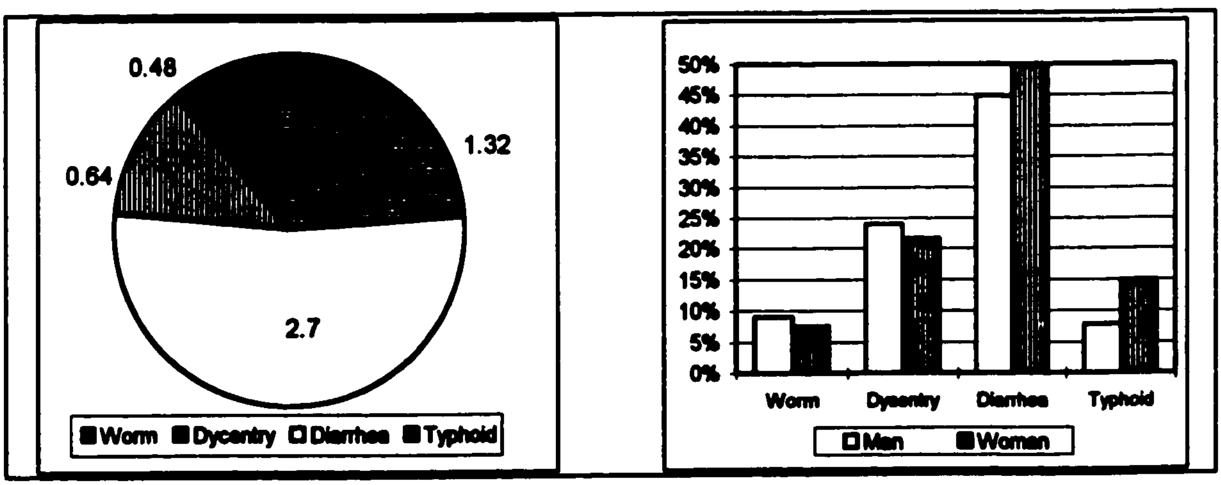
Table 7.7:Relationship between Quantity of Water and Income (NRs.)					
Attributes	Household Income (Per Annum)				
	≤25,000	25-35,000	35-50,000	50-75,000	≥75,000
Total quantity of water used (lt./hh./day)	263	319	461	565	734
Ratio between Brought home: Used at source	1:1.2	1:1.1	1.0.9	1:0.9	1:0.7
Average distance from the tap-stand (meters)*	251	235	180	165	113

* The figures are for the dry season. In the rainy season springs emerge in many parts of the area and substantially decrease the distance. (Participatory Estimates: 1995-7)

7.3.4.3 Issues Related to Water Quality

The incidence of water-borne disease in human beings and animals was taken as a proxy indicator to determine the water quality problems in the area. As Figure 7.2 indicates, morbidity due to water-borne diseases was very high in the area. On an average, every household suffered from 2.7 episodes of diarrhea, 1.32 episodes of dysentery, 0.48 episodes of worms and 0.64 episodes of typhoid cases per year. The distribution of occurrence of the diseases was uniform across the river reaches. Out of these figures, 50 percent of the cases were reported to be serious in nature and the remaining were minor illnesses. *However, in a country where the annual water borne morbidity is only four in every 100 people (WHO: 1984), the finding at the small watershed must be regarded as significantly higher than the national average.*

Fig 7.2: Average Number of Episodes of Water Borne Diseases by type (per HH) and Incidence by Sex



12 months (1995 June -1996 May) (Participatory Estimates: 1995-7)

Figure 7.2 also indicates that the incidence of diarrhea and typhoid are higher among the women. In contrast, the incidence of worm and dysentery are higher among men (Participatory Estimates: 1995-7). It is not that people in the small watershed are unaware about the situation. They are very aware. This issue was one of the most discussed topics in the group meetings. The people are aware of the need for boiling of water, but they flatly reject it based on the assertion that the cost of fuel could be even higher than that required for medical treatment. Similarly, at times when they are working on their fields, it is not practicable to carry water from home. They bluntly put that they would rather carry more agricultural implements and tools than water.

Table 7.8: The Reasons for Wage Loss in the Area (1st order only)				
	Upstream	Midstream	Downstream	Small watershed
Water Related Illness	37.8	30.0	34.3	34.03
Job is not permanent	33.3	35.0	28.6	32.3
Economic activity in the area	17.8	25.0	22.8	21.87
Other Illnesses	11.1	10.0	14.3	11.8
Total	100	100	100	100
Average Days of Wage Loss and Corresponding Values				
	Upstream	Midstream	Downstream	Small watershed
Average Days	11	17	9	12.33
Economically Active Members/hh	4.16	5.24	5.21	4.87
Average Wage Rate per person (NRs./day)	90	100	120	103.33
Total loss to the family income (NRs.)	4118.4	8908	5659.2	6228.53
Percentage of total household income	22.3	36.2	17.4	25.3

(Participatory Estimates: 1995-7)

The problem of water quality was also analyzed based on reasons given by the villagers for wage loss (Table 7.8). It is evident that water-related illness is a major factor for wage-loss in the area. Water-related illness resulted in a loss of as much as 36 percent of the total household income. The average days of wage-loss due to water-related illness was more than 12 during the period of June 1995 to May 1996. Based on this figure, the annual total wage-loss for the entire watershed calculates to NRs. 16.5 million. Consequently, the per capita loss of income due to water-related illnesses approaches NRs. 975 (Participatory Estimates: 1995-7).

It is evident from Table 7.9 that because of these diseases, more than 82 percent of the households had to forego some income for attending the sick members in the family. On an average, the opportunity cost to each family was about 4 days of job loss of the attendant. In addition, the average medical expense of the sampled households was more NRs. 1000. *If the opportunity cost of the attendant and medicines are added to the figure corresponding to the per capita loss, the total per capita loss due to water-borne disease approached more than NRs. 1200* (~ US $20 or 10 percent of the national per capita income estimate).

Table 7.9: Consequence of Family Member Suffering from Water Related Illnesses

	Upstream	Midstream	Downstream	Small watershed
Added responsibility	91.1	80	77.1	82.73
Average days of Wage loss of attendant (days)	5	3	3	3.67
Value of Wage Loss (NRs.)	450	300	360	370
Medical Expenses (NRs.)	980	1370	764	1038
Percentage of total Household Income	3.87	5.5	2.3	3.89

(Participatory Estimates: 1995-7)

The finding of this thesis contradicts the research conducted by Auffrey (1994) in The Philippines and Malawi. Unlike Auffrey's conclusions, this study found no relationship between water-related morbidity and the women's education or total household income. It, however, is in conformity to Feecham's work (1978). Like Feecham's conclusions, this thesis found that *water alone is not responsible for water-borne disease morbidity*. Evidently, if this were not the case, the total number of disease incidences would have been similar in all three river reaches. Consequently, hygiene is not affected by availability of water or, for that matter, by the proximity of a household to a water source. Justifiably, the availability of clean water reduces the total number of days in illness. Water-related illnesses also depend on the mobility of the villagers. The number of water-borne diseases was reported to be higher by almost three folds among those who frequently traveled in and out of the watershed.

The livestock sector equally suffers from the water quality problem in the area. During the fiscal year of 1995/6, about 82 percent of the morbidity in livestock resulted from water-related problems in the area. The District

Veterinary Office's out-patient register recorded 51 percent of the total animals from Gerkhu area suffering from tapeworm, 14 percent from sever diarrhea, 11 percent from Ascaries, and 6 percent from liver-fluke (DVH: 1996). The District Veterinary Officer opined that minor cases of diarrhea are locally treated. The total number of deaths recorded during this period was 14 for the entire watershed. The total loss due to livestock morbidity was assessed at the group meeting; and the average loss was appraised at NRs. 620 for per household per annum. However, this figure, according to the District Veterinary office, is significantly lower than the real loss (Field Survey: 1995-7).

7.3.4.4 Problems Encountered by Farmers

On an average, irrigation is available in the area for about 5 months in a year. The standard deviation for the duration of irrigation availability is 3.87 months. The farmers used more than one source. The shortage of water is also felt in the agriculture sector. Table 7.10 indicates that the most important problem that required immediate attention in the agricultural sector is the shortage of irrigation water.

Table 7.10: Problems Encountered by Farmers in Agriculture

Problem	Percentage	Rank
Shortage of Irrigation Water	98	I
Shortage of Inputs in Time of Need	58	II
Cash or credit shortage	36	III
Marketing, cooperatives facility etc.	38	IV
Lack of practical know-how and extension support	28	V

(In Multiple response) Participatory Estimates: 1995-7

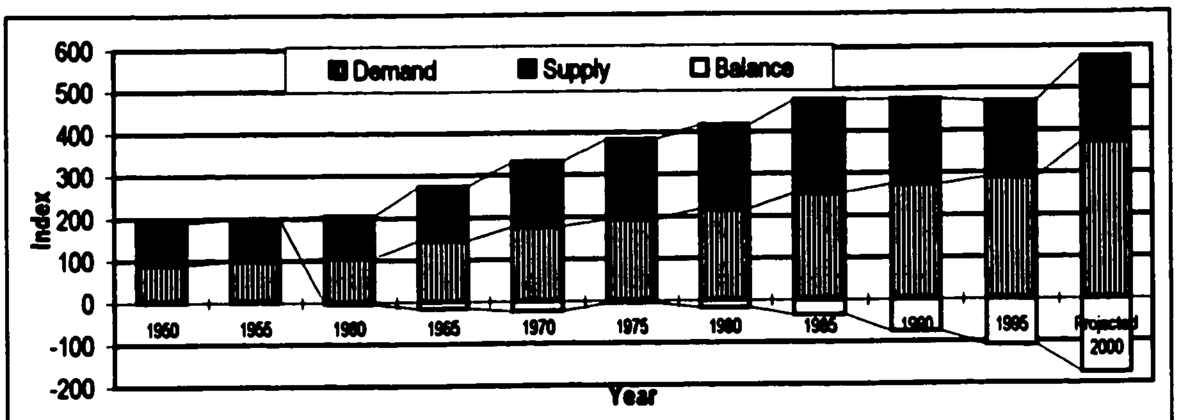
7.3.5 Water Balance

It has been described earlier that the total supply or the physical availability of water in the area is well above the total water demand. However, the quality of water in all available source and difficulty related to the exploitation provide a completely different scenario. This aspect was also put through a rigorous and iterative participatory analysis. The stone-and-stick method was used to analyze this aspect (Box: 7.5).

Box 7.5: Stone and Stick Method
This is a very commonly used method in participatory research. Normally, locally available stones and twigs are used to quantify or elaborate a variable or an issue. Care must be taken to select stones, pebbles, and sticks of uniform sizes. The value of each pebble, stone, or stick must be agreed before initiating the assessment. This method can also be used for comparative judgment, and to determine relative importance. (Ashe, J. (1979) Assessing Rural Needs: A manual for Practitioners, VITA, Mt. Rainier, USA; Carruthers, I. and Chambers, R. eds. (1981) Special Issue on Rapid Rural Appraisal. Agricultural Administration, 8 -6.)

The participatory analysis of the water balance was approached from two angles. First, the situations in the meaningful past and meaningful future were calculated based on the index value of 1950 as 100 (Fig 7.3). The response received indicates that the farmers were unable to predict the demand for water beyond the year 2000 AD. They perceived that by the year 2000, an additional quantity of water equivalent to about 180 index value would be needed to compensate for the increased demand (Participatory Estimates: 1995-7). Since villagers were not able to assess if they would be changing their cropping pattern or introducing new crops and new husbandry method, the analysis was not successful to determine the changes in the irrigation demand.

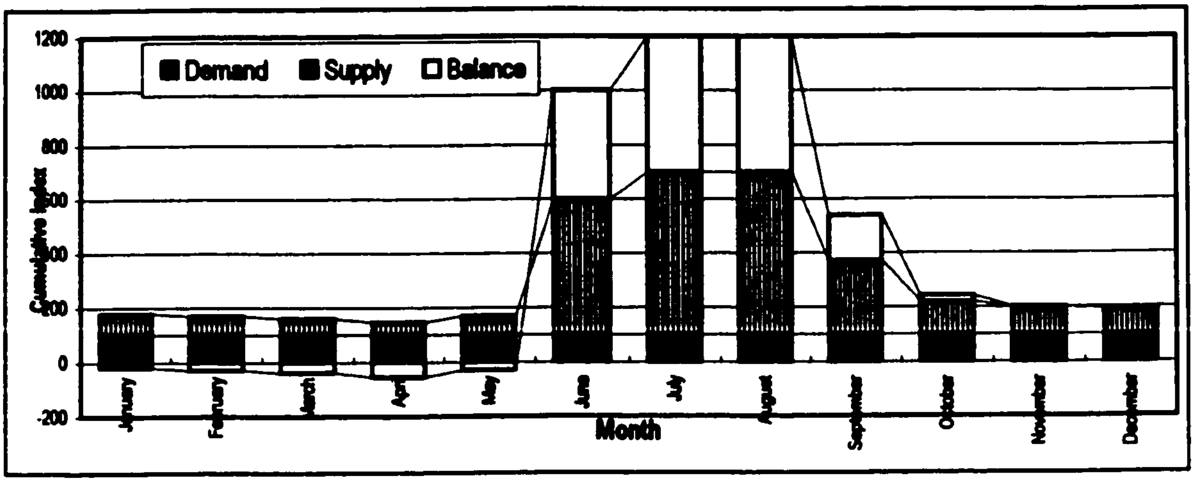
Figure 7.3: Demand, Supply and Balance of Water: Gerkhu Khola



Index: 1955 = 100 (Participatory Estimates: 1995-7)

Similarly, the villagers were asked to prepare an annual demand-supply-balance structure for the area. Figure 7.4 presents the summary of this exercise. Evidently with the demand remaining constant at 100 (adjusted to a constant drinking water demand of 65 lppd and irrigation water demand of 5.5 cm per day), the supply structure fluctuated by as much as 600 index points. The villagers' analysis matches with the monsoon and other seasonal hydrological characteristics of the area. Except for the months June to October, for the rest, the water balance was reported to be negative (Participatory Estimates: 1995-7). However, the analysis could not grasp the extreme hydrological events. *This provides a sense that the community deals with the hydrological dynamics by considering the normal precipitation in mind.* Thus, watershed community appeared to live in a constant fear toward the hydrological extremes. *However, on a positive account, this fear always kept people prepared for such events and represented a natural expression of disaster preparedness.*

Figure 7.4: Seasonal Demand, Supply and Balance of Water: Gerkhu Khola



Index: 40 lt./day = 100 (Participatory Estimates: 1995-7)

7.4 Analyses of the Actions Related to the Principles

The analyses presented in this section elaborate some of the demand- and supply-side observations those corresponding to the principles of sustainable water resource management (SWRM) (ICWE: 1992).

7.4.1 Actions Related to Principle I

Fresh Water is a finite and vulnerable resource, essential to sustain life, development, and the environment (ICWE: 1992)

7.4.1.1 Awareness of Water Resource Set-up

One of the remarkable findings of this research is the ability of the people of the small watershed to identify, assess, and do preliminary analyses of the tentative feasibility or exploitability of the water sources. The participant analysis revealed that the people often visit the sources and discuss among themselves the possibility of exploitation. This action was properly demonstrated in people's ability to identify the 27 sources in the area (Table 7.2). The survey data indicated that more than three-quarters of the respondents knew where the water sources are located in the watershed. More than two-third were knowledgeable about the tentative discharge of water and could tell the discharge of the sources almost accurately in their local measures. Similarly, about 69 percent were able to tell about the possibility of exploitation of water sources, which included the observation on the types of slope alignment requirements Similarly, 54 percent could tell the tentative fluctuation in supply (Table: 7.11).

The study solicited responses from the community to better assess their awareness of the finiteness of water. As Table 7.12 indicates, more than 92 percent of the people had noticed that the total physical availability of water is declining in the area. Similarly, about 86 percent could describe the water retention capability of the soil; 65 percent felt that the downhill run-off is increasing; and 61 percent felt that the discharge of some springs and sources as decreasing or drying out completely.

Table 7.11 : Respondents Knowledgeable about the Water Sources (%)

	Upstream	Midstream	Downstream	Small watershed
Aware about the Location	88.9	90.0	57.1	78.7
Aware about the water yield	75.6	75.0	51.4	67.3
Aware of the exploitability and slope alignment	82.2	75.0	48.6	68.6
Aware of the fluctuation at source	55.6	57.5	48.6	53.9

(Participatory Estimates: 1995-7)

Table 7.12: Common Responses that Support the Sense of Finiteness of Water

Common Response	Upstream	Midstream	Downstream	Small watershed
Water availability has declined	93.3	95	88.6	92.3
Water Retention capacity of soil has declined	86.7	92.5	77.1	85.43
The run-off has increased	71.1	87.5	37.1	65.23
Springs and water sources have dried.	60	72.5	51.4	61.3
Quality of water has declined	95.6	97.5	88.6	93.9
Water quality determines the available quantity	55.6	70.0	34.3	53.3

(Participatory Estimates: 1995-7)

There were two major responses, which supported the villagers' awareness regarding the interrelationship between water quantity and quality. In this token, 94 percent of the respondents had observed the declining quality of available water and about 53 percent could describe the relationship between the quality of water with the available quantity.

7.4.1.2 Coping with the Normal Stress

It is discussed in an earlier section that the villagers did not have a mechanism to deal with extreme hydrological events; however, they had a strong sense of preparedness for normal stress. Upon asked, how the community dealt with hydrological extremes, the villagers could not provide any definite answer. Given the physical setup of the landscape, and the normal monsoon cycle, minor landslides, inundation of the lowland area and water-related degradation were common in the area. *Although these incidences led to extensive damage, the community regarded them as 'normal' events* (Field Survey: 1995-7). However, such degradation have been interpreted as 'extremes' by many researchers in the past (Ekholm: 1978, Bhatta: 1981, Agarwal: 1982, Bruijnzeel and Bremmer: 1989, Alfrod: 1992). The community regarded these stresses[29] as part of the normal hydrological activity to which it felt comfortably adapted. *Conversely, the community responses during the times of 'extreme' stresses are different and applied on an 'as it comes' basis.*

It was revealed through the analyses that both drinking water and irrigation were considered as the major problems in the area. The community had adopted a number of activities to adjust to such stress. The farmers adopted these practices singly or in combinations; and the adoption did not follow a fixed order or pattern. The findings related to these practices were comparable in adjacent small watershed areas. Smadja's research in the Salme area, and APROSC's study in Chaugadha, both in Nuwakot District, indicated a similar response of people toward the hydrological variability (Smadja: 1994, APROSC: 1994).

Selection of Drought Resistance Crop Variety

Through years of selection, a majority of the farmers used drought resistant cultivars. Especially, the farmers used local varieties of maize, soybean, and mustard as winter-season crops. The irrigation requirements of these varieties were reported to be about 10 - 45 percent lower than the normal varieties of the same crops. *The trade-off between the yield loss due to the selection of these cultivars and the danger of total crop failure is well perceived by the villagers* (Participatory Estimates: 1995-7). The District Agriculture Office reported that the National Agricultural Research Council (NARC) is currently conducting an outreach-research to justify the farmers' action through scientific studies (Field Survey: 1995-7). However, none of the farmers claimed to have ever been visited by the scientists from NARC (Participatory Estimates: 1995-7).

Soil Moisture Management

Soil moisture management to reduce irrigation requirements was another common practice adopted by the farmers. This was normally practiced by leaving the land fallow, adopting zero-tillage-like practices, crop rotation and

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[29] Here the normal stress is defined as the conditions of average water shortage, landslides ensuing from normal monsoon rain, and excessive water availability during the peak monsoon precipitation.

optimizing the moisture content through various crop-husbandry methods, including less surface weeding, cultivation of green manure crop, etc. Similarly, some farmers also practiced mulching to retain the soil moisture. However, this practice was common only on the seedbeds.

Box 7.6: It is for the Mouse!

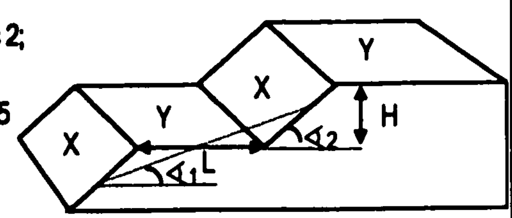
During June of 1996, Mr. Tuka Nath Pokharel, a resident of Bitalab, Gerkhu 5, his son and wife spent days to remove all the grass and vegetation cover of the X surface (see figure) of the terrace. Upon watching this action, the researcher, as anybody else, thought that the removal of vegetation cover would increase the runoff and the chances of soil erosion as well as decrease the water retention capability. Upon being asked, Mr. Pokharel replied that if the grass and other soil cover was left, the mouse and other wild animals would burrow holes on the surface of Y through X. As it would not be spotted with the soil cover, it could increase the chance of bigger slides. Thus, the vegetation cover actually increased the chances of erosion. This also provided an opportunity to spot all the weak points, animal burrows, and cracks, etc. on X surface and helped to keep a sharper focus on such weak points. Without cover, the field would appeal less to the domesticated livestock for grazing and reduce the chances of pre-monsoon trampling. Similarly, the reduced cover would lead to less weeds and reduced the requirement for weeding, and when the removed weeds would decompose on Y surface, it would increase organic matter content in the soil (Participatory Analysis: 1997). However, the slope of Mr. Pokhrel's field, except for those closer to the foothills, reached up to 32° for ∢1 and 59° for ∢2. There may be some unknown benefits to maintaining the outward sloping terrace, because the angles measure almost equal in all parts of the small watershed (Field Survey: 1995-7).

Terrace Shape according to Theoretical Stability (Green's Hypothesis on Slope Stability)

General Slope ∢1 ≤ 29°; Low wall slope ∢2 ≤ 1 times 2;

Low wall Height H ≥ 1.5; Terrace width L ≥ H times 1.5

(cf. Smadja: 1994:26)



<u>Siphoning Water From the Hydropower Project Channel</u>

About 12 people in the small watershed had their land very near to the channel that brings water from the Trishuli River to the hydropower plant in Trishuli Bazaar. Although it is illegal to draw water by using any pumping devices, these farmers have devised a unique way of irrigation. They irrigated the land below the channel by siphoning. It is very noteworthy that such practices, although very unsustainable by modern definitions, increased the productivity by as much as 30-50 percent.

<u>Adjustments in the Planting Time</u>

The other unique method adopted by the people in the small watershed was the shifting of the planting or transplantation time to coincide with the rainfall. It was observed that the farmers wait for as much as two months to sow maize or transplant rice (Participatory Estimates: 1995-7). *The shifting of the planting dates often led to a loss of yield by as much as 30 percent, however, the total saving of the farmers in terms of the seed and fertilizer or total crop failures compensated the loss.* The lower yield reported in the area, to some extent, could be attributed to similar adjustments.

Utilization of Spring by Digging a Ditch Around the Source

It is described in an earlier section that to most of the households, the water available in the tap was not enough for the entire year. Because of this, the farmers would identify alternate water sources to be exploited during the time of such stress. Normally, they selected the seepage in the spring and collectively dug a ditch of about 2 feet in radius around it. This would increase the total water storage area around the seepage. The villagers did the same thing for small wells (Participatory Analysis: 1995-7).

Collection and Use of Rainwater in Earthen Pond

The villagers also collected rainwater in earthen ponds dug in their back yard and used it for vegetable cultivation. The size of such ponds varied from 3 to 10 cubic meters. However, these ponds rarely hold enough water to be used for any other purposes. Some farmers use the manure pit to collect rainwater, which often create health problems to small children and other members in the community. The collected water was nearly enough for the kitchen garden of a size of 15 square meters (Participatory Estimates: 1995-7).

Construction of Temporary Headwork

It is described earlier that farmers constructed irrigation structures to irrigate their fields on either banks of Gerkhu Khola. To divert the water to their fields, farmers developed temporary headwork, irrigation canals, and diversion structures. These structures seldom lasted the peak monsoon flow; however, such structures provided insurance to the farmers until the monsoon arrived. This was one of the reasons why the farmers having cultivable land in the lowland areas seldom complained about the problems of irrigation. However, during the winter season, frequent disputes emerged for the sharing of water.

Waste Water For Vegetables

The majority of the respondents had a unique method of increasing the efficiency of total water brought home. All the water used for the household chores would be allowed to flow through a small trench either to the kitchen garden or to the earthen pond described earlier.

Water Retention Ridge Construction

In order to check the loss of water from paddy-fields and its controlled flow from one parcel of the field to another, farmers prepared ridges (approximately 30 cm to 45 cm high) on the edges of the field. While ridges reduced the velocity of downhill runoff by as much as 50 percent, they also helped in retaining water for paddy cultivation. This practice was quite common, because it helped retain water for a number of days. Furthermore, it helped in application of fertilizer, and improved the nutrient uptake.

7.4.2 Actions Related to Principle II

Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels

7.4.2.1 Knowledge About the Present Initiatives

One of the primary concerns of capacity assessment was to find out if the people had any knowledge about programs currently being implemented in the area. As the analysis indicates, 22 percent of the people were aware of the government's initiatives. About one-third had heard about NGOs operation in the area (Table 7.13). Similarly, 80 percent of the people were aware of the local initiatives for WRM in the area. This observation provides a sense that in a small watershed like Gerkhu Khola, an informal way of innovation diffusion often works better than a structured approach. Similarly, it provided a sense that such linkages could also be effectively used in disseminating any new external intervention in the area.

Table 7.13: Percentage of Population Aware About Current Initiatives

	Upstream	Midstream	Downstream	Small watershed
Government Initiation	13.3	20.0	34.3	22.5
NGO's initiations	17.8	11.4	77.1	35.4
Community Initiation	84.4	82.5	71.4	79.4

(Participatory Estimates: 1995-7)

7.4.2.2 Collective Works

One of the major findings of this thesis was on the villagers' way of communication, idea sharing, diffusion of ideas, and responsibility sharing. The research tried to evaluate the villagers' performance in the collective works. During the research period, about 93 percent of the respondents participated in meetings, 37 percent contributed ideas, 59 percent contributed labor, and 33 percent contributed cash or kind for the collective works. Consequently, the total value of such contributions during 1995 June to 1996 May was NRs. 1140 per household (Table 7.14). *This is a very high amount, if the average per capita contribution in water resource projects at the national level is taken into* *consideration (IIMI: 1997)* (see Chapter 4). This figure was initially regarded as less credible, because there were not many visible projects that could validate the value of their contributions (Participatory Estimates: 1995-7). However, the participatory observation revealed that the farmers did spend more than 15 days in maintaining the irrigation canals and contributed a minor amount of money to buy some cement and other fixtures to fix the reservoir. *If the opportunity cost of labor is taken into consideration, this amount comfortably justifies the farmers' claim.* This finding indicated that the small watershed offered itself as a good ground to implement projects requiring labor contribution. However, except from a limited number of individuals belonging to higher strata, people should not be expected to contribute in monetary terms.

Table 7. 14: Percentage of Population Who Spent Time in WRM

	Upstream	Midstream	Downstream	Small watershed
Participated in Meetings	93.3	87.5	97.1	92.6
Contributed Ideas	22.2	37.5	51.4	37.0
Contributed labor	12.2	12.5	10.9	11.9
Contributed Cash/kind	24.4	32.5	42.9	33.3
Value of labor cash/kind Contribution/ hh NRs.	970	1100	1350	1140

Response for the thesis period (1995-96) (Participatory Estimates: 1995-7)

7.4.2.3 Knowledge of Existing Planning Structure and Budgeting Process

One of the fundamental concerns and meanings of WRM is to bring the planning process closer to the people and make it more transparent as well as participatory. As a proxy indicator to this fact, the analyses revealed that only 29 percent of people were aware about the planning process and 21 percent actually participated in the planning process (Table 7.15). It must be noted, however, that the district offices are responsible to prepare plan for entire district, of which Gerkhu Khola is only a small part. Yet, with the new projects being implemented in the area, the figures appear as inconsistent.

A similar issue is the participation of the people in the budget preparation process. The survey data indicates that only 22 percent of the respondents were aware of the budget structure and only about eight percent had received an opportunity to participate in this process. Upon being asked if those who participated were given an opportunity or were encouraged to contribute, all answers were negative. Most of them were either not allowed speaking in such meetings, or were too much influenced by the presence of the officers among them.

Table 7. 15: Percentage of Population Aware and Participated in the Planning and Budgeting Process				
Planning Process	Upstream	Midstream	Downstream	Small watershed
Aware	22.2	27.5	37.1	28.9
Participated	22.2	12.5	28.6	21.1
Budgeting Process	Upstream	Midstream	Downstream	Small watershed
Aware	8.9	20.0	37.1	22
Participated	2.2	2.5	20.0	8.23

(Participatory Estimates: 1995-7)

7.4.2.4 Awareness of the Water Rights

Table 7.16: Percentage Response Regarding Awareness of the Water Rights and Legal Provisions				
	Upstream	Midstream	Downstream	Small watershed
There exists a legal provision	8.9	7.5	17.1	11.2
Fundamental right provisioned in the new constitution	4.4	15.0	22.9	14.1
Awareness About the Legal Provisions				
Muluki Ain	64.4	72.5	71.4	69.43
Water Resource Act	4.4	0	11.4	5.27
Water Resource Regulation	4.4	0	11.4	5.27
Irrigation Policy	8.6	0	17.1	8.57
Decentralization Act	40.0	45.0	62.9	49.3
Solid Waste Management Act	0	0	2.9	0.97

(Participatory Estimates: 1995-7)

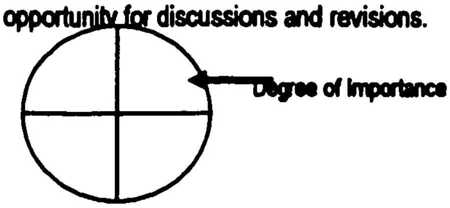
Although not fully, but only 11 percent of the total respondents knew about the legal provisions of WRM. In the same token, 14 percent knew that the new Constitution of Nepal, 1990 has safeguarded Nepali citizens' right to use natural resources, including water (Table: 7.16). The awareness of these provisions was minimum for the respondents in the upstream, and highest for the respondents in the downstream areas. This discrepancy could be attributed to the proximity of the downstream people to the district headquarters. The researcher asked if the villagers had a different sense of water right. The answer received in this regard was very encouraging. Reportedly, people think that they are maintaining their water rights by participating in the community efforts to manage water, in construction, rehabilitation, and maintenance of drinking water projects and irrigation systems.

7.4.2.5 Awareness of the Legal Responsibilities

The research also assessed people's knowledge toward various water resources acts and laws. Muluki Ain appeared as the most popular legal document in water resources. About 70 percent of the respondents were aware of this civil code of conduct. The Decentralization Act was also popular among the people in the area. Other acts, which are recent, come with standard codes, and bestow their allegiance to the people (Khadka: 1997) were least known to the people. *Water right was differently defined in the community and was regarded more as a territorial than legal right.*

Box 7.7: Pie chart Method[30]

The Pie Chart method is a very easy to administer and is a commonly used tool in PRA. The method is commonly used to determine relative importance. A pie is drawn on a sheet and diametrically divided into four, eight or 16 segments. The respondents are then asked to color or paste paper cut-outs over the divided segments to express comparative importance or familiarity of one variable to the other. By nature of its administration, it allows ample opportunity for discussions and revisions.



(Ashe, J (1979) Assessing Rural Needs: A manual for Practitioners, VITA, Mt. Rainier, USA. Carruthers, I. and Chambers, R. eds. (1981) Special Issue on Rapid Rural Appraisal. Agricultural Administration, 8 -6.)

An interesting observation could be made at this point. If the present mode of water utilization the area were to be examined vis-à-vis the legal provisions in the country, all collective utilization and almost two-thirds of the individual utilization would become illegal. It is because the WRA and WRR assert that water can not be utilized unless the users obtain a legal use-right from the DWRC or have it legally transferred from someone, who holds a right to use the water (Chapter 4).

7.4.3 Actions Related to Principle III

Women play a central part in the provision, management, and safeguarding of water (ICWE: 1992)

[30] A similar approach was used to collect pair-wise comparison data for preference analysis.

7.4.3.1 Responsibility for Water Collection

It is evident from table 7.17 that the responsibility for water collection lied almost entirely on women. The pie method was used to determine the level of responsibility borne by men, women, and children. Evidently, more than 80 percent of water collection tasks were the burden of women. The men and children each contributed about eight percent toward the collection responsibility. The figures, however, were often disputed, as men took it as an insult during the group discussions. During participatory analysis it was observed that women begin their day as early as 3:15 a.m. and end as late as 11:30 p.m. *Interestingly, women's first and the last tasks of the day were water- related.*

Table 7.17: Responsibility of Water Collection (Percentage)

	Upstream	Midstream	Downstream	Small watershed
Women	80	85	87	84
Men	12	7	5	8
Children	8	8	8	8

(Participatory Estimates: 1995-7)

7.4.3.2 Time Spent by Women in Collecting Water

It is indicative from Table 7.18 that women spent as much as 9 hours every day to fetch water. The average time spent for every trip was 25 minutes. The time includes to and from journey to the water source. Women made between 19-30 trips to the source everyday (standard deviation 17.4 for the entire data set). The opportunity cost for every woman on time spent in water collection and management was as high as NRs. 89 per day. Thus, *one of the major factors that determined the type of source to be utilized depend on women's willingness to travel and total amount of time they want to save by using a particular source. Consequently, this information served as the basis to determine the source(s) for improvement.*

Table 7.18: Average Time Spent by Women in Water Collection (Per day)

	Upstream	Midstream	Downstream	Small watershed
Number of trip to and from the tap/hh	25	18	20	21
Average time spent per trip (minutes)/hh	20	30	19	23
Total Time Spent (Hour)/hh	8.33	9.0	6.33	9.05
Equivalent Value in Wage NRs.	83.3	100.0	84.4	89.23

(Participatory Estimates: 1995-7)

7.4.3.3 Appreciation on the Time Spent by Women

Table 7. 19: Appreciation to Women's Work				
	Upstream	Midstream	Downstream	Small watershed
Social Responsibility	80.0	75.0	85.0	80.0
No Comment	10.0	15.0	10.0	11.7
Appreciate	10.0	10.0	5.0	8.3

(Participatory Estimates: 1995-7) Figures are percentage

The majority of the people in the small watershed did not appreciate the amount of work done by the women in WRM. It is generally believed that the WRM efforts made by women is integral to the societal role that they ought to play. The respondents felt that the work that women put in collecting and managing water are their social responsibility. Only about 8 percent of the people appreciated the work done by women. About 12 percent respondents wished not to comment on this subject.

7.4.3.4 Women' Participation in WRM

It was very unfortunate to note that not only the community but the external efforts also ignored women during planning, training and management exercises. As the survey data indicated, none of the sampled women had ever participated in such activities. This necessitated a total enumeration to find out the difference between the opportunity provided to men and women in the area. Only one woman received an opportunity to participate in the training programs organized outside of the small watershed, whereas about 13 women were trained on different aspects of water/agricultural/forest management. Five women, including one from among the sample, had participated in the planning exercises. However, women had yet to receive any opportunities to attend management committee meetings.

Table 7. 20: Comparative Participation in Water Related Planning and Management Activities*								
	Upstream		Midstream		Downstream		Small watershed	
During 1996 April - 1997 August	Women	Men	Women	Men	Women	Men	Women	Men
Training outside the watershed	0	7	0	6	1	9	1	22
Training inside the watershed	2	13	4	19	7	25	13	57
Attendance in planning exercises	1	3	2	4	2	7	5	14
Management committee meetings	0	1	0	1	0	3	0	5

(Participatory Estimates: 1995-7) *Total Enumeration in number

In contrast, 22 men received training on various aspects that were conducted outside the watershed area. Similarly, 57 men were trained within the watershed area, 14 were given opportunity to participate in the planning exercises, and a few participated in the WRM decision-making exercise. Although a distinct relationship could not be drawn, the WRM ability in men appeared comparatively more refined than that of the women.

To understand the above assertion, two drinking water systems, one managed entirely by men and the other by women group, were compared (Table 7.21). As the table indicates, although the system managed by women was fairly new, its physical and managerial conditions were comparatively weaker than that managed by men. Especially, the conveyance efficiency and the sanitary condition were significantly better in the project managed by men than in that managed by women (Field Survey: 1995-97).

Table 7.21: Comparison between two Drinking water Projects in the Area

Attributes	Managed by Women	Managed by Men
Location	Gerkhu 3	Gerkhu 3
Radius of the pipe	1.5 cm	1.5 cm
Established Year	1996	1986
General condition	Fair	Fair
Sanitation Condition around the tap-stand	Fair	Fair
Condition of the source	Degraded	Fair
Sanitation around the source	Unsanitary	Fair
Number of leakage	2	5
Conveyance Efficiency	67 %	72%
No of disputes in the last 12 months	9	5
Meetings held in Last 6 months	1	2
General preference of use	Not much liked	Fairly liked

(Field Work: 1995-7)

The success of the project managed by men may be attributed to the opportunities received by men as compared to women. However, this relationship was impossible to corroborate during the group discussions. First, none of the male respondents could describe the content of the training programs or summarize the knowledge gained from them. Second, the comparison of two projects could not be generalized to provide the picture in totality. As this was the first project initiated and managed by women, many felt that the present level of achievement itself must be realized as satisfactory (Participatory Estimates: 1995-7).

7.4.4 Actions Related to Principle IV

Water has an economic value in all its competing uses and should be recognized as an economic good (ICWE: 1992)

7.4.4.1 Understanding of Economic Value of Water

More than 90 percent of the respondents expressed that any effort made to manage water reduces the total amount of time spent in collecting water (Section 7.4.3). The opportunity cost borne for walking long distances and through missing days of works (Sections 7. 3 and 7.4.3) were in the knowledge of the villagers. A tentative estimate of the benefits foregone provides a figure in excess of NRs. 3600 (Table 7.22). The villagers also knew that management of water involves a struggle against the topographical realities. About 86 percent felt that such space manipulation, expressed in terms of transferring water from one place to another, is extremely expensive. The community knew and was positive about the necessity and requirements of external support to improve the water quality. As many as 92 percent of the people felt that there exists a need for external support. However, the community was not too enthusiastic about the need for cost sharing in WRM.

Table 7. 22: Common Responses that Supported the Sense of Economic Value of Water

During 1996 April – 1997 August	Upstream	Midstream	Downstream	Small watershed
Appreciation to time saved	84.4	97.5	88.6	90.2
Opportunity cost of water collection (NRs.)	3275	4446	3129	3616.7
Space manipulation of water is very expensive	88.9	87.5	82.9	86.4
Require support to bring it to a usable form	91.1	95.0	88.6	91.6
Aware about the need to share the cost	66.7	55.0	65.7	62.5

(Participatory Estimates: 1995-7)

7.4.4.2 Priority of Water Use

The community's knowledge on the value of water could also be sensed through the community's prioritization of use of water. As demonstrated in table 7.23, livestock received the top priority, which, in fact, also was the largest source of household income (about 37 percent). The cumulative ranking for the quantity required for drinking was the lowest, while that for the livestock need was the highest.

Table 7. 23: Priority of water use										
	1st order		2nd order		3rd order		4th Order		Cumulative ranking	
	Need	Quantity	Need	Quantity	Need	Quantity	Need	Quantity	Need	Quantity
Livestock	13	60	80	40	10	7	17	13	II	I
Drinking	107	5	13	35	0	20	0	60	I	IV
Washing	0	30	14	15	80	50	26	25	III	II
Bathing	0	25	13	30	30	43	77	22	IV	III
Total	120	120	120	120	120	120	120	120		

(Participatory Estimates: 1995-7) (*Includes chores, cleaning etc.)

7.4.4.3 Realization of Lost Wage and Opportunity

The community's realization of the finiteness of water could also be illustrated by citing the concern of people regarding wage and opportunity loss. As demonstrated in section 7.4.1, the community was fully aware and responding to the loss of income through unavailability of irrigation and clean drinking water.

7.4.4.4 Investment in Water Resource Development

It is demonstrated in section 7.4.2 that the economic value of water was well appreciated by the people in the area. The farmers' sense of contribution in WRM could be realized through the amount of labor and other contributions made for the development of water resources. Besides, there were a few personal initiatives made by the farmers. The case of Mr. Ghimire is provided in the Box below.

Box 7.8: Mr. Nara Nath Ghimire's Effort
The small farm of Mr. Nara Nath Ghimire of Gerkhutar, Gerkhu 3, is located on the western slope of Gerkhu VDC. He has managed to develop a personal Kulo (canal) from Gerkhu River that brings close to 2 lps water to his homestead. The conveyance efficiency of his Kulo is about 60 percent. The water is securely channeled to a pond that holds approximately 20 cubic meters of water. Mr. Ghimire's effort has been regarded as unique in the area, as he uses the pond not only for irrigation and drinking, but also to rear silver carp. It is a routine for Mr. Ghimire to walk with a small Kuto (a rake-like agricultural tool) twice daily along the length of the Kulo (about 500 meters) removing small crabs that notoriously burrow holes. He immediately fixes any structural problems as soon as he notices them.
(Participatory Analysis: 1995-7)

7.4.4.5 Cost of Production

Table 7.24.Cost of Cultivation and Gross Margin of Major Crops of Upstream (NRs. Per hectare)							
Inputs	Paddy L.	Paddy I	Wheat	Maize	Pulses	Oilseed	Potato
Seed	400	600	800	154	400	105	5000
Manure	800	1750	900	400	440	600	1650
Fertilizer	450	1000	1125	250	150	150	1750
Agro-chemicals	-	170	250	60	-	350	300
Human Labor	4840	5120	3180	3200	1440	2800	11200
Bullock Power	1750	1750	1700	1960	420	1540	2940
Agri-Machine	-	-	500	-	-	-	-
Total Variable cost	8240	10390	8455	6024	2850	5545	22840
Total Fixed Cost	276	276	276	276	276	276	276
Total Cost of Cultivation	8516	10666	8731	6300	3126	5821	231116
Gross Income	12736	12851	9000	8690	4840	7875	27450
Gross Margin	4220	2185	269	2390	1714	2054	4334
Midstream (Per hectare)							
Seed	292.5	600	800	200	400	100	4900
Manure	750	1000	900	300	300	300	1500
Fertilizer	450	1000	1100	667			1810
Agro-chemicals		150	200			500	600
Human Labor	4760	4800	4480	3180	1200	2800	11600
Bullock Power	1610	2100	1770	1360	210	700	2800
Machine and Implements			800				
Total Variable cost	7862.5	9500	10170	5707	2110	4400	23210
Total Fixed Cost	276	276	276	276	276	276	276
Total Cost of Cultivation	8138.5	9776	10446	5983	2386	4676	13786
Gross Income	11340	12790	9700	7800	3250	6300	25835
Gross Margin	3201.5	3014	-746	2369	1140	1624	2901
Downstream (Per hectare)							
Seed	200	400	700	100	320	50	5000
Manure	600	700	600	300	300	300	1000
Fertilizer	450	800	1100	-	-	-	1555
Human Labor	4080	4800	2800	2920	1200	2400	10800
Bullock Power	1260	1400	1630	1070	210	560	2800
Agri-Machine				500			
Total Variable cost	6590	8100	6830	4890	2030	3310	21215
Total Fixed Cost	276	276	276	276	276	276	276
Total Cost of Cultivation	6866	8376	7106	5166	2306	2586	21491
Gross Income	10500	10665	7750	6500	3730	5754	26374
Gross Margin	3634	2289	644	1610	1700	2444	5132

The survey analyzed the cost of production and conducted gross-margin analyses as proxy indicators of the villagers' sense of economic value of water. The detailed costs of production of selected crops by the river reaches are presented in Table 7.24. The fixed cost was calculated based on land tax and depreciation of tools and utilities used within the farm. The variable cost constitutes the price paid to buy inputs viz. fertilizer, seed, manure, and agro-chemicals. The labor cost constitutes both human and draft animals. The margins calculated include the opportunity cost of family labor. It is evident that *selection of a less profitable option in most of the cases is due to the unavailability of water, social milieu, and food habits rather than the margin of the crop per se.*

Interestingly, the margin of improved paddy was considerably lower than that for local paddy. This could be attributed to the frequent irrigation demand of the improved paddy. *This finding supports that the people in the small watershed have a unique sense of adjusting their cropping pattern to suit to the water availability of the area.* The gross margin for wheat was found to be minimal and even negative in the midstream area. This provides the justification for adopting a mono-cropping system by the farmers. This issue could also be corroborated by presenting the figures for minor crops like potato, pulses, and oilseeds. Even with considerably lesser attention, these crops provided considerably better yields and margins. However, these were not very popular among the people because the performance of these crops depends on the availability of good irrigation. Seemingly, the people base their agricultural pattern entirely around available quantity of water.

7.5 Implications of Action Analysis

This section provides a synthesis of the foregoing discussion and consolidates the water- related realities in the area.

7.5.1 The Problem Structure

The action analyses showed that there are a number of problems and weaknesses (anti-capacity) that needs to be properly answered in order to improve the WRM situation in the area.

7.5.1.1 The Three-Pronged Problem

The problems related to water utilization in the area can be explained in three ways. In the small watershed, the *first problem* of water was related to the *physical reduction in the per capita availability of water.* This has occurred due to the changes in demand as well as supply-related variables. The demand-related pressures have increased due to the expansion in total number of settlements, changes in the population characteristics and, to some extent, changes in the life style that requires more water. The total population in the sub-basin increased by approximately 18 percent during the past six years and is increasing by 2.4 percent annually. During the same period the literacy rate, which is linked to cleanliness consciousness (Auffrey: 1994), increased by almost 16 percent and is increasing at a steady rate (CBS: 1998). All of these have contributed to an increased demand of water.

Similarly, the Langtang-Trishuli watershed area faces a great diversity in human activities that range from migration to transhumance. The studied area has not escaped altogether from these dynamics of socioeconomic importance. These issues also have strong manifestations to the regions' hydrological and WRM realities. In the same context, the studied area provides an income generating opportunity to enterprising people from the high mountains to establish especially, the tourism-related services. Such establishments have sprawled in the snout of the Gerkhu Khola. This has caused a unique urban-rural interaction. Consequently, the people living in the small watershed, although indirectly, have started to receive economic benefits that surpass their traditional agriculture. The motorable road that joins the north-south corridor of central Nepal (Kathmandu -Trishuli-Syabrubesi Highway) has added an extra momentum to this dynamism.

Landuse changes and increased human activity have equally influenced the supply-side of water. The degradation of some of the supply sources has strong socioeconomic and environmental importance. In short, the demand and supply side dynamism has reduced the total quantity available in the area. A related issue is the numerous development-related pressures – especially those associated with governmental programs – emerging in the area that have distorted the people's observance of the micro-hydrological cycles. Forest concessions, quarrying licenses, and incoherent measures for afforestation all have negative impacts on the fragile watershed system. These all result in a high rate of run-off and, consequently, increase the seasonal disparity in total water supply. *The disparity has very little to do with the wider hydrological cycle and these problems are very specific to this area.*

The *second reason* contributing toward the problem is the *deterioration in the quality of water*. The changes in lifestyles of the people in the small watershed have led to an increased waste production. Although villagers have devised strong managerial strategies, often some episodic occurrence leaves a long-term impact on the quality of water. Only 14 out of the total sampled households had pit latrine systems constructed in their backyard. Without a proper waste management system, even unknowingly, the quality of the fresh water degrades in the area. The shrinkage of forest, pastureland, and increased agricultural activities have opened up the water sources as the best site for livestock grazing. The increased incidence of animal waste and human waste around the supply sources are the result of these activities. Although the extent of industrialization is very small, most of the existing facilities dump their waste directly in the river without treatment. The analyses of water sources (tables 7.2 and 7.3) attest these facts.

The third problem is the effect of the quantity reduction and quality degradation in the use of other resources and income generating activities. Due to these factors, not only agricultural productivity but also other economic activities have been affected. The degradation of water releases a long strand of effects on other associated resource systems. It is not that the villagers are unaware of the emergence of these problems, they are! However, if the existing socioeconomic conditions and the level of efforts are concurrently analyzed, this proves that external efforts in the form of local capacity building measures are definitely needed.

7.5.1.2 General Weaknesses (Anti-Capacity)

The action analyses also indicated weaknesses in the area. Brief discussions of some of the weaknesses are provided in the following bulleted list.

1. Although farmers could express the importance of quality of water and perform an almost academic level of cost-benefit analysis, they portray themselves as invincible to water-borne diseases. They clearly believe that the water, if is flowing, can never be impure.

2. The community explained that the lack of fuel is one of the reasons, why they do not boil water. It was later observed that the farmers could receive a subsidy of up to NRs. 10,000 to build a toilet and biogas in their homestead from the Agricultural Development Bank. This could eliminate two of the immediate problems seen in the area – the human waste contamination in water and the shortage of energy. However, they felt that cooking or even using biogas is unsanitary and against their Hindu beliefs.

3. The large farmers are closer to the planning, budget, and administrative process. In contrast, the small farmers and women hardly received any responsibilities. The most disturbing fact was the unwillingness of women and small farmers to participate in the WRM planning process, even when opportunities were provided. It appeared that a patron-client relationship persists and it is very deeply rooted in the community.

4. As already described, the farmers have unanimously decided to discontinue some of the local institutions. The recent takeover of temporary headwork maintenance by a local NGO could be cited as an example. This, however, could have two separate manifestations. Firstly, may be the society has advanced and the NGO taking over of this task is the mode of societal adaptation to changing resource environment. The second, however, could be the influence of negative modernization.

5. The conflicts were reported in abundance. There were 3 formal court cases, which have evolved out of water disputes. Gupta (1993) defined that the conflicts are sometimes the expression of the existence of democratic rule in the community. The conflicts arising in the community could be an overt example of such democratic exercise. Yet, the other explanation could be that the conflicts arise when there is a scarcity. Thus, *it was very difficult to understand exactly what prompted conflicts in the studied watershed.*

6. In some parts of the watershed area, farmers did not seem serious in farming. For instance, near Trishuli, most of the landowners did farming as a secondary occupation as many of them were engaged in other activities like trade, business, or service. It was apparent that they were holding land for speculative purposes. This has created an extreme sense of nonexcludability in the community (Bruke and Heaney: 1975, Easter and Hearne 1993). The term, nonexcludability, refers to the difficulty in excluding the non-participating (for modern systems, non-paying) individuals from taking benefits from WRM efforts. A similar issue was observed by Odihi (1988) in Nigeria. He posited that often such circumstances lead to a condition known as *supply drought*, which is unwillingness of people to exploit or manage available sources.

7. It is apparent that the villagers have, but can not use, software systems (knowledge) because they lack proper hardware (technology) to optimize them. Similarly, the modern water management has hardware systems that can seldom stand-alone. A logical link of these two "wares" can help achieve the ultimate goal.

Seemingly, the problems at the small watershed level could go beyond the manageability of the people and indirectly, it indicates the need to develop a new hybrid management method by logical crossing of "people's science" and "contemporary management sciences". Similarly, the efforts are extremely essential to internalize the peoples' action and sense of finiteness of water, users' role and participatory framework, women's role and economic value of water into any programs planned are conceived in the area.

7.5.2 Solution Structure

The action analyses provided a number of strengths or ingenuity (Capacity) existing within the community that could be utilized to better manage water in the area.

1. Although the locally evolved institutions are started to submit themselves to the organizations, whose operation is characterized more by external demands than internal commands, there still exists a few that can be utilized for better WRM. Simultaneously, local NGOs are also evolving into sound organizations in the studied area. Although these local NGOs have yet to venture into WRM practices, their success in the other sectors provides an encouraging scenario. The existing NGOs, except for one exception, are not in any controversy, and a free, fair and democratic norm and practices are observed in their overall functions

(Participatory Analysis: 1995-7). The revival of existing institutions and the externally developed organizations, however, depend above all in securing their compatibility with the people's culture and society. The people also need to realize that such activities are beneficial and must be continued. However, considering the examples that characterize the communities sense of participatory operation (Box 7.9), *it does appear to be an easy task.*

2. Another aspect is the community's ability to sustain the essence of participation, despite the community having gone through massive modernization and changes. It was observed that the degree of participation in the traditional institutions has remained the same, except in some cases where such institutions have been abandoned.

3. The smallness of the watershed is beneficial in that it secures the level of interpersonal relationship.

4. People's perception of benefits of safe water is significantly higher and they are willing to travel longer distances and spend time to get safe water even when unsafe water was near at hand. In quantitative terms, on the average, people value their time at a rate slightly less than half the wage for unskilled workers. This valuation increased with income level.

5. The analysis amply demonstrated that the resource deprivation is positively correlated to resourcefulness. If the data are synthesized in perspective, the midstream people suffered most compared to the upstream and the downstream reaches. The analysis indicated that the respondents from the middle reach are the most knowledgeable about the resource set-up in the area, have contributed most in WRM, have the highest regards to the work of women and also have understood the value of water. Thus, there exists a strong relationship between the deprivation and the relative refinement of the management responses

7.5.3 Dilemma of CATCH -22

CATCH -22 was conceived as an acronymic response to synthesize the problem and solution structures within the area. The major issues that emerged and left unanswered are the Core of the solution/problem, extreme cases of Alienation, annexation, and arbitrariness, the Threshold issue, lack of a Common platform, Haphazard management planning, and the context of bi-polar distinction (22).

7.5.3.1 Core of the Solution

There has never been any program that regarded local people as the centre of the program. (UDA: 1988). The villagers could draw a time-line since the initiation of the Trishuli-Devighat Hydropower project in the early sixties. There have been a number of other initiatives like Rasuwa Nuwakot Integrated Rural Development Project, which operated in the area for more than 10 years (APROSC: 1984). The ADB's sector irrigation project and ILC irrigation rehabilitation project also operated in the area for a number of years (DIO: 1997). However, people still lack the confidence and often express that the projects are for the officers and not for them. The recent efforts by DANIDA do not altogether escape this criticism. However, it is very recent and it is yet to be seen to what extent and how it enters the area and takes people as part of its modus operandi.

Thus, public participation in the area has been a misnomer. *People hardly believe that a construct of planning exists for achieving success by the people and not for them.* Seemingly, this situation has emerged because the local potentials, indigenous technology, local institutions, and local level aspirations and needs have never been considered in WRM processes. The villagers' response on their participation in planning and budget processes elucidates this fact (Section 7.3.3).

7.5.3.2 Forgotten <u>As</u>

<u>Alienation</u>

Following Anish Dani (1989), the concept of alienation has been adopted to synthesize the problem and solution structure. The alienation refers to the removal of the people's right to use water. For example, a drinking water system for the Trishuli Bazaar was completed on Phalangu Khola in the same year as this study started. The pipe (12 cm in diameter) that takes the water to the bazaar has been aligned along the length of Gerkhu 3. However, the people are not allowed to take even a single glass of water from the project. Consequently, the villagers allowed their children to puncture a hole in the pipe or damage it. It is definitely not to express their sense of vandalism but to express anger against the alienation. By 1997, all the pipes were put in a trench and this problem has been solved. However, even now, if the villagers see leaks or other damages, they do not report them to the authority.

<u>Annexation</u>

Annexation normally reduces the importance of the entity being added to the main. All the programs previously implemented in the area were designed for Trishuli basin or for Nuwakot District as a whole. Being closer to the district headquarters, the area is often regarded as a developed *fringe* of Trishuli. The statistics are frequently extrapolated to include the area as one of the most developed part within the district. Consequently, the annexation often perpetuates the disadvantaged situation of the area. They have yet to receive any program of a significant nature. The high hopes placed on DANIDA sponsored project is based on the same conviction.

Box 7.9: People would do Anything for Water: Gerkhu Tar Experience
The community water tap that is located in ward no. 3 of Gerkhu VDC was initiated initially by the early settlers in 1955 AD. The project was considered important because of occasional outbreak of cholera and death among children during the early monsoon season. The villagers had no money or support that they could use to buy pipes and other materials. They made requests to a number of agencies, including the Trishuli Hydropower Project, which was being constructed at the time, but were unsuccessful in generating any kind of support. Some villagers came up with the idea of getting pipes through illegal means. One of the villagers was then asked to take a job as a security guard with the Trishuli Hydropower Project. The person who got the job insisted on taking the night duty. After this person got well established in his job, the villagers took their plan to the next level. Three volunteers from every household spent two weeks to dig channel from the source to the place, where it was tentatively agreed to install the tap-stand. They also constructed the tap-stand and a small reservoir. Following that night, with the help of the guard, they burglarized pipes by secretly entering the project compound. The pipes were all head-carried from the project to the village located 4 km away. Before leaving, they tied the guard, so that his action would go unnoticed. Within 3 days about 2 km of conveyance structure was laid, without any engineering estimation or alignment work and within 72 hours of that incidence the villagers had running water in the community. The structure still operates with 59 percent conveyance efficiency (Field Survey: 1995-7). Yearly, the community contributes about 11 man-day of labor/hh. for the system O&M (Participatory Analysis: 1995-7)

Arbitrariness

Arbitrariness is a process of putting everything in an arbitrary mode. Here arbitrary management has been taken as dictatorial, subject to the planners' judgment, and uncertain or vagarious. As discussed earlier, this study was the reason why many officers visited the area for the first time. Apparently, decisions taken for the area hitherto were based on the judgment of the Local-level Implementers. Many such planning appeared to be dictatorial, as people were not consulted during their formulation but were asked to participate or generate resources. Many appeared to be full of uncertainty, as nobody knew what was happening. Similarly, many plans appeared as vagarious because they were based on whim or were appealing to the donor community.

These "A"s tend to limit the people's creativity and ability to work and interact with the resources.

7.5.3.3 The Threshold Issues

A related issue is the blind submission to the concept of invincibility or the titanic resilience of Himalayan watersheds. However, the resilience, as this thesis has established is neither invincible as the recent work of McDonald (1994), Butz et al. (1996) have tried to portray, nor is it titanic as the work of Eckholm (1978), Postel (1990) or UNICEF

(1995) shows. The middle approach has to be agreed upon that there are certain limitations to the WRM techniques of the people. Similarly, people do have a refined sense on WRM that many tend to ignore. Nonetheless, the DANIDA project is also designed on the basis of Nepal Environmental Policy Action Plan (NPC: 1994), which as the review in Chapter 2 and 4 adequately demonstrated, is based on the conventional spiral down theory, or Eckholmism (Guthman: 1997).

7.5.3.4 Common Platform

It was observed that a common platform for water resource planning does not exists. Planning at the district level is logically supposed to combine the need and aspiration going from the bottom, and the policy directives from the top. However, this has not taken place and has lead to the misinterpreted goals and misinterpreted roles. WRM is observed more as a political agenda. Especially, the function of DWRC and implementation of the Water Resource Act, Water Resource Regulation are observed to be too rigid. Similarly, the institutional development agenda is also very poor in a number of respects.

It was observed that minor decisions are taking place in the local tea-stall, which is centrally located and is on the way to the city. This explained the degree of informality and quickness in decision making desired by the people. Often, the government approach, which requires painstaking form-filling and formal processes, is rejected by the people in the area or is participated in very unwillingly.

7.5.3.5 Haphazard Planning

Management planning was observed to be very haphazard and done without a solid database. As mentioned before, there was no database in all offices with regard WRM responsibilities. The offices neither had a concrete plan that would guide them for the management of water in the area, nor had they an established relationship with the people that they could expedite for management.

7.5.3.6 Bipolar Distinction (22)

The other issue is the bipolar distinction of various decisions making variables in water resources planning (Box: 7.10). These not only complicate the implementation of programs but also distort the understanding of the problem and solution structures as presented in section 7.5.2. The most crucial is the resource perspective of water – whether it is the water resource that needs to be managed or the water use that needs to be managed. When the present planning and management system cannot even properly understand the 'use' scenario, asking them to manage the water 'resource' may be extremely demanding, if not impossible.

Box 7. 10: Bipolar Distinction of Management of Water		
Action	Scenario I	Scenario II
Problem	Structured	Unstructured
Analysis	Normative	Behavioral
	Prescriptive	Descriptive
Decision Making	Unitary	Collective
	Community	Regional/ National
Problem Attribute	Single	Multiple
Model of Man	Rational	Nonrational
Community	Traditional	Modern
Perspective	Individual	Aggregate
	Atomistic	Organismic
	Holistic	Reductionist
	Institution	Organization
Goal	Given	fluid
Resource Perspective	Value-laden	Free
	Problems	Specificities
Influence of time	Static	Sequential

Modified after: Friedmann: 1971, Burke and Heaney: 1975, Boulding: 1966

7.6 Conclusion

The analysis of actions related to sustainable WRM and, to some extent, awareness of it, provided the sense of existence of a few noticeable strengths or ingenuity among the people. The analysis enabled better definition of problem structure and better synthesis of the solution structures. Similarly, the integration of problem and solution structures evolved into the CATCH - 22 and presented the need for attitudinal and preference analyses.

CHAPTER EIGHT

UNDERSTANDING ATTITUDES

"Many persons approach all social science research [or any other types of research that involve human beings] with a healthy skepticism. This is excellent and to be encouraged. It is however, at least as important to examine traditional principles and practices with skepticism. Long acceptance does not make a matter right. Common practice does not make it the best practice. Newness does not necessarily ensure an improvement. When deciding what knowledge to accept, what principles and practices to employ, it is decidedly worthwhile to ask, "What is the evidence? How do you know?' Tough-minded examination of the evidence and rigorous separation of objective, quantified data from impressions, expressed judgment, or fads can significantly improve the art of management (Rensis Likert: 1932: viii).

8.1 Background

A detailed literature survey, assessment of people's actions toward water resources, and contextual discussions held at various levels revealed that integral to the capacity assessment process is the analysis and synthesis of attitudes (Bichar). This realization resulted in the incorporation of attitudinal analysis in the research design. Admittedly, it can be argued that the nature of people's use of water is a reflection of their perception toward its existence and management. The actions of the people demonstrated that they have a unique and very refined understanding toward water resources set-up of the area. However, at the Actor Groups' meeting that followed action assessment, it was repeatedly brought up by the participants that their actions often contradicted with sub-principles of WRM. Their actions were also depended on various physical realities, which the researcher felt were less emphasized in the action analysis. As the research could only document the actions of two seasons, it would be misleading to generalize the findings for a longer term.

Equally, an important issue was to be self-critical based on the reactions received during the actor groups' meetings. It was felt that the level of unanimity desired while drafting of the sub-principles might have been too demanding in some instances. It is remarked in Chapter 7 that although the detailed and participatory analyses of the Dublin Principles were carried out, an assessment of attitudinal inclination and the degree of similarity of support would be equally essential. During the actor group meetings, three things were strikingly visible. First, the individuals had different levels of adherence toward the principle and the sub-principle goals. Second, the individuals belonging to two actor groups seldom demonstrated similar levels of adherence. The third was a poor representation of the implementers or the facilitator groups in the research.

Equally, an alternative method of assessment was needed to adjust to the probable discrepancy that may have occurred due to the peer pressures, and the tendency to present oneself as more "water use conscious" among the group members. Thus, inquiry into the actions alone was not sufficient to grasp the existing capacity in its entirety. Similarly, it could have killed the creativity of the research, as the reliance on actions alone would require too many theorizations. Such theorizations could go against the basic premise of "situatedness" as conceived in the research design. Thus, the researcher felt a need to understand the attitudes and find perception variability among actor groups.

The need for attitudinal assessment can also be justified in terms of the goal of sustainable WRM. Previous research has demonstrated that the aim of any sustainable WRM is to maximize all of its component goals (Falkenmark et al.: 1988, Gale: 1992, Young et al. 1994, Neupane and Young: 1997). In a similar token, this researcher believed that the aim of WRM should be to maximize all principle and sub-principle goals. Conversely, assessment of attitudes of people would provide indication on their adherence to support or receive programs based on principles and sub-principles (Likert 1967, Saaty: 1981, Gale: 1992). Because as Steel (1996: 28) argued: "attitudes predispose individuals to behave in a certain manner." Moreover, as WRM is a complex issue requiring simultaneous action of many stakeholders having diverse roles (Falkenmark: 1995, Spash: 1997, Neupane and Young: 1997, Briscoe: 1998), knowledge of their readiness or similarity in perception can provide a stronger basis for program design and implementation.

8.1.1 Objectives of the Chapter

The main objective of this chapter is to present attitudes of the grass roots level stakeholders in the selected area. Specifically, this chapter aims:

- to provide attitudinal adherence of various actors toward principles and locally analyzed sub-principles of WRM.
- to analyze possible perception variability existing among different actors.
- to present a synthesis of findings to establish the significance of attitudinal analysis in capacity building.

8.2 Results of Attitudinal Analysis

8.2.1 General

Attitudinal studies are human-centered and often time consuming. Therefore, the participatory analysis of the attitudinal adherence of major stakeholders toward different principles and sub-principles of sustainable WRM is considered as a significant outcome of this research. Similarly, the collection of information in a short time and the opportunity to recheck their validity are also regarded as important results of this thesis. These findings support the soundness of the adopted integrated and iterative methodology. The validity of the attitudinal adherence was maintained by asking the respondents to submit their judgments twice. The resubmission of the questionnaire was requested in an interval of two weeks. This iterative process provided an opportunity to maintain the consistency of the received information.

The findings presented in this chapter are based on the scaled scores of briefs generated through a cross-sectional and participatory survey. The survey generated small explications for each of the sub-principles associated with WRM. The adherence and/or antithetical scores were calculated by using a simple mathematical procedure as described in Chapter 5.8.

8.2.2 Sub-Principles under the First Principle of SWRM

8.2.2.1 Sub-Principle I

"<u>Water is the central to all other resources</u> and, in that, its availability depends on the <u>entirety of other resource structure</u> (Participatory Analysis: 1995-7).

<u>**Adherence Scores**</u>

The study estimated the attitudinal inclination of actor groups by requesting them to comment and react to the first sub-principle under finiteness of water resources. It is indicated in figure 8.1 that Women, Off-farm Workers, Small Farmers and the Large Farmers all received adherence scores of over 75. This indicates that the finiteness of water in terms of its unsubstitutability and its place in the resource set-up of the area is highly realized by the community group[31]. However, this issue is not so much appreciated by selected Local-level Implementers and NGO Workers. These two actor groups believed that the conservation of the forest in the area should be regarded as central to all solutions. NGO Workers also vehemently argued water to be totally substitutable.

The findings revealed that not all locally evolved solutions are working in the area. Alternatively, this means that the WRM in the Himalayan communities is no longer a "keep the hands off" affair, and both the external support and its demand in the community can be comfortably justified. This finding is comparable to a similar study conducted in Nigeria (Oredugba: 1991). Similar to Oredugba's study, the researcher observed that the communities always keep

[31] Small Farmers, Large Farmers, Off-farm Workers and Women are collectively termed as community group and Local-level Implementers and the NGO Workers are collectively termed as facilitator group.

tract of the relative availability and the quantity of water against the modernization, population in the community and changing preferences. The communities were capable of sensing even the faintest signal of lost of balance between the community and the water resource system. Various adjustments and acceptance of tradeoffs in the societies were due to similar realizations.

Perception Variability

The perception variability test (χ^2 test) to present the similarity or dissimilarity of the attitudinal inclination is summarized in Table 8.1. The results show that the actors within the community group possessed a similar outlook. Their views, however, were different from the facilitator group. This difference could be attributed to difference in values assigned by community and the facilitator groups for water use. It also provided a sense as to why the WRM efforts were often aborted in the area at their initial planning stages. However, the existing perception similarities among community group presented a capacity that could be effectively used as an entering point in future WRM efforts. There also existed a strong attitudinal similarity between Local-level Implementers and NGO Workers toward these sub-principle goals. This implies that a distinct gap prevails between those who implement WRM activities and those who receive them. In addition, from the perspective of understanding of water, it is essential that the capacity of NGO Workers and the Local-level Implementers are built to make them more responsive toward the watershed.

Table 8.1: Attitudinal Variability - Chi-square Test Result, Sub-Principal I of Principal I

Water is the central to all other resources and, in that; its availability depends on the structure of other resources

Sectors	Large Farmer	Off-farm Workers	Women	Local-Level Implementers	NGO Workers
Small Farmers	H_o =A	H_o =A	H_o =A	$H_o = R^*$	$H_o = R^*$
Large Farmer	X	H_o =A	H_o =A	H_o = R	$H_o = R^*$
Off-farm Workers		X	H_o =A	$H_o = R^*$	$H_o = R^{**}$
Women			X	H_o = R	$H_o = R^{**}$
Local-level Implementers				X	H_o = A

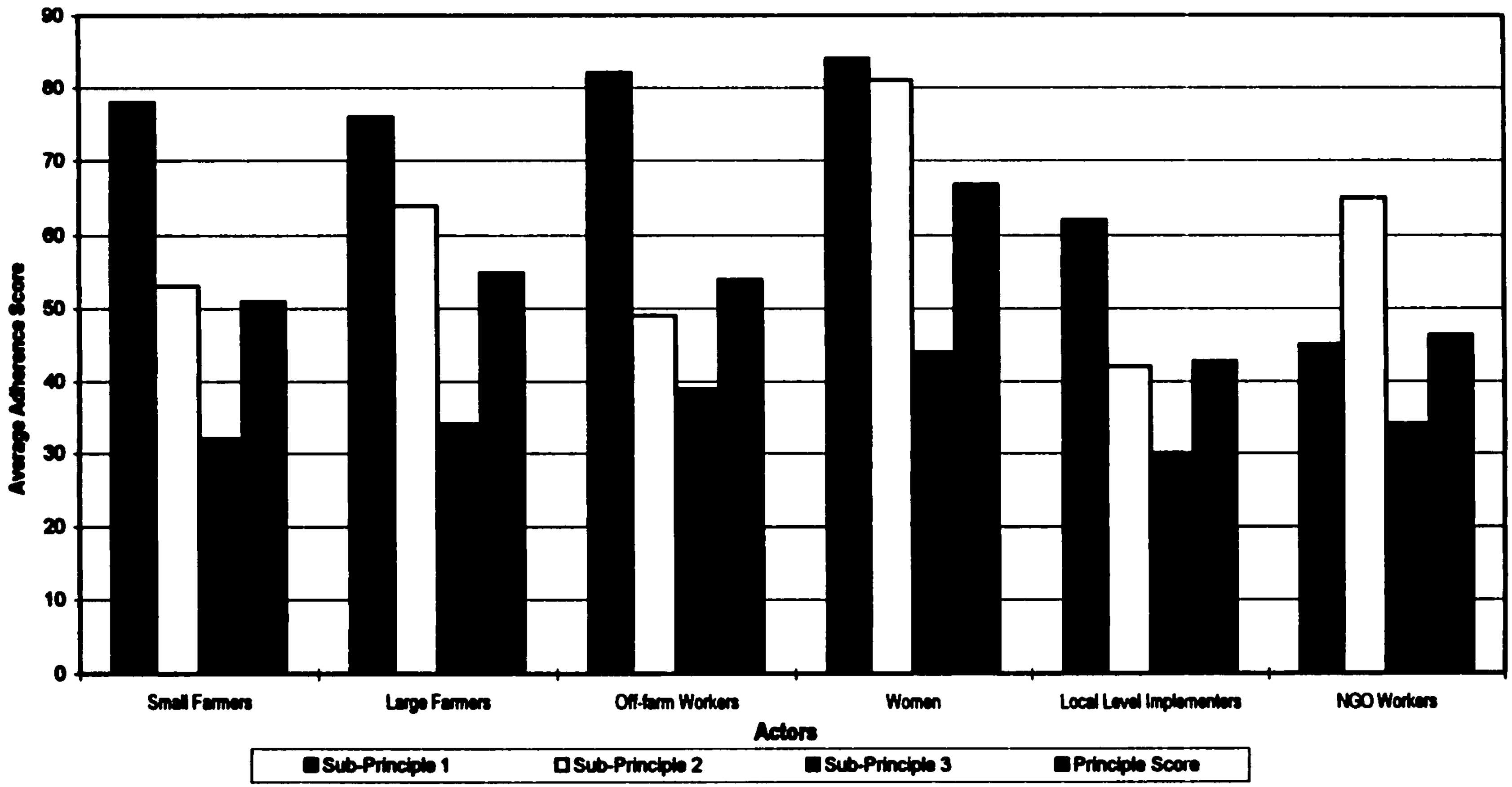
Ho: There is no significant difference between two actor groups indicating that their attitudes are similar.
R: Reject Hypotheses A: Accept Hypotheses. Df. = 4, p= 0.01**, 0.05*, .1 No Symbols

8.2.2.2 Sub-Principle II

Quality of water affects the total availability and, in that, it must be recognized that if deteriorated it is only partly reversible.

Fig. 8.1: Average Adherence Scores Obtained by the Actors in Principle I

Fresh Water is a finite and vulnerable resource, essential to sustain life, development and the environment



(Field Work: 1995-7)

Sub Principle 1:	Water is the center of all other resources and, in that, its availability depends on the entirety of the resource structure
Sub Principle 2:	Quality of water affects the total availability and, in that, it must be recognized that if deteriorated it is only partly reversible
Sub Principle 3:	Technological suitability is the key to the finiteness of water. Awareness about the appropriate technology (Participatory Analysis: 1995-7)

Adherence Scores

Although water quality was one of the most important issues raised by both the community and the facilitator groups, their attitudinal adherence to this sub-principle was much lower than expected. As in the first, in this sub-principle also, Women obtained the highest score (Figure 8.1). The rest of the intervening groups, except Local-level Implementers, scored moderately. Off-farm Workers and Small Farmers less strongly supported this principle. While the small farmers admitted their ignorance to this sub-principle, Off-farm Workers admitted that their economic activities often directly conflict with the qualitative aspects of water. However, considering the socioeconomic condition in the area, such ignorance or conflict did not render any surprise. However, this finding clearly links attitudinal inclinations with actions and awareness.

Local-level implementers received the lowest score, which may be attributed to two fundamental reasons. Firstly, the existing implementation strategies in the district aim primarily to address the quantity and not the quality aspect of water, and secondly, the concept of quality is taken for granted in small watershed conditions. In this context, the chairman of DWRC strongly stressed that initially, everybody in the district should receive an access to tap water, which should precede the activities for water quality improvement (DWRC Interview: 1997). NGO Workers moderately asserted the need to improve the quality of water in the area. They admitted their recent involvement in WRM, and disagreed with the notion of irreversibility of water quality. It was later learned that the group was soliciting some bilateral support for water quality and sanitation.

Difference in Preference

Table 8.2: Attitudinal Variability - Chi-square Test Result, Sub-Principal II of Principal I

Quality of water affects the total availability and, in that, it must be recognized that if deteriorated it is only partly reversible.

Sectors	Large Farmer	Off-farm Workers	Women	Local-Level Implementers	NGO Workers
Small Farmers	Ho =R	Ho =A	Ho =R**	Ho = R	Ho = R
Large Farmer		Ho =R	Ho =R*	Ho = R	Ho = A
Off-farm Workers			Ho =R**	Ho = A	Ho = R
Women				Ho = R**	Ho = R*
Local-level Implementers					Ho = R

Ho: There is no significant difference between two actor groups indicating that their attitudes are similar.
R: Reject Hypotheses A: Accept Hypotheses. Df = 4, p= 0.01**, 0.05*, .1 No Symbols

The degrees of similarity or dissimilarity of actor groups of attitudinal adherence to the second sub-principle have been presented in Table 8.2. Unlike in the first principle, the hypothesis related to this sub-principle was normally rejected. This signifies prevalence of an extreme degree of perception variability among the actor groups. However, the views of Small Farmers and the Off-farm Workers, Large Farmers and the NGO Workers, and the Off-farm Workers and the Local-level Implementers were observed to be similar.

8.2.2.3 Sub-principle III

"Technological suitability is the key to the finiteness of water. Awareness about the appropriate technology (Participatory Analysis: 1995-7)"

Adherence Scores

The adherence scores obtained by various actor groups provided a concern that limits of technology was yet to be realized by both community and facilitator groups. The finding of this study is similar to a slope stability study carried out by Smadja (1992) in Salme village of Nepal. In this study too, the issue of the use of new technology and its cultural incompatibility was argued. Smadja argued, "...it appears that the local conditions do not lend themselves to significant improvement; the villagers have already developed a well-adapted approach, and all that is required is to ensure annual repair of the damage that does occur..."(1992: 26)

Box 8.1: Limits to Technology: Dilemma of the Proposed Gerkhutar-Simutar Irrigation project
The irrigation project can not be implemented without a feasible technology package that can be locally supported. The annual operation and maintenance cost of the project must be at least three percentage points lower than the cost of capital (UDA: 1989). However, feasibility studies on different alternatives have established all of them as not feasible. The latest study provided an internal rate of return of 11 percent, while the cost of capital in Nepal is 18-24 percent. The project is also unlikely to be implemented, if it is viewed against the investment ceiling for irrigation development. The proposed scheme in 1996/97 price would need over NRs. One million per hectare, while the ceiling is NRs. 80,000 (Irrigation Policy: 1997). Even if the project is implemented, the farmers in the area must annually find at least 3-5 percent of the total cost of irrigation development (Water Resource Regulation: 1994) for the O&M. The O&M of the project would need resources well over the gross incremental benefits to the farmers at current price. The entire technology for development of the system must be solicited externally; and can create a perpetual dependency. Thus, it could lead to potentially grave consequence toward self-reliance and to the locally grown institutions (Based on UDA: 1988/ 1994: Feasibility Study of Gerkhutar-Simutar Irrigation Project, Kathmandu, Nepal).

Apparently, years of false promises and the demonstration effect on the application of technology, the community had become extremely technologically conscious (Box: 8.1). *The villagers did not consider a small improvement in their traditional technology as an improvement.* When the researcher tried to extract their view on appropriate technology, the discussion focused mainly on lift irrigation, tunneling, etc. Strikingly the villagers felt that such advanced WRM technologies are totally manageable.

It was also one of the most discussed issues in the actor group meetings. There too, it was argued that technology has no bounds. The community did not regard the simple technology to be of any use to them. All groups strongly believed that most of the programs that advocated appropriate technology fail to present anything visibly different. It was reported that such programs contained demonstration or training packages on something similar to what the community had been practicing for along time. Seemingly, the nature of appropriate technology, and an implementation modality that would provide visibly different results were complicated issues in the area. Reportedly, *if the villagers were given a choice, it would be very unlikely that they would prefer any programs on appropriate technology. Therefore, a technological audit involving this watershed and similar others in WRM is observed to be essential.* The adherence scores for this sub-principle were between 32 to 44 (Figure 8.1).

This issue was also discussed at the central level. A response received from a senior officer of the National Planning Commission in Kathmandu has been presented here to clarify as to how the technological issue is being handled in Nepal.

> *"...Nepal has provided a ground where WRM under extreme economic condition can be tested. On the background where 10 years old sustainable development strategies have just recently started to trickle down, the application of approaches that advocate the use of appropriate technology on sustainable WRM must wait. Undoubtedly, the need to develop a new home-grown management approach is mounting, but no-one seems to have the needed patience to develop it with its users as the main partners (NPC, Nepal, Personal Conversation: 1997)".*

Perception Variability

Table 8.3: Attitudinal Variability - Chi-square Test Result, Sub-Principal III of Principal I

Technological suitability is the key to the finiteness of water. Awareness about the appropriate technology

Sectors	Large Farmer	Off-farm Workers	Women	Local-Level Implementers	NGO Workers
Small Farmers	H_o =A	H_o =A	H_o =A	H_o =R	H_o =A
Large Farmer	X	H_o = R	H_o =A	H_o =A	H_o = A
Off-farm Workers		X	H_o =A	H_o = A	H_o =A
Women			X	H_o =A	H_o =A
Local-level Implementers				X	H_o =A

Ho: There is no significant difference between two actor groups indicating that their attitudes are similar.
R: Reject Hypotheses p=.1 A: Accept Hypotheses. Df = 4

The perception variability under this sub-principle is presented in Table 8.3. Strikingly, the hypotheses were accepted in almost all cases, which indicate that all sectors have a similar attitudinal inclination on the issue on technology. A weak perception variability of Women with Local-level Implementers and Small Farmers were observed, however, no conclusive explanation could be drawn during the actor group meeting. *As there existed similarity in attitudinal outlook, the technology issue may prove to be an appropriate platform or an entry point to implement WRM programs.*

8.2.3 Sub-Principles under the Second Principle of SWRM

8.2.3.1 Sub-Principle I

Knowledge about the current planning structure should be uniformly available to all and, in that, all receive equal opportunity to contribute (Participatory Analysis: 1995-7).

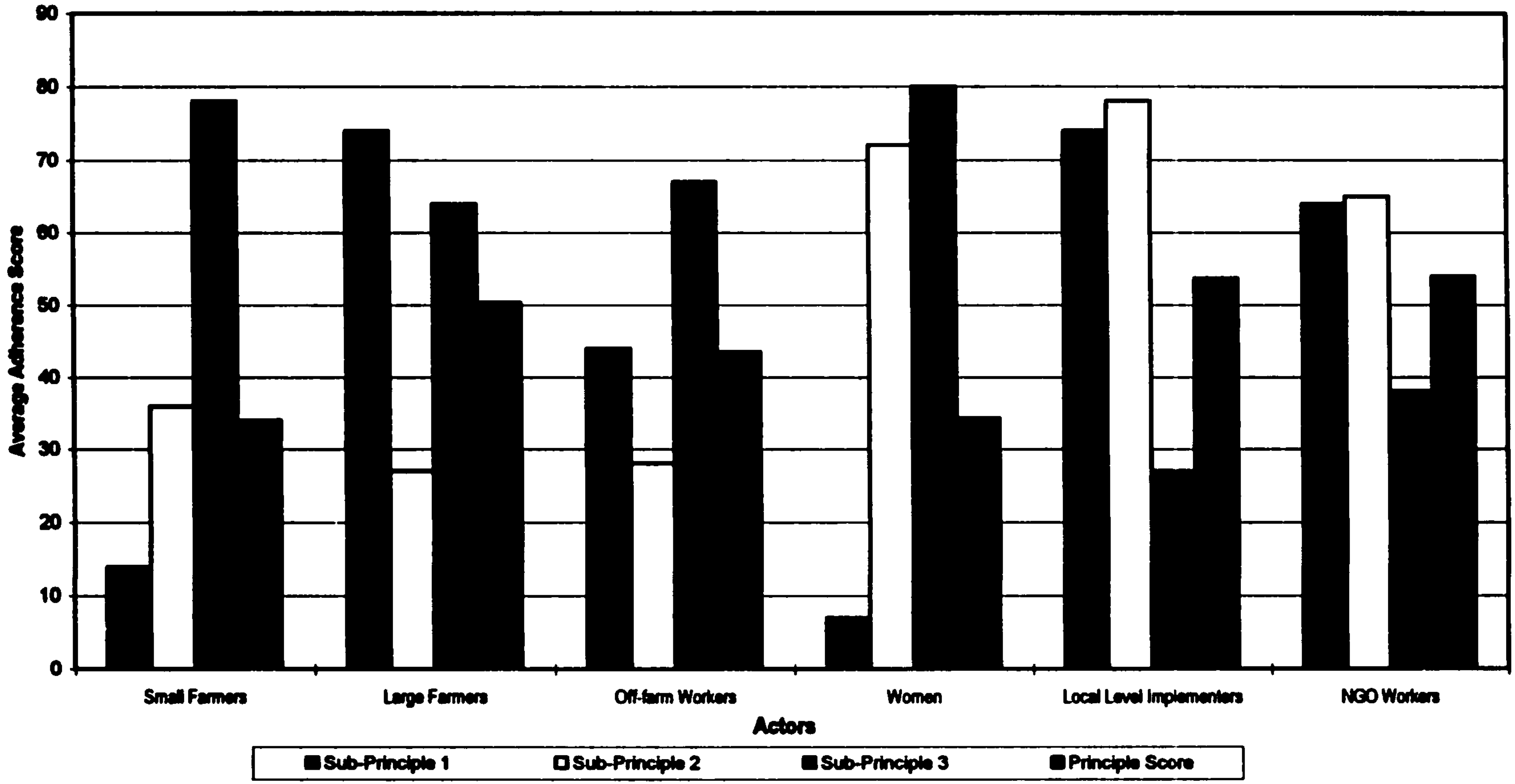
Adherence Scores

It is evident from Figure 8.2 that the Women and Small Farmers showed a very weak attitudinal inclination to this sub-principle. There were two main reasons cited for this. First, only privileged members among the community group had access to the current planning structure. Second, it was reported that repeated exclusion from management and planning efforts has corroborated a sense of inferiority complex among these two actor groups. Consequently, they perceived that being unaware of the planning structure is perhaps better for them. To some extent this could also be attributed to an indirect expression of their frustration. Although the facilitator groups scored very high, both acknowledged some degree of favouritism. They argued that such favouritism helps them to identify a leader. They also conceded that their search for leaders seldom go beyond the people of the higher social stratum. Admittedly, the leader selection process operated more on a basis of interpersonal relations rather than on democratic principles.

Similarly, Off-farm Workers received a moderate score, which implies that they are also not included in the ongoing management efforts. Large Farmers showed their strong adherence toward this sub-principle. They are very knowledgeable and often hold the privilege of being the main contact group for management approaches being implemented in the area. The analysis of this sub-principle resulted into a very interesting finding, which also corroborates the finding of action analysis that there are certain actor groups within the area, who have better access to the current administrative structure than others.

Fig. 8.2: Average Adherence Scores Obtained by the Actors in Principle II

<u>Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels</u>



(Field Work: 1995-7)

Sub Principle 1: <u>Knowledge about the current planning structure</u> is uniformly available to all and, in that, all <u>receive equal opportunity to contribute</u>

Sub Principle 2: <u>Continuous participation</u> is a key to the success of water resource management programs

Sub Principle 3: <u>Equity and transparency</u>, especially for cost sharing and allocating access, must be adequately maintained in all water resource management initiatives (Participatory Analysis: 1995-7)

Perception Variability

The perception variability tests for this sub-principle are presented in Table 8.4. Evidently, the perception of Women and Small Farmers were significantly different from that of Large Farmers, Local-level Implementers and NGO Workers. The off-farm sector's attitudinal inclination was different from all other intervening groups. Local-level Implementers, NGO Workers and Large Farmers groups revealed a common thinking. Conceivably, *it supports the conventional thinking of natural alliance of people belonging to the higher status.*

Table 8.4: Attitudinal Variability - Chi-square Test Result, Sub-Principal I of Principal II

Knowledge about the current planning structure is uniformly available to all and, in that, all receive an equal opportunity to contribute.

Sectors	Large Farmer	Off-farm Workers	Women	Local-Level Implementers	NGO Workers
Small Farmers	H_o =R**	H_o =R*	H_o =A	H_o =R***	H_o =R*
Large Farmer	X	H_o = R	H_o =R**	H_o =A	H_o = A
Off-farm Workers		X	H_o =R	H_o = R	H_o =R
Women			X	H_o =R***	H_o =R**
Local-level Implementers				X	H_o =A

Ho: There is no significant difference between two actor groups indicating that their attitudes are similar.
R: Reject Hypotheses A: Accept Hypotheses. Df = 4, p= 0.001 ***, 0.01**, 0.05*, .1 No Symbols

8.2.3.2 Sub-Principle II

Continuous participation is a key to the success of WRM programs (Participatory Analysis: 1995-7)

Adherence Scores

Local-level Implementers, Women and NGO Workers' attitudinal views strongly supported the need for continuous participation in WRM. They also opined that WRM must be regarded as a day-to-day affair. The rest of the actor groups obtained very low scores under this sub-principle. They posited that WRM must not demand excessive participation. They argued that such demands often conflicted with their other works or basic livelihood. They felt that they are already offering whatever is their fair share. They argued that the Women are willing to provide their continuous participation, because they have more free time compared to their male counterparts.

Perception Variability

The cross-sectional χ^2 tests under this sub-principle are presented in Table 8.5. The actor groups appear to be divided equally in two groups. The actor groups that strongly favoured the need for continuous participation – Local-level Implementers, Women, and NGO Workers – had a similar perceptions. Similarly, those who presented themselves not very keen on continuous participation – Large Farmers, Off-farm Workers, and Small Farmers – held a similar perception toward this sub-principle.

Table 8.5: Attitudinal Variability - Chi-square Test Result, Sub-Principal II of Principal II

Continuous participation is a key to the success of WRM programs

Sectors	Large Farmer	Off-farm Workers	Women	Local-Level Implementers	NGO Workers
Small Farmers	H_o =A	H_o =A	H_o =R**	H_o =R**	H_o =R**
Large Farmer	X	H_o = A	H_o =R**	H_o =R**	H_o =R*
Off-farm Workers		X	H_o =R**	H_o =R**	H_o =R*
Women			X	H_o =A	H_o =A
Local-level Implementers				X	H_o =A

Ho: There is no significant difference between two actor groups indicating that their attitudes are similar.
R: Reject Hypotheses A: Accept Hypotheses. Df = 4, p=0.01**, 0.05*, 0.1 No Symbols

8.2.3.3 Sub-Principle III

<u>Equity and transparency</u>, especially for cost sharing and allocating access, must be adequately maintained in all WRM initiatives (Participatory Analysis: 1995-7).

<u>Adherence Scores</u>

Of late, the realization of unfair, unjust and inequitable distribution of WRM programs has influenced its philosophy. It is now widely argued that more transparent and equitable approach is needed in WRM. The analysis in Gerkhu Khola provided a similar realization. The community group felt that *the management aspects needed to become not only more consistent to the people's need and preference but should guarantee an equitable distribution of benefits while maintaining high level of transparency* (figure 8.2). In contrary, the facilitator groups were attitudinally against the idea of maintaining the required transparency and equity in the WRM programs. They opined that the equity and transparency are relative terms and that these may not be feasible to maintain during planning and implementation.

The group discussion revealed that WRM has remained as a prerogative of the implementers in the area. Almost in all cases, the implementation may or may not have involved the users, but the accountability remained with those who administer these programs. A recent IIMI study reported that the sustained hegemony on the part of the agency staff has resulted in a rigid planning and subsequent monitoring and evaluation structures and decreased the users' participation in WRM (IIMI: 1997). While clarifying these low scores, the facilitator groups posited that there exists a need to define properly and thoroughly what transparency really requires. They feared that *transparency would be taken as a right by the people to entirely distort and* ruin the originality and flow required in projects/programs.

Perception Variability

The tests conducted to reveal similarity or dissimilarity in perception is presented in Table 8.6. Evidently, the views of the actors could again be grouped into two categories. While the community actors upheld one set of perceptions, the facilitator groups formed another set of opinion. It also provided a sense that *transparency and maintaining equity in distribution of programs is an area where immediate intervention could be necessary.* This finding also supports the need for a common platform in WRM that has been argued through CATCH - 22 in Chapter 7.

Table 8.6: Attitudinal Variability - Chi-square Test Result, Sub-Principal III of Principal II

Equity and transparency, especially for cost sharing and allocating access, must be adequately maintained in all WRM initiatives.

Sectors	Large Farmer	Off-farm Workers	Women	Local-Level Implementers	NGO Workers
Small Farmers	H_o =A	H_o =A	H_o =A	H_o =R**	H_o =R**
Large Farmer	X	H_o = A	H_o =A	H_o =R**	H_o = R**
Off-farm Workers		X	H_o =A	H_o = R**	H_o =R**
Women			X	H_o =R**	H_o =R**
Local-level Implementers				X	H_o =A

Ho: There is no significant difference between two actor groups indicating that their attitudes are similar.
R: Reject Hypotheses A: Accept Hypotheses. Df = 4, p= 0.01**, 0.05*

8.2.4 Sub-Principles under the Third Principle of SWRM

8.2.4.1 Sub-Principle I

"It must be recognized that the Women are over burdened in terms of water resources use and management" (Participatory Analysis: 1995-7).

Adherence Scores

It is evident from figure 8.3 that the idea of increasing Women's role in WRM was very poorly supported by Small Farmers, Large Farmers, Off-farm Workers and Local-level Implementers (all men). In this sub-principle, the actor groups claimed that utilization of water was solely a Women's job; a job, *the nature of which is both gender-defined and socially constructed.* Except for the Women themselves and NGO Workers, the rest of the actor groups' scored very low in this sub-principle.

Currently, most of the programs implemented through NGOs include a specific component for Women in development. This might be one of the main reasons why NGO Workers demonstrated a strong inclination toward Women's role in WRM. In contrast, Local-level Implementers felt that any activities launched on behest of Women are bound to fail resulting in loss of benefits to the entire community. This group cited examples from agricultural, WRM and sanitation sector implemented in the area during the past. They posited that these programs aborted because they failed to provide any noticeable benefits to the community. In the water resources sector, a recently completed drinking water project in Gerkhutar has failed to provide any significant benefits compared to similar projects developed and managed by men (Chapter 7). Local-level Implementers felt that it is not women whose involvement made a project successful, but the needed qualities to perform the job best.

In this context, group discussion provided responses, which could be grouped as: a) that the governmental agencies lack the required trust in women; and b) that the government are highly risk averse while implementing programs, given the fact that the women's performance is yet to be assessed properly. *Similarly, c) it appeared that the recent mode of channeling of the programs has sparked a sense of competition among the males, who were traditionally involved in most of the WRM and other developmental programs. The groups strongly felt that such programs as an infringement in the prerogative currently enjoyed by men.* Although repeatedly stimulated during group meetings, it was very surprising to note that, very limited discussion was preferred on this topic.

Perception Variability

Cross sectional *chi-square* tests between the intervening sectors have been computed and are presented in Table 8.7 According to the test results, the attitudinal inclination of the NGO Workers and Women were similar for this sub-principle. However, the attitudinal inclinations of these two actors were significantly different from the rest of the actor groups. The attitudinal inclinations of the rest of the actor groups were observed to be similar. It is very indicative that this sub-principle required careful response.

Table 8.7: Attitudinal Variability - Chi-square Test Result, Sub-Principal I of Principal III

It must be recognized that the Women are over burdened in terms of water resources use and management

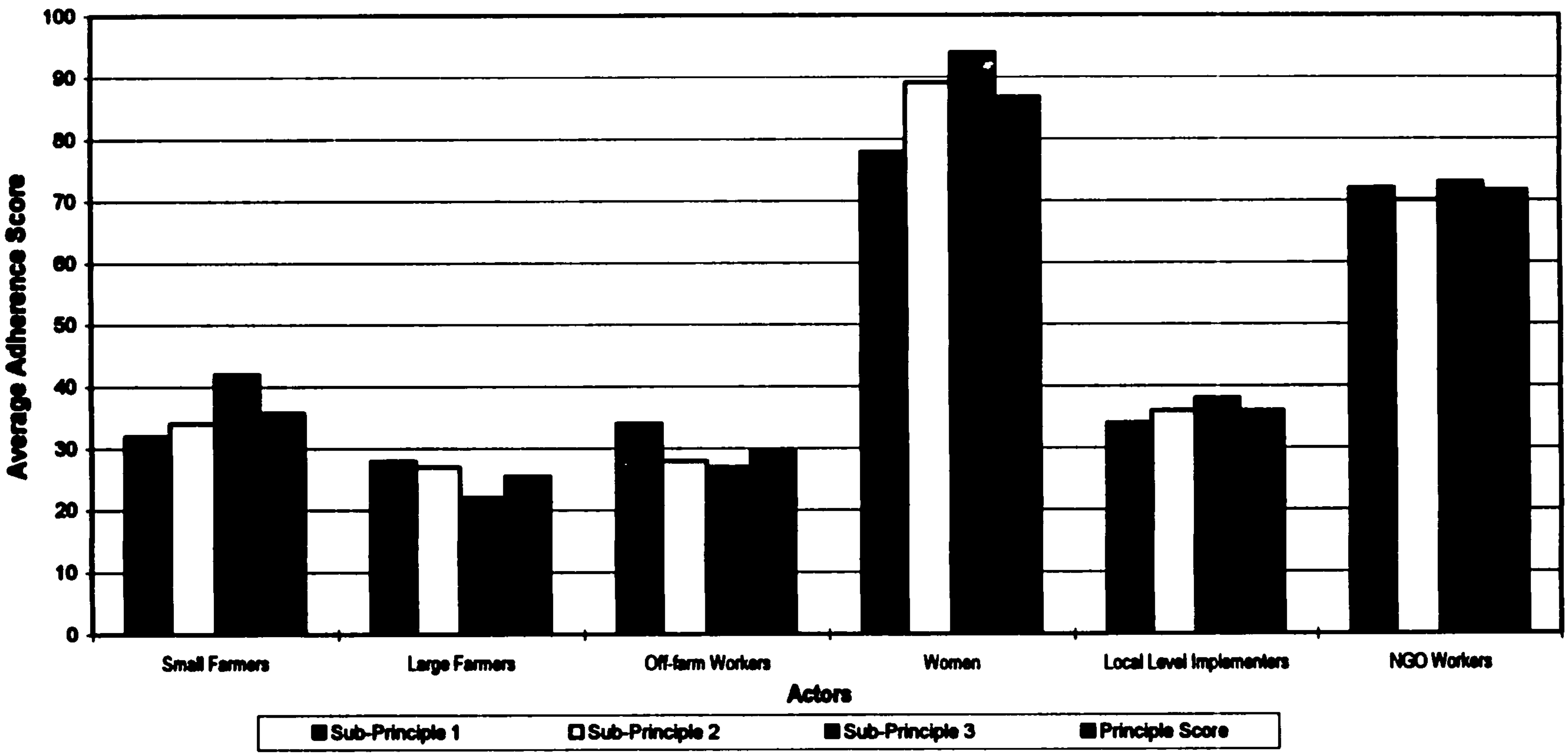
Sectors	Large Farmer	Off-farm Workers	Women	Local-Level Implementers	NGO Workers
Small Farmers	H_o=A	H_o=A	H_o=R**	H_o=A	H_o=R**
Large Farmer	X	H_o = A	H_o=R**	H_o=A	H_o = R**
Off-farm Workers		X	H_o=R**	H_o = A	H_o=R**
Women			X	H_o=R**	H_o=A
Local-level Implementers				X	H_o=R**

Ho: There is no significant difference between two actor groups indicating that their attitudes are similar.

R: Reject Hypotheses A: Accept Hypotheses. Df = 4, p= 0.001 ***, 0.01**, 0.05*

Fig 8.3: Average Adherence Scores Obtained by the Actors in Principle III

Women play a central part in the provision, management and safeguarding of water



(Field Work: 1995-7)

Sub Principle 1:	It must be recognized that the Women are over burdened in terms of water resources use and management
Sub Principle 2:	Women should have equal access in decision making and planning, and should receive greater responsibilities in water resource management
Sub Principle 3:	Empowerment of Women is essential to enable them to participate in all levels of water resource management programs

(Participatory Analysis: 1995-7)

8.2.4.2 Sub-Principle II

Women should have equal access in decision-making and planning, and should receive greater responsibilities in WRM (Participatory Analysis: 1995-7).

Adherence Score

Figure 8.3 suggests that the adherence scores under this sub-principle have shown a pattern similar to that of the previous. Women showed a very strong attitudinal inclination toward this sub-principle. It was observed that Women took the research as an opportunity to speak out[32] of some about the injustice and negligence that they had previously suffered. NGO Workers also scored a very impressive score. This can be taken as an indication for the success – although limited – in some other programs, especially literacy and, to some extent, in income generation. However, the NGO involvement in the area was recent and their sectoral coverage was not directly related to water. Thus, these observations are shallow.

The rest of the actor groups obtained scores between 27 to 36. These groups were asked to provide justification on their response in the group meetings. They contended that the Women would not speak out even if were given responsibility and the programs would suffer. *Yet, the researcher gathered that it is not that Women could not speak, but they were not allowed to partake in development work, if that involved mingling with outsiders, visits to the offices and areas outside the watershed. The assessment indicated the need for organizing activities within the sub-watershed area and to involve women as trainers, researchers or facilitators.*

Perception Variability

The cross sectional *chi-square* tests for this sub-principle are presented in Table 8.8. Accordingly, NGO Workers and Women shared a common view on the issue. Similarly, the views of Small Farmers, Large Farmers, Off-farm Workers and Local-level Implementers were similar. The views of these sectors, however, were not in conformity to Women and NGO Workers. Not only the actor groups demonstrated that their attitudes were different, but the significance level was at the probability levels of 0.001.

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[32] This openness, however, was taken negatively by the males in group and a majority were barred to participate in similar meeting organized for preference assessment

Table 8.8: Attitudinal Variability - Chi-square Test Result, Sub-Principal II of Principal III

Women should have equal access in decision-making and planning, and should receive greater responsibilities in WRM.

Sectors	Large Farmer	Off-farm Workers	Women	Local-Level Implementers	NGO Workers
Small Farmers	H_o =A	H_o =A	H_o =R***	H_o =A	H_o =R*
Large Farmer	X	H_o = A	H_o =R***	H_o =A	H_o = R*
Off-farm Workers		X	H_o =R***	H_o = A	H_o =R*
Women			X	H_o =R***	H_o =A
Local-level Implementers				X	H_o =R*

Ho: There is no significant difference between two actor groups indicating that their attitudes are similar.
R: Reject Hypotheses A: Accept Hypotheses. Df. = 4, p= 0.001 ***, 0.01**, 0.05*, .1 No Symbols

8.2.4.3 Sub-Principle III

Empowerment of Women is essential to enable them to participate in all levels of WRM programs (Participatory Analysis: 1995-7).

Adherence Scores

As the figure 8.3 presents, *empowerment of Women* was regarded as a very important aspect by Women in the sub-watershed. The findings explicitly indicate that Women require more exposure to WRM activities. During the actor group meeting, it was emphatically asserted that empowerment could lead to better WRM. Consequently, women would spent less time for water collection, there would be less health problems in the family, and total income of the individual households would increase. NGO Workers attested this fact. However, Small Farmers, Large Farmers and Off-farm Workers were not convinced. They felt that the programs must not compartmentalize Women as a special group from others. They emphasized that empowerment is desired by everyone in the community. The Local-level Implementers also supported these actor groups' assertion.

Perception Variability

In this sub-principle as well, the actor groups demonstrated a similar pattern of perception variability as in the previous. As Table 8.9 presents, while the perception of NGO Workers and Women were similar, their perceptions significantly differed from other actor groups. Especially, Women's perception of empowerment was different from other community actors at a probability level of 0.001.

Table 8.9: Attitudinal Variability - Chi-square Test Result, Sub-Principal III of Principal III

Empowerment of Women is essential to enable them to participate in all levels of WRM programs

Sectors	Large Farmer	Off-farm Workers	Women	Local-Level Implementers	NGO Workers
Small Farmers	H_o =A	H_o =A	H_o =R***	H_o =A	H_o =R*
Large Farmer		H_o = A	H_o =R***	H_o =A	H_o = R*
Off-farm Workers			H_o =R***	H_o = A	H_o =R*
Women				H_o =R***	H_o =A
Local-level Implementers					H_o =R*

Ho: There is no significant difference between two actor groups indicating that their attitudes are similar.
R: Reject Hypotheses A: Accept Hypotheses. Df = 4, p= 0.001 ***, 0.01**, 0.05*, .1 No Symbols

Seemingly, there was not much variation in degree of acceptance among the actors when it came to empowerment of, giving more responsibility to, or acknowledging the role played by Women in WRM. This may be unique to this area. However, this aspect is very crucial and requires further exploration based on the comparative analysis of a few similar small watershed areas. Apparently, if the programs continue, without a proper capacity-building program of Local-level Implementers and the community groups the success of the program is very questionable.

8.2.5 Sub-Principles under the Fourth Principle of SWRM

8.2.5.1 Sub-Principle I

Water must be treated as an important good having an economic value recognizable and understandable to both the providers and receivers (Participatory Analysis: 1995-7).

Adherence Score

Economic value of water was one of the least talked-about principles in the entire course of the research. However, the common response was not "why do we have to talk about a free resource" but, "why do we have to pay for something that we have been taking care of for so long " (Participatory Analysis: 1995-7). The people were concerned that they would be paying for nothing. The Women group thought that if the quality of water would be properly ensured they would be willing to pay. This finding is in conformity with Powell's work (1991). Powell conducted a contingent valuation survey in 12 communities with respect to the household's willingness to pay. He observed large differences in willingness-to-pay for increased water supply protection, both within and across communities. The households' willingness-to-pay varies with their experience of water supply contamination. Conversely, the quality consciousness and the income of the households significantly affect the households' willingness-to-pay.

There were obvious concerns that any attempt to establish water's economic value in the area must be accompanied by a program that would assess the historical cash and labor borne by the community in managing water. It was also argued that there should be an assessment also of the people's ability to pay. Small Farmers scored maximum, which provides a clear sense that, those whose livelihoods is entirely dependent on water resources are more concerned toward the economic value of water. This supported the finding of the action analysis that the resource constraints determine the degree of resourcefulness. Large Farmers, who also used the maximum quantity of water in the area (Chapter 7), scored lowest. The Off-farm Workers felt that as they mostly used running water directly from the river, they should not be included in payers' list. Consequently, this sector also scored very poorly in this sub-principle. Women scored moderately as they fear that a cost to water could mean less water available for the family and reduced income. *It is that people always tend to draw upon their economic position to express their opinion on the economic valuation of water resources.* This is one of the major areas, where capacity-building is essential.

Perception Variability

The χ^2 test results for this sub-principle are presented in Table 8.10. Small Farmers, Local-level Implementers and NGO Workers upheld a similar attitudinal outlook. Similarity was also observed among the attitudes of off-farm sector and Large Farmers. For the other groups, the hypotheses were rejected.

Table 8.10: Attitudinal Variability - Chi-square Test Result, Sub-Principal I of Principal IV

Water must be treated as an important good having an economic value recognizable and understandable to both the providers and receivers

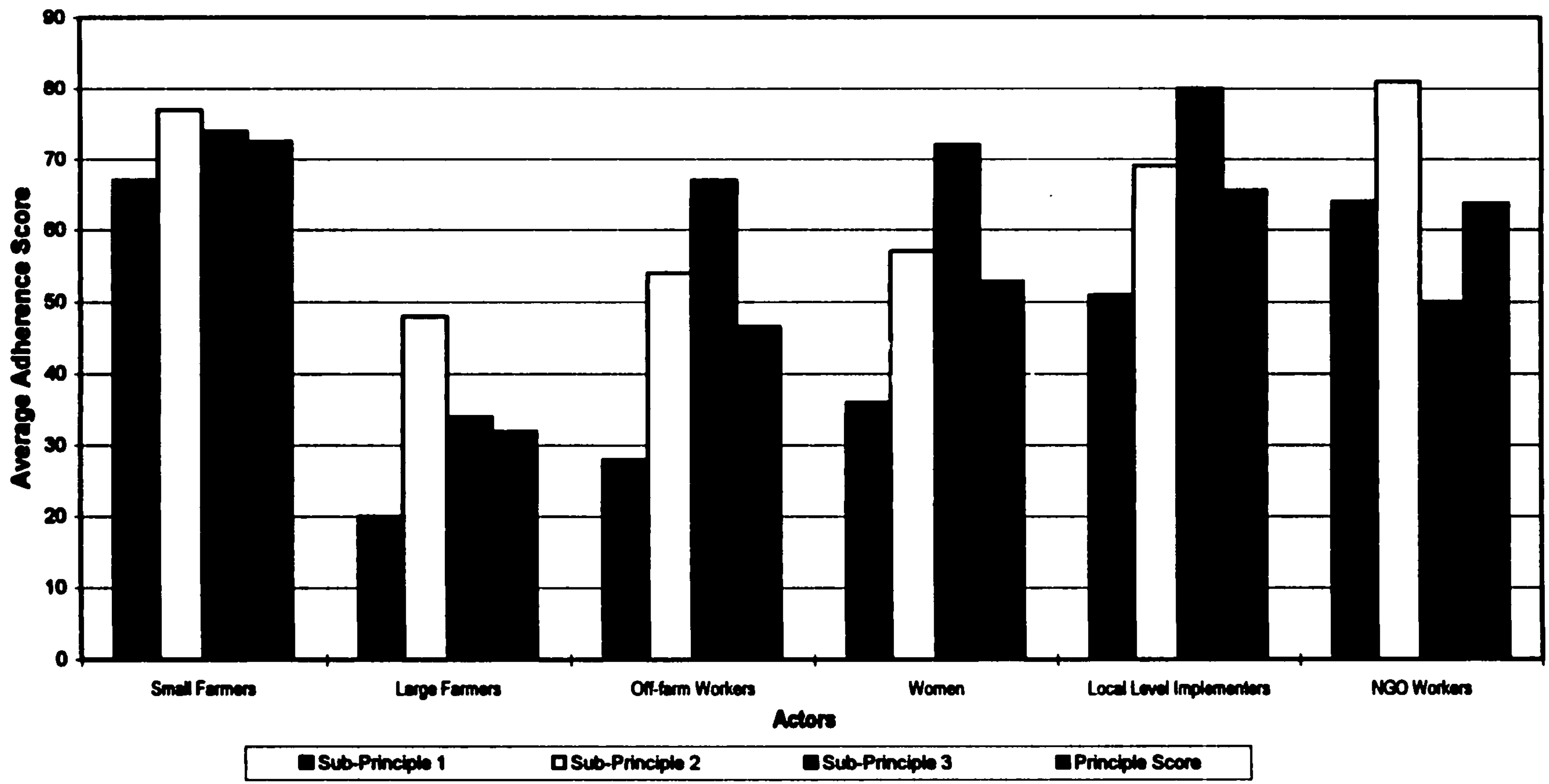
Sectors	Large Farmer	Off-farm Workers	Women	Local-Level Implementers	NGO Workers
Small Farmers	H_o =R**	H_o =R*	H_o =R*	H_o =A	H_o =A
Large Farmer	X	H_o = A	H_o =R	H_o =R*	H_o = R**
Off-farm Workers		X	H_o =R	H_o = R*	H_o =R*
Women			X	H_o =R*	H_o =R**
Local-level Implementers				X	H_o =A

Ho: There is no significant difference between two actor groups indicating that their attitudes are similar.

R: Reject Hypotheses A: Accept Hypotheses. Df = 4, p= 0.01**, 0.05*, .1 No Symbols

Fig.8.4: Average Adherence Scores Obtained by the Actors in Principle IV

Water has an economic value in all its competing uses and should be recognized as an economic good



(Field Work 1995-7)

Sub Principle 1: Water must be treated as an important good having an economic value recognizable and understandable to both the providers and receivers

Sub Principle 2: Equity in distribution and cost sharing is essential and, in that, a participatory mode of assessment of true value of water and value of contribution is essential

Sub Principle 3: Progressive system of cost sharing based on the amount of use and total waste disposal is essential (Participatory Analysis: 1995-7)

8.2.5.2 Sub-Principle II

"Equity in distribution and cost sharing is essential and, in that, a participatory mode of assessment of true value of water and value of contribution is essential" (Participatory Analysis: 1995-7)

Adherence Score

The equity in cost and water sharing was accepted moderately to strongly by the actor groups. The lower scores obtained by the actor groups is an indirect expression of a fear that an equity perspective may reduce the total available quantity. They also raised a concern that the analysis of the principle only weakly incorporated the ownership of water issue. It was feared that non-paying or non-participating members or communities would receive an equal amount of benefit from the WRM works as themselves. NGO Workers scored highest, which signifies their approach as being relatively fairer to that of the government workers (Local-level Implementers). However, Local-level Implementers also scored strongly and favoured cost sharing as an important mechanism to develop a sense of responsibility among the users.

Perception Variability

The perception variability for this sub-principle has been computed and presented in Table 8.11. It is indicative that Small Farmers, Local-level Implementers and NGO Workers shared similar views regarding this issue. Similarly, Large Farmers, Off-farm Workers and Women held similar attitude toward the equity perspective in WRM. The rest of the actors' attitudes were significantly different from each other.

Table 8.11: Attitudinal Variability - Chi-square Test Result, Sub-Principal II of Principal IV

Equity in distribution and cost sharing is essential and, in that, a participatory mode of assessment of true value of water and value of contribution is essential

Sectors	Large Farmer	Off-farm Workers	Women	Local-Level Implementers	NGO Workers
Small Farmers	H_o =R*	H_o =R	H_o =R	H_o =A	H_o =A
Large Farmer	X	H_o = A	H_o =A	H_o =R*	H_o = R**
Off-farm Workers		X	H_o =A	H_o =R	H_o =R*
Women			X	H_o =R	H_o =R**
Local-level Implementers				X	H_o =A

Ho: There is no significant difference between two actor groups indicating that their attitudes are similar.

R: Reject Hypotheses A: Accept Hypotheses. Df = 4, p= 0.001 ***, 0.01**, 0.05*, .1 No Symbols

8.2.5.3 Sub-Principle III

A progressive system of cost sharing based on the amount of use and total waste disposal is essential (Participatory Analysis: 1995-7)

Adherence Score

The participatory analysis established that one of major requirements for sustainable WRM is to institute a progressive system of cost sharing based on the amount of use and waste disposal. The findings, as shown in figure 8.4, indicate that all the actor groups demonstrated a moderate to high adherence toward this sub-principle. The highest score was obtained by the Local-level Implementers, while the lowest was scored by the Large Farmers. Except for the latter group, the outlooks of rest of the actor groups were observed to be high. Seemingly, future WRM activities may be successfully implemented with a refined cost sharing mechanism having a progressive structure. Along a similar line, a World Bank report argued that the water prices must be based on volumetric supply, and service fees should not be directly related to the volume of water supplied (Frederiksen et al.: 1993)

It was also very noteworthy that the watershed community fully supported Hoffer's (1995) finding that spoon feeding, such as subsidies and loans from government often obstruct effectiveness and result in a passive attitude. Everybody supported a more realistic water use fee, but nobody wished to pay for the license fee or obtain a license (WRR: 1994) (Chapter 4.5.10)

The low score obtained by Large Farmers indicated their unwillingness to accept a progressive structure of cost sharing. As it is discussed in Chapter 7, the level of income and the daily gross quantity of water used are positively correlated. Any progressive structure would mean the Large Farmers paying a significantly higher cost as compared to their counterparts.

Perception Variability

Evidently, the perceptions of all actor groups, except for the Large Farmers, were similar (Table 8.12). A low level of perception variability was observed between the perceptions of NGO Workers and Local-level Implementers. This issue was indicated at the actor group meeting. However, a second round of data collection and response conformity check did not change the score or the finding. The NGO Workers presented a view that no one in the area as rich, and instituting a progressive structure for cost sharing might not be necessary or practicable.

Table 8.12: Attitudinal Variability - Chi-square Test Result, Sub-Principal III of Principal IV

Progressive system of cost sharing based on the amount of use and total waste disposal is essential

Sectors	Large Farmer	Off-farm Workers	Women	Local-Level Implementers	NGO Workers
Small Farmers	H_o =R**	H_o =A	H_o =A	H_o =A	H_o =A
Large Farmer	X	H_o = R*	H_o =R**	H_o =R**	H_o = R*
Off-farm Workers		X	H_o =A	H_o = A	H_o =A
Women			X	H_o =A	H_o =A
Local-level Implementers				X	H_o =R

Ho: There is no significant difference between two actor groups indicating that their attitudes are similar.
R: Reject Hypotheses A: Accept Hypotheses. Df = 4 p= 0.01**, 0.05*, .1 No Symbols

8.3 Synthesis of Attitudinal Assessment

8.3.1 First Principle

Water is a finite and vulnerable resource, essential to sustain life, development and the environment (IWCE: 1992)

Adherence Score

Figure 8.5 presents the average adherence scores of all the actor groups. All intervening sectors have received moderately strong scores toward this principle. The average adherence scores among the actor groups range from 43 to 67. The overall sub-watershed score of the first principle was 52 indicating that the implementation, or if essential integration of sub-principles within it, would not be very difficult.

Perception Variability

Table 8.13: Attitudinal Variability - Chi-square Test Result, Principal I

Water is a finite and vulnerable resource, essential to sustain life, development, and the environment

Sectors	Large Farmer	Off-farm Workers	Women	Local-Level Implementers	NGO Workers
Small Farmers	H_o =A	H_o =A	H_o =A	H_o =A	H_o =A
Large Farmer	X	H_o =A	H_o =A	H_o =A	H_o =A
Off-farm Workers		X	H_o =A	H_o =A	H_o =A
Women			X	H_o =R	H_o =A
Local-level Implementers				X	H_o =A

Ho: There is no significant difference between two actor groups indicating that their attitudes are similar.
R: Reject Hypotheses A: Accept Hypotheses. Df = 4, p= 0.001 ***, 0.01**, 0.05*, .1 No Symbols

The perception variability for the first principle of SWRM indicates a similar outlook of all the actor groups toward this principle. There existed a thin attitudinal difference between Women and the Local-level Implementers. The rest of the intervening groups had a similar outlook toward this principle. The attitudinal similarities and differences are summarized in Table 8.13.

8.3.2 Second Principle

Water Development and Management should be based on a participatory approach, involving users and policy makers at all levels

Adherence Score

The adherence scores obtained by the different actor groups are presented in Figure 8.5. Seemingly, the attitudes of the individuals are shaped according to the degree to which the society holds an actor group responsible for planning and decision making. Although it was not possible to quantify the present level of responsibility held by different actor groups, a positive correlation could be established between the present levels of responsibility held and the degree of attitudinal adherence. It indicates that the participatory approach and users' involvement is shaped through time and is subjected to the degree of responsibility enjoyed. The Small Farmers and Women scored lowest, while Local-level Implementers and NGO Workers obtained the highest scores. The overall adherence score for the entire watershed was 44, which indicated that some efforts are essential to increase the total adherence score.

Perception Variability

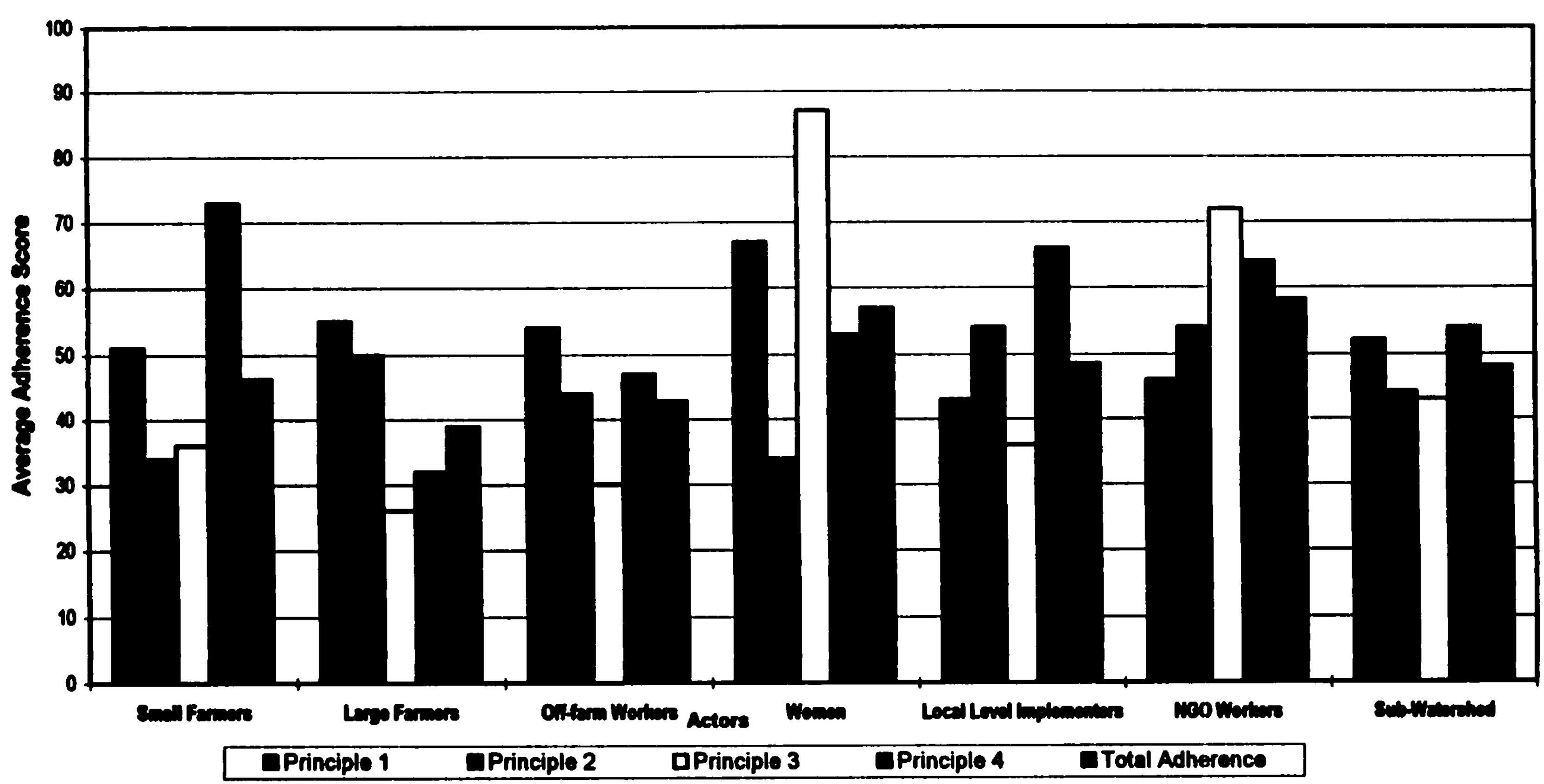
Table 8.14: Attitudinal Variability - Chi-square Test Result, Principal II

Water Development and Management should be based on a participatory approach, involving users and policy makers at all levels

Sectors	Large Farmer	Off-farm Workers	Women	Local-Level Implementers	NGO Workers
Small Farmers	H_o=R*	H_o=R	H_o=A	H_o=R*	H_o=R*
Large Farmer	X	H_o = R	H_o=R*	H_o=A	H_o = A
Off-farm Workers		X	H_o=R	H_o = R	H_o=R
Women			X	H_o=R*	H_o=R*
Local-level Implementers				X	H_o=A

Ho: There is no significant difference between two actor groups indicating that their attitudes are similar.
R: Reject Hypotheses A: Accept Hypotheses. Df = 4, p= 0.001 ***, 0.01**, 0.05*, .1 No Symbols

Fig. 8.5: Sustainable Water Resource Management Adherence Score



(Source: Field Work: 1995-7)

Principle I :	Fresh Water is a finite and vulnerable resource, essential to sustain life, development and the environment
Principle II :	Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels
Principle III:	Women play a central part in the provision, management and safeguarding of water
Principle IV:	Water has an economic value in all its competing uses and should be recognized as an economic good (ICWE: 1992)

The $\chi 2$ test results for the second principle of WRM are presented in Table 8.14. The results indicate similarity in perception among Women and Small Farmers. However, their perception differed from those of all other actor groups. Large Farmers, NGO Workers and Local-level Implementers shared a similar outlook regarding the participatory and users' involvement. Off-farm workers upheld a middle view, and this group's perception was slightly different from all other groups.

8.3.3 Third Principle

Women play a central part in the provision, management, and safeguarding of water (ICWE: 1992)

Adherence Score

This principle was one of the most discussed, contested and sometimes disliked as a deliberate attempt at favouritism by the actor groups. Except for Women and NGO Workers, the rest of the actor groups provided a very low support for this principle. This is one area where concerted effort is immediately essential. The overall score of the sub-watershed area was 43, which is marginally lower than average.

Perception Variability

Table 8.15: Attitudinal Variability - Chi-square Test Result, Principal III

Women play a central part in the provision, management and safeguarding of water

Sectors	Large Farmer	Off-farm Workers	Women	Local-Level Implementers	NGO Workers
Small Farmers	Ho =A	Ho =A	Ho =R**	Ho =A	Ho =R*
Large Farmer	X	Ho = R*	Ho =R**	Ho =A	Ho = R*
Off-farm Workers		X	Ho =R**	Ho = A	Ho =R*
Women			X	Ho =R**	Ho =A
Local-level Implementers				X	Ho =R

Ho: There is no significant difference between two actor groups indicating that their attitudes are similar.
R: Reject Hypotheses A: Accept Hypotheses. Df = 4, p= 0.01**, 0.05*, .1 No Symbols

It is evident from the chi-square test results (Table 8.15) that the perception of NGO workers and Women were similar. The rest of the actor groups held a different outlook than Women and NGO Workers but similar to each other. It was observed that capacity building efforts are essential under this principle. The need was seen especially among the Local-level Implementers. If the planning and budget preparation in the sub-watershed is observed (Chapter 6), it becomes evident that it would be very difficult to introduce a more democratic procedure in the sub-watershed.

The continuation of the status quo[33] would mean a sustained influence of Local-level Implementers, and, in that, a marginalized role of women in WRM and planning.

8.3.4 Fourth Principle

Water has an economic value in all its competing uses and should be recognized as an economic good (ICWE: 1992)

Adherence Score

The sub-watershed recognized the economic value of water and need to appreciate its competing uses. As Figure 8.5 presents, this principle was supported moderately to strongly by all the actor groups. While the Small Farmers appeared most concerned about this issue, the Large Farmers obtained the lowest score. As has been already discussed, there existed a positive correlation between the annual income and the per capita use of water (Chapter 7.3.4.2). The low score obtained by Large Farmers could be justified based on the same. The total adherence score for the entire watershed area is 54.

Perception Variability

Table 8.16: Attitudinal Variability - Chi-square Test Result, Principal IV

Water has an economic value in all its competing uses and should be recognized as an economic good

Sectors	Large Farmer	Off-farm Workers	Women	Local-Level mplementers	NGO Workers
Small Farmers	H_o=R**	H_o=R	H_o=R	H_o=A	H_o=A
Large Farmer	X	H_o= R	H_o=R*	H_o=R*	H_o= R*
Off-farm Workers		X	H_o=A	H_o= R	H_o=R
Women			X	H_o=R	H_o=R
Local-level Implementers				X	H_o=A

Ho: There is no significant difference between two actor groups indicating that their attitudes are similar.
R: Reject Hypotheses A: Accept Hypotheses. Df = 4, p= 0.001 ***, 0.01**, 0.05*, .1 No Symbols

As Table 8.16 indicates, the perceptions of actor groups were generally different. It was observed that the attitude of Small Farmers was similar to that of Local-level Implementers and NGO Workers. The perceptions of Women and Off-farm Workers were also similar. The attitudinal outlooks of the rest of the intervening sectors were different.

[33] Chapter 9 provides the priority and preference of the actor groups toward various WRM activities. The chapter has analyzed the preferred mode of implementation of activities and, in that, the present management approach has been put under people's scrutiny.

The attitudinal survey and a series of extended group discussions provided an indication that the economic value of water is always associated with willingness to pay when this issue is approached from the user's perspective. However, the 'costs' and 'benefits' are the main basis for determining the willingness to pay among the people. Piper (1996) evaluated different willingness to pay models and posited that the quality of water and willingness to pay are correlated.

Fig 8.6: Relationship between Willingness to Pay and Relative Access and quality

8.4 Implications of Attitudinal Analysis in Capacity Assessment

The analysis presented a strong understanding that the success of any WRM effort depends on the attitudinal inclination of various actor groups and the degree of harmony in their thinking. The research suggests that the success of any WRM program depend on the attitudinal inclination shown by individual actors. Conversely, these inclinations also define the level of resistance that one should expect while implementing any WRM programs. Especially, they can determine the position of participating stakeholders. This also provides an insight into what kind of or in what area or group capacity building would be required, and how specifically a response package could be designed.

WRM is a complex issue, involving a number of activities that must be integrated and applied in the given context (Gale: 1992, Biswas: 1992, Falkenmark: 1994, Neupane and Young: 1997, Nigam and Rasheed: 1998). Attitudinal assessment can also provide the inclination of different actor groups that can assist in perfecting reorientation frameworks. It can also provide the guideline on which the programs can be blended and implemented.

Another useful finding is that the analysis of WRM "as a whole" does not represent a true picture. The findings indicate that it is essential to apply a reductionist approach followed by a deductive mode of exploration. The 'whole' of WRM should be broken down into 'parts' and individually analyzed. The 'parts' then should be put through a process of logical reconstruction to understand the overall picture of the problem at hand. This finding reiterates the significance of deontology and deconstruction presented in Chapter 2 and 3. This also justifies the significance of situated analysis in WRM.

CHAPTER NINE

UNDERSTANDING PREFERENCES

"To the best of our understanding, the world is a complex system of interacting elements... In our complex world system, we are forced to cope with more problems than we have the resources to handle. To deal with unstructured economic, social and political issues, we need to order our priorities, to agree that one objective outweighs another in the short term, and to make tradeoffs to serve the greatest common interest ...Most of us believe life is so complicated that in order to solve problems we need more complicated ways of thinking. Yet thinking even in simple ways can be taxing... Simple thinking about such problems leads to combinations of ideas whose structure is not unlike a dish of spaghetti in which all strands are separate—but tangled. (Saaty: 1982:4)."

9.1 Background

The body of information that this thesis generated through a detailed literature survey, and assessment of people's action and attitudes, suggested that one of the integral components of capacity *assessment* is the analysis and synthesis of preferences (**Chahana or Awasyakata**). WRM involves the need to simultaneous maximize a combination of goals, and involves internal controversies. These controversies arise due to the differences in the level of importance given to the various goals by different stakeholder groups.

The perception variability demonstrated in Chapter 8, in many ways, deconstructs the classical notion that prevails in WRM (Steel: 1996, Spash: 1997). The existing notion in WRM is characterized by neoclassical environmentalism This research demonstrated that the stakeholders supported or rejected an objective function, not because they were totally "unconcerned" about the water resource requirement, but because these functions contrasted with their societal, economic, cultural, (and sometimes bureaucratic) milieu. This perspective, however, endorses that the assessment of capacity is incomplete until the people's role as the true manager of the water resource is carefully defined. Conversely, *it calls for an appreciation that one of the most meaningful capacities of the people is reflected in their ability to answer the question of "how the programs should be implemented?"* If the people demonstrated in their actions and awareness very attuned to the water resource conditions of the area, and demonstrated attitudinal inclination to "sustainable" WRM principle goals, they must equally be capable of pointing out their personal preferences in WRM alternatives.

The assessment of this ability could produce multiple benefits. It could better synthesize the action and attitudinal analysis and consolidate them into implementable actions. If programs are based on such consolidated preferences, they could directly stimulate the people's likelihood to internalize the program easily and quickly. Similarly, it could help in designing different program components by highlighting specific issues or better allocation of available resources. Moreover, this could help improve the participation of the main stakeholders, as the activity would be tailored in a sphere where people feel most comfortable to participate. Finally, it could be helpful to ingrain a democratic process in WRM and easily internalize the existing management practices into externally designed management approaches. This chapter builds entirely on the sub-watershed community's responses gathered through the *action and attitudinal analyses* as documented in Chapter 7 and 8.

9.1.1 Objective of this Chapter

The main objective of this chapter is to prioritize the different activities within the four principle goals of WRM. Specifically, this chapter aims:

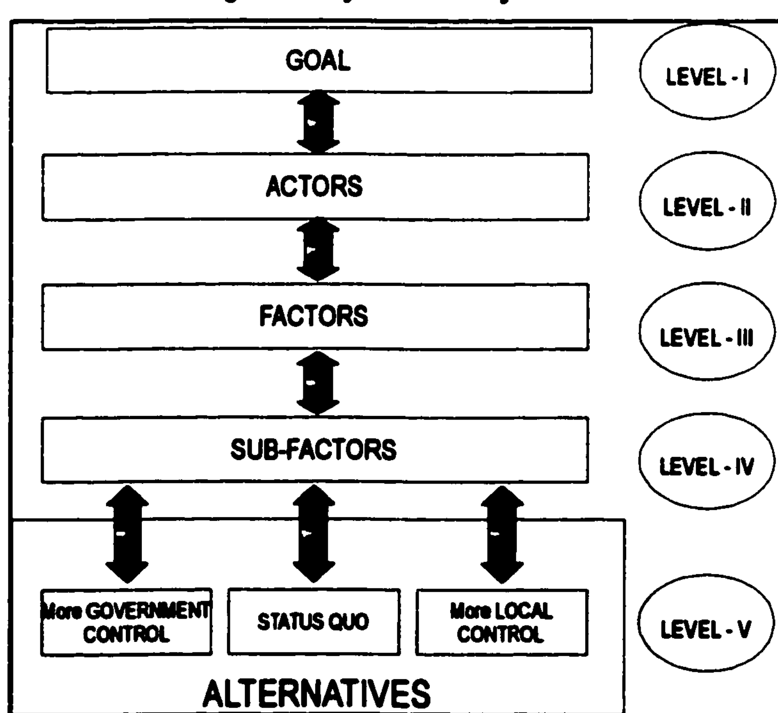
- To provide individual preference hierarchy and pair-wise judgment results.
- To present relative ranking of factors, sub-factors, and alternatives.
- To draw inference based on the above two.

9.2 AHP Results

9.2.1 General

The assessment of preference was based on multiple attribute decision making theory and used the Analytical Hierarchy Process (AHP) for preference synthesis. The detailed methodological account of the hierarchical assessment is given in Chapter 5. The study sought priority responses from 90 randomly selected responded, for which it used a five-level Analytical Hierarchical Model (Fig 9.1, 5.6).

Fig. 9.1: Analytical Hierarchy Format



Participatory analysis of the preferred activities under the principles of sustainable WRM could be considered as a significant outcome of this thesis. Similarly, collection of information within a valid inconsistency limit using a difficult decision support approach – at least until rigorous explanation was secured – could also be regarded as an important result. The validity of the relative importance between two factors or sub-factors was maintained by adopting an iterative process (Chapter 5).

9.2.2 Individual Factor Preference

It is presented in Table 9.1 that 52 percent of the respondents want WRM activities to improve the finiteness of water in the area. This consolidated the understanding that people are suffering from water resources shortage, quality degradation, and lack of proper technology to improve the present situation. The finding is also in conformity to their attitudes and actions. It clearly indicates that the people are adjusting themselves and accepting various tradeoffs to increase water use efficiency in the area. The respondents also voiced the need to initiate programs to increase user's involvement in WRM. This factor was the first order preference for 28 percent of the respondents. Similarly, 19 percent felt the need to improve Women's role as the most important factor. Only one- percent respondents prioritized the need for implementing activities to implement activities that would improve the realization on water as an economic resource.

Table 9. 1: Individual First Order Preference of Factors: Principles of SWRM

Factor Preference in Descending Order	Percent Respondents
Improving the Finiteness	52
Participatory and Increased User's Involvement	28
Recognizing Women's Role	19
Realizing Economic Value	1

(Participatory Estimates: 1995-7)

9.2.3 Individual Sub-factors Preference

9.2.3.1 Finiteness of Water

Table 9.2 indicates that any program having a strong emphasis on water quality would be strongly received in the sub-watershed. About 68 percent of the total respondents prioritized activities that would improve the quality of water as their first choice. This finding is in conformity with the problems related to the quality of water as described in Chapter 7.

The finding on water quality, however, contradicts with the theme of a keynote paper presented by J. Briscoe, World Bank, in a recent Expert Group Meeting on freshwater management in Harare (1998). Briscoe presented that "...water quality is a luxury good, the demand for it [is] growing as income grows"(1998:33). It may be true if analyzed at the national level, as Nepal Environmental Policy has indicated:

Table 9. 2: Individual First Order Preference of Sub-factors Under Finiteness of Water	
Sub-factor in Descending Order	Percent Respondents
Quality of Water	68
Quantity of Water	28
Technological Improvement	4

(Participatory Estimates: 1995-7)

"In many rural areas, insufficient attention has been paid to protecting water sources. A lack of understanding about the transmission mechanisms of waterborne diseases means that people often pollute water sources indiscriminately in various ways and manner without understanding the consequences" (1994: 29).

Seemingly, such generalizations could have been founded because often people's response for water quality degradation is much slower than the rate with which the water quality degrades. However, a slower response does not adequately justify making a blanket statement that the water quality is not an issue of concern for poor people in rural communities.

Out of the total, 28 percent of the respondents wanted activities to increase the total quantity of water. A lower priority given to this aspect could be because of a refined knowledge about water resource set-up among the respondents. The cumulative response also supports the findings presented in Chapter 7. Similarly, it could also be due to the refined economic sense on the part of the respondents. It is presented in Chapter 7 that the economic loss due to water quality – explained in terms of loss of yield, wage and livestock earnings – is significantly higher than that from water quantity problems. This leads to the consolidation of idea that water quality degradation is a recent phenomenon in the community. Equally, it becomes clear that although the community realizes the consequences, they lack locally evolved response mechanisms for water quality improvement. It also appears that so far no concrete measures have been taken by the external agencies to improve the water quality situation in the area, as the finding of Cowater et al. (1994: 2-11) attested:

"... hygiene education and sanitation activities had been limited to a few verbal instructions and reminders to the users by the technical staff during the initial project phases...

Only four percent of the total respondents wanted programs that would improve the technology in WRM to be implemented in the area. The lower response is in conformity to the finding of Chapter 7 that the sub-watershed believes in receiving programs that can render results of greater magnitudes. This may be one of the reasons why the terrace improvement program of Department of Watershed Management and Danish International Development Agency has not been received very enthusiastically by the community (DANIDA: 1997). First, it only marginally helps to improve their way of terracing and second, it conflicts with the people's way of terracing. Moreover, as Smadja's (1994) research in an adjoining sub-watershed pointed out, the marginal loss (at least by the local definition) is far less in comparison to the hassles involved in adopting the external advice. Also, there may be some other advantages, which are yet to come to the notice of the scientific community. This finding provides a reasonable perspective on the failure sustained by many projects implemented for technology development in WRM. For example: the failure of Resource Conservation and Utilization Project (APROSC: 1974), Karnali-Bheri Integrated Development Project (CIDA: 1993), etc., can be attributed to similar issue.

9.2.3.2 Participatory and Users' Involvement

The synthesis of individual preference presents that the programs providing equal access to use water were the most preferred activity under the second principle of WRM (Table: 9.3). Evidently, although the current programs contain a framework for all to participate, they fail to provide an equal access for all to be a part of the programs. This also suggests that the participatory framework of the programs currently in implementation may have been loosely defined. The less interest among the disadvantaged groups to participate could be due to this limitation. This justifies the lower attitudinal scores of Small Farmers, Women, and Off-farm Workers presented in Chapter 8. The need to reduce conflict was ranked second indicating that the sub-watershed is experiencing conflicts while using water. This supports the findings presented in Chapter 7.

Table 9. 3: Individual First Order Preference of Sub-factors Under Participatory Framework and Users' Involvement

Sub-factor in Descending Order	Percent Respondents
Equal Access	36
Conflict Reduction	23
Equal Opportunity	16
Political Suitability	13
Significance to Sub-watershed	12

(Participatory Estimates: 1995-7)

The rest of the activities, on increasing equal opportunities, political suitability, and increasing the significance of the watershed within the larger basin were almost equally preferred. These activities were ranked in first priority order by 12 to 19 percent of the respondents. It suggests that there exist a great degree of similarity in the preferential inclination toward the sub-principles and programs preferred within it.

9.2.3.3 Women's Role in WRM

The empowerment of Women in WRM was ranked as the first order priority by 47 percent of the respondents. Similarly, greater responsibility to Women in WRM was indicated by about 42 percent of the respondent as first order priority. The individual preference statistics are presented in Table 9.4. It is revealed through the quantification of attitudinal dispositions that the actor groups, except for Women and NGO Workers, are not very positive about Women taking control of water resources (Chapter 8). The hierarchical finding under this principle provides a meaningful justification toward such uneasiness.

Table 9.4: Individual First Order Preference of Sub-factors Under Women's Role in WRM

Sub-factor in Descending Order	Percent Respondents
Empowerment	47
Responsibility	42
Access	11

(Participatory Estimates: 1995-7)

Three caveats should be given concerning this finding of the preference assessment. First, a majority feels that Women need to receive programs that can increase their capacity in WRM. Conversely, this means it is believed in the sub-watershed that currently Women have insufficient capability to manage water. The community and facilitator regard women simply as the source of labor. The following conclusion of Cowater et al. supports the finding of this thesis:

> *"In...projects they [women] had no say in project planning and management, but in construction period, when households were asked to provide labor for the construction of the scheme, women were sent to work. In general, women were used as labourers this being the community's contribution to the project (1994: 2-11)"*

Second, the stakeholders expressed that Women must receive an increased responsibility that can positively contribute to establish their ability and worthiness of managing water. Even more important reason to believe that the community regards the traditional role of Women in WRM as a socially constructed phenomenon. It supports the existing perception of "Women must fetch water" as a socially constructed issue (Sharma: 1987). Traditionally, Women have been assigned a much greater responsibility to use water than men have, however, socially; their actions have been limited to fetching water or occasional labor contribution. Therefore, unless Women prove their worthiness by participating in activities that are alien to the sub-watershed, the prevailing perception is very unlikely to change and accept the role of women in decision-making, planning and implementation. Apparently, this indicates the existence of a paradoxical situation. Neither are the stakeholders ready to give any kind of responsibility to women, nor, without some form of initial trust, can women prove their worthiness. Thus, there exists a need for *capacity building* on this front. As a realistic solution, the women may be gradually given more responsibility and simultaneously empowered by designing special projects/programs exclusively for women. However, this initiative also faces a danger of running into a situation, which may not be acceptable to the predominantly Hindu society of the sub-watershed, and can be counter productive with grave consequences.

Thirdly, it is apparent that the role of Women in WRM is noticed. The examples could be observed in the actions (Chapter 7) and the attitudes of the people (Chapter 8). As presented in the above paragraph, unless women prove their ability, it is very unlikely that the watershed community will support providing more access to women. Thus, there exists a need to prepare small programs for women that can help them prove their ability in WRM. A simpler way would be to make efforts in institutionalizing some of the WRM tasks that women are doing as their social responsibility. For example: women could be used in water resource assessment or in generating data for monitoring and evaluation of the projects that are in implementation.

9.2.3.4 Economic Value of Water

The individual preference synthesis reveals that the ability to9 pay is highest priority for 45 percent of the respondents. The activity to assess the willingness to pay was ranked as first order preference by 32 percent of the people. About 23 percent of the respondents felt that the present cost sharing procedure is unfair and improperly designed. They felt that a mutually acceptable assessment method needed before the activities are implemented. IIMI (1997) found a similar gap in the process of irrigation service fee (ISF) collection in irrigation systems.

Table 9. 5: Individual First Order Preference of Sub-factors Under Economic Value of Water

Sub-factor in Descending Order	Percent Respondents
Ability to Pay	45
Willingness to Pay	32
Improve the Process of Assessment	23

(Participatory Estimates: 1995-7)

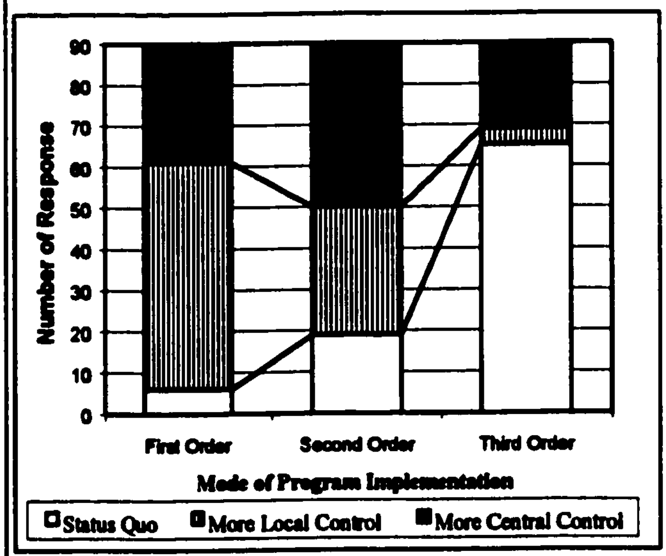
Cowater et al. (1994) observed the problem of assessment in drinking water projects and recommended conducting studies to consolidate the issue in accordance to general socioeconomic condition of Rural Nepal.

It can also be indirectly inferred that if programs in water management are implemented with income generating activity, such programs will have a very high acceptance rate. As Cowater et al (1994: 2-12) "*most of the NGO water supply projects were integrated with their community development activities and thereby achieved more interaction and time with people.*" Table 9.5 provides the individual first order preference of activities under the fourth principle of ICWE (1992).

9.2.4 Individual Preference to the Alternatives

The finding indicates that the area overwhelmingly supports *people taking a greater control in WRM program formulation and implementation.* Sixty-two percent of the respondents believed that the role of people must be increased in WRM. Similarly, about 33 percent of the total respondents believed that the government should take greater control in WRM in the area. A small proportion of the respondents (~5%), however, believed that the present mode of implementation is the most appropriate mode of program implementation in the sub-watershed. This clearly indicates that an overwhelming majority of the respondent are not satisfied with the present mode of program implementation. The summary, presented in Figure 9.2, indicates that any program in the area would be received with less resistance if the approach management were vested either to the people or to the government.

Fig. 9.2: Individual Preference and Their Priority on Mode of Program Implementation



(Participatory Estimates: 1995-7)

Two caveats should be given concerning these findings: First, the current WRM lacks the required preciseness to receive attention of both the watershed community and the actors responsible for taking it to the watershed. Second, any effort of WRM would be overwhelmingly received in the sub-watershed, if it would demonstrate some level of difference in the implementation procedure from that of the current approaches. People in the area preferring NGOs over government to implement programs may be justified on this ground.

9.2.5 Actor Group Preference

The finding under this section reflects the pattern of individual actor groups' prioritization and preferences. The results are the outcomes of the synthesis of AHP model using Expert Choice 9.5 software. The AHP model synthesis was done in the field itself and all results were discussed both in a general mass meeting and separate actor group meetings. The analysis was conducted with an inconsistency index of less than 0.1. This indicates that the group data synthesis was done with both scientific rigour and to the satisfaction of the actor groups. The relative success of this model may be attributed to the smallness in the spatial coverage of the area, methodological refinement, and the level of established rapport among the researcher, research assistants, and the stakeholder groups.

9.2.5.1 Small Farmers

Small Farmers indicated that they wish to receive programs that would provide equal opportunity for all and demand more users' involvement. It was revealed from action analysis that they are least aware of the WRM activities in the area. Conversely, they feel that the more their voice would be heard during the process of management, their access to water would increase. They perceived that an increased role would enable them better bargaining power and they would receive an increased quantity of fresh water, which was their second priority (Table 9.6). It was very logical in the sense that majority of the small farmers' survival depend on the availability of water. Often the relative prosperity among Small Farmers is determined based on the nearness of their agricultural plots to the source of water. It was later revealed in the group discussion that none of the 15 Small Farmers who provided the response had ever participated in any WRM programs. The situation, with a few exceptions, was similar for all Small Farmers in the sub-watershed. This finding is also in conformity to their attitudinal outlook presented in Chapter 8 of this thesis.

Within finiteness of water, the Small Farmers overwhelmingly prioritized the quality of water. This was a very genuine response, because most of the Small Farmers work as wage labourers, and any day of work missed can bring serious cash flow problems to the whole family. In addition, getting sick involves paying for the doctor and taking care of medical bills. The justification for this reaction is presented in Chapter 7.

Small Farmers prioritized the empowerment of the Women in the sub-watershed as the most important sub-factor to improve women's role in WRM. Similarly, they prioritized the need to provide equal opportunity to everybody under the second principle of WRM. As has been presented earlier, Small Farmers least support the notion of putting an economic value of water. It was the major reason revealed later as to why they have prioritized the need for activities that will help generate the sense of willingness to pay among the people of the sub-watershed. It was reported that Small Farmers feel that it is not they but the farmers of higher strata do not realize the true value of water.

Table 9.6: Summary Sheet: How Small Farmers Preferred WRM Programs

Aspect in order of preference	Preference Score (AHP Synthesis)	
Participatory and Users' Involvement		**0.52**
Equal Opportunity to Everybody in Planning	0.44	
Equal Access to Everybody in Planning and outcome of planning	0.275	
Political Suitability	0.164	
Minimum Conflict	0.078	
Empowerment of the community & increasing its significance	0.043	
Finiteness of Water		**0.371**
Water Quality	0.731	
Water Quantity	0.188	
Technology for WRM	0.081	
Women's Role in WRM		**0.072**
Empowerment	0.743	
More Responsibility	0.194	
More Access	0.063	
Economic Value of Water		**0.036**
Willingness to Pay	0.69	
Assessment of true value of water	0.229	
Ability to Pay	0.075	
Synthesis of Leaf Nodes with Respect to Ideal Mode		
More Local Control	0.493	
More Government Control	0.334	
Continuation without any changes in the design and implementation	0.226	

The synthesis of Small Farmers' preferences presents that they wish to take greater control of WRM in the sub-watershed. Their second priority is the government taking greater control of water resource in the area. The Small Farmers put the status quo approach as the least preferred option.

9.2.5.2 Large Farmers

Large Farmers provided the most pessimistic response. It is obvious that this group currently enjoys a clear dominance in all WRM projects and programs being implemented or proposed in the sub-watershed. They have, in most of the cases, the best-located land that receive year round irrigation and often the community taps are purposefully located in proximity to their houses. Despite this dominance, this group felt that the finiteness of water is the most important aspect in the sub-watershed (Table 9.7). Surprisingly, the actor group ranked participatory role and more users' role in managing water as their second order preference.

Table 9.7: Summary Sheet: How Large Farmers Preferred WRM Programs		
Aspect in order of preference	Preference Score (AHP Synthesis)	
Finiteness of Water		**0.47**
Water Quantity	0.709	
Water Quality	0.179	
Technology for WRM	0.113	
Participatory and Users' Involvement		**0.334**
Political Suitability	0.438	
Empowerment of the community & increasing its significance	0.188	
Minimum Conflict	0.182	
Equal Opportunity to Everybody in Planning	0.118	
Equal Access to Everybody in Planning and outcome of planning	0.075	
Economic Value of Water		**0.115**
Ability to Pay	0.528	
Assessment of true value of water	0.333	
Willingness to Pay	0.14	
Women's Role in WRM		**0.082**
More Access	0.547	
Empowerment	0.345	
More Responsibility	0.109	
Synthesis of Leaf Nodes with Respect to Ideal Mode		
More Local Control	0.538	
Continuation without any changes in the design and implementation	0.257	
More Government Control	0.205	

Within Finiteness of water, larger farmers preferred programs to increase the total quantity of water. As it is clearly demonstrated in Chapter 7, this is a very natural response. Seemingly, the quantity of water used by the people is positively correlated with the income level of the households. Apparently, this group suffered relatively less from the water borne diseases, could afford to boil water and also, in the case of illness, pay for the doctor and medicine.

Often it is from within the Large Farmers that the local leaders are selected. This was one of the main reasons why Large Farmers feel that the political suitability of the WRM programs is the most important sub-factor that needs to be maximized. They felt that political stability could help increase participation and induce greater involvement of local people. The Large Farmers felt, and accordingly prioritized, that providing greater access to Women is the best way to increase their roles in WRM. Regarding the economic value of water, Large Farmers felt that there is a need to increase the ability to pay of the people in general. It appeared that the Large Farmers wanted to categorize themselves among the unable-to-pay candidates in the sub-watershed.

These all preferences funnel to the reason why the Large Farmers felt that the government should take greater control of water resource in the area. Their second choice of program implementation was to maintain the status quo. The Large Farmers demonstrated a strong level of similarity in the spectrum of its factor and sub-factor preferences. The factor and sub-factor preferences were linked in such a way that all would sustain the benefit that the Large Farmers are currently enjoying.

9.2.5.3 Off-farm Workers

As discussed earlier, Nepal is an agricultural country and because of this, the majority of the programs designed in water resources provide a greater emphasis to the farming groups. Recently, this attention and value has started to shift in the favour of Women. However, very few programs cater to the specific needs of the off-farm sector. There are a few programs initiated at the central level to relate the off-farm sector with the water, however, most currently cater to the interest of the big enterprises and businesses. This must be one of the reasons why Off-farm Workers strongly felt that WRM programs ought to be more participatory and must involve the users. The Off-farm Workers second choice was to increase the women's role in WRM. Understandably, because most of the off-farm activities are family-managed business, they have regarded the importance of involving women in WRM.

The majority of the Off-farm Workers selected for this study were involved in income-generating activities directly linked to water, such as water-milling, canal-digging, masons, etc. These people have, by virtue of their trade, relatively greater knowledge of the available technology. This was reported as one of the reasons why these people selected technological suitability as the most important sub-factor within finiteness of water (Table: 9.8). Similarly, these people preferred programs to give Women greater access in WRM. They reasoned that if the access to act in a real situation is provided, this could dramatically improve the women's ability to involve in WRM and quickly empower them.

Water often has a conflicting use in the off-farm and farming sectors. The minor feuds between the farmers and the off-farm sectors are sometimes inevitable. In these conflicts, the farming community always receives an upper hand as it is a traditional occupation and many people are involved in it. Thus, Off-farm Workers strongly favoured the need to minimize the water use conflicts in the area. This overwhelming support required reevaluating their responses because the Large and Small Farmers had given lower preference to such activities. The extended inquiry resulted that the Off-farm Workers were very truthful in their response. It was also revealed that the conflicts are more serious during the wheat (dry) season. It indicates that the preference of the people in being involved in a WRM program is season dependent. The preference is very fluid and changes with the variability in the availability of water.

Table 9.8: Summary Sheet: How Off-Farm Workers Preferred WRM Programs		
Aspect in order of preference	Preference Score (AHP Synthesis)	
Participatory and Users' Involvement		**0.549**
Minimum Conflict	0.424	
Equal Access to Everybody in Planning and outcome of planning	0.262	
Empowerment of the community & increasing its significance	0.188	
Equal Opportunity to Everybody in Planning	0.144	
Political Suitability	0.053	
Women's Role in WRM		**0.243**
More Access	0.731	
Empowerment	0.188	
More Responsibility	0.081	
Finiteness of Water		**0.147**
Technology for WRM	0.55	
Water Quality	0.362	
Water Quantity	0.061	
Economic Value of Water		**0.036**
Ability to Pay	0.733	
Willingness to Pay	0.199	
Assessment of true value of water	0.068	
Synthesis of Leaf Nodes with Respect to Ideal Mode		
More Local Control	0.430	
Continuation without any changes in the design and implementation	0.360	
More Government Control	0.210	

The off-farm group gave the ability to pay as the most preferred sub-factor within the economic value of water. This group preferred that the watershed community should take greater control of the water resources asserting that the responsibility to design WRM program and implement them should be with the people and not with the government.

9.2.5.4 Women

It is reported in chapter 7 that Women are responsible to take care of over 95 percent of the activities related to water resources in the sub-watershed area. However, most of these actions are limited to the use of water and labour contribution, which are seldom appreciated. The strategic planning report of drinking water sector in Nepal has reported that very rarely women's role is recognized other than labourers in system design and construction (Cowater et al.: 1994). Perhaps, there exists a need to properly analyze these roles, as fetching water for the household may take a lot of time, but the decision on where to place a tap within the community is much more critical. Unfortunately, the women's role on the former is completely disregarded as a duty assigned to them based on social division of labor.

Table 9.9: Summary Sheet: How Women Preferred WRM Programs	
Aspect in order of preference	Preference Score (AHP Synthesis)
Women's Role in WRM	**0.486**
Empowerment	0.707
More Access	0.223
More Responsibility	0.070
Participatory and Users' Involvement	**0.306**
Minimum Conflict	0.424
Equal Opportunity to Everybody in Planning	0.262
Empowerment of the community & increasing its significance	0.188
Equal Access to Everybody in Planning and outcome of planning	0.144
Political Suitability	0.053
Finiteness of Water	**0.154**
Water Quality	0.664
Technology for WRM	0.271
Water Quantity	0.085
Economic Value of Water	**0.054**
Ability to Pay	0.758
Willingness to Pay	0.151
Assessment of true value of water	0.091
Synthesis of Leaf Nodes with Respect to Ideal Mode	
More Local Control	0.491
More Government Control	0.333
Continuation without any changes in the design and implementation	0.177

Recently a few programs have been introduced in the sub-watershed, which give the sole or more responsibility to plan, manage, and operate WRM projects to Women. However, a comparative process and impact evaluation of two projects, one managed entirely by women and other entirely by men, indicate that the former project is poorly managed than the latter (Chapter 7). This selected case is one of the most frequently cited examples for women's incapability to manage water. Unfortunately, Women themselves feel that their project has failed to provide the envisaged benefit to the watershed community. These are some of the reasons why Women expressed the need to implement programs that can enhance their roles in WRM (Table: 9.9). As could be expected, their second preference was the activities that magnify the users' role in WRM.

Women regarded water quality as the most important sub-factor within the finiteness of water. Because of quality deterioration, women suffer most because of reduced income to the household, to act as the caretaker of the ill member of the family and to divert attention from other economic activities. Thus, their being most concerned can be very well justified.

Similarly, in other factors, they considered that empowering them could really help increase their roles and performance in WRM. The women encounter most of the water-related conflicts in the area; thus, they reasoned that the area's WRM would really improve if conflicts were minimized. Similarly, they regarded ability to pay as the most important sub-factors to realize the economic value of water.

In overall, the Women overwhelmingly emphasized that the people in the watershed should take an increased control of water resources. It must be noted, however, that the Women's responses could not be cross-examined through a separate group. Twice such meetings were called, but only two Women showed up for group discussions. Reportedly, the Women were not allowed to go 'alone' to attend the meeting.

9.2.5.5 Local-level Implementers

Local-level Implementers currently shoulder the responsibility of implementing almost 95 percent of the developmental works and approximately 98 percent (calculated on the basis of Dollars spent) of the WRM programs. A gradual shift in the activities is taking place from the government to NGOs. However, the shift is very slow, and the process of this departure is vagarious rather than based on practicability. In addition, NGOs too have failed to maintain the required level of transparency. As it is reported in chapter 6, the budget and planning processes are very complicated, and often these do not involve, at least in practice, common people in the watershed area. This has given Local-level Implementers an upper-hand and, often an unquestionable prerogative in deciding, planning and implementing programs on WRM.

The Local-level Implementers have asserted, however, that they would like to see a better participative framework introduced in WRM (Table. 9.10). Their second preference was to increase the availability of water quantity and improve its quality. The sector advocated that such water quantity and quality improvement efforts are subject to the availability of a proper technological base. They strongly believed that the empowerment of Women can make their roles in WRM more refined. Unfortunately, none of the programs currently underway seemed to have realized such necessity.

Table 9.10: Summary Sheet: How Local-level Implementers Preferred WRM Programs	
Aspect in order of preference	Preference Score (AHP Synthesis)
Participatory and Users' Involvement	**0.502**
Political Suitability	0.449
Equal Opportunity to Everybody in Planning	0.295
Equal Access to Everybody in Planning and outcome of planning	0.132
Minimum Conflict	0.082
Empowerment of the community & increasing its significance	0.043
Finiteness of Water	**0.225**
Technology for WRM	0.674
Water Quality	0.226
Water Quantity	0.101
Women's Role in WRM	**0.178**
Empowerment	0.549
More Access	0.249
More Responsibility	0.157
Economic Value of Water	**0.094**
Assessment of true value of water	0.733
Willingness to Pay	0.199
Ability to Pay	0.068
Synthesis of Leaf Nodes with Respect to Ideal Mode	
More Government Control	0.412
Continuation without any changes in the design and implementation	0.343
More Local Control	0.245

Often Local-level Implementers' decisions are politically motivated, which, if they fail to follow, may lead to transfer or dismissal from the job. As Cowater et al. stated:

> *"the DWSO is not immune from the influence of DDC members and MPs during the short listing and feasibility studies. Influence can also be exerted during the process of selecting projects for implementation. The process of allocating budgets to the DWSO is also not immune to influences...the result is a distortion of the development program that prevents DWSO from implementing community management policies" (1994: 2-31).*

This must be the main reason for Local-level Implementers giving the first priority to political suitability. The Local-level Implementers provided strong opinion to establish a method of assessment that can help properly define the true value of water.

The Local-level Implementers preferred that the government should take greater care of WRM in the sub-watershed area. This preference is very justifiable, in the sense that giving more responsibility to the sub-watershed community would mean that they have less responsibility to exercise. This finding supports the assessment of attitudinal adherence of the Local-Level Implementers. Provided this sector has a greater control of water resources in the area, its current domination in the WRM can continue.

9.2.5.6 NGO Workers

Contemporary WRM approaches regards NGOs as the backbone to advance specific programs or activities to the beneficiaries (Cowater et al: 1994, Briscoe: 1998, Nigam and Rasheed: 1998). Although in Gerkhu Khola Watershed, many external and internal (see chapter 6) NGOs are operating, and their involvement in WRM is very new and indirect. The recent efforts made by DANIDA and RWSSFP to use local and external NGOs are the first of its kind in the area. As the programs are to be implemented, the sub-water community could not provide much information about the nature of their dealings with NGOs. However, the programs implemented in other sectors – some of which are very closely related to water – received some degree of appreciation from the beneficiaries.

This research received an overwhelming support of the NGOs, which indicate that they have a higher level of developmental sense than their counterparts in the government sector. NGO Workers felt that the WRM programs must insure greater involvement of people in the watershed by giving them more responsibilities (Table 9.11). They also favored to increase and recognize the Women's role in WRM programs, which indicates their higher level of appreciation of how the global and national understanding in WRM is changing.

The NGO Workers strongly felt that increasing water quality and quantity is dependent on the introduction of right kind of technology. They felt that the Women's role in WRM could be recognized better if their access to WRM planning is increased. The overwhelming support of NGO Workers to increase Women's access is reflected in the programs that are being designed in the area. Both the DANIDA and RWSSFP supported programs have taken Women as the contact group in the village for program implementation.

It was surprising to note that NGO Workers have experienced conflicts emerging in the sub-watershed area. Consequently, the NGO Workers overwhelmingly supported the need for minimizing conflicts in the area. To find a justification for this unprecedented preference, the researcher made a deeper inquiry into this issue. It was revealed that the primary reason for the conflict is the limited funds available with the NGOs, which requires them to be selective and they can support only a few hamlets within the sub-watershed area. This has given people in the watershed a view that the functioning of NGOs is often biased or politically conscious in favour of a certain VDC or hamlet. A minor conflict between two hamlets in Upallo Gerkhu was caused due to uneven distribution of resources. This conflict must have given the NGO Workers a reason to believe that the sub-watershed area needs special programs to reduce conflicts.

Table 9.11: Summary Sheet: How NGO Workers Preferred WRM Programs

Aspect in order of preference	Preference Score (AHP Synthesis)	
Participatory and Users' Involvement		**0.549**
Minimum Conflict	0.424	
Equal Opportunity to Everybody in Planning	0.262	
Empowerment of the community & increasing its significance	0.188	
Equal Access to Everybody in Planning and outcome of planning	0.144	
Political Suitability	0.053	
Women's Role in WRM		**0.243**
More Access	0.731	
Empowerment	0.188	
More Responsibility	0.081	
Finiteness of Water		**0.147**
Technology for WRM	0.55	
Water Quality	0.362	
Water Quantity	0.082	
Economic Value of Water		**0.061**
Ability to Pay	0.733	
Willingness to Pay	0.199	
Assessment of true value of water	0.068	
Synthesis of Leaf Nodes with Respect to Ideal Mode		
More Local Control	0.478	
More Government Control	0.334	
Continuation without any changes in the design and implementation	0.188	

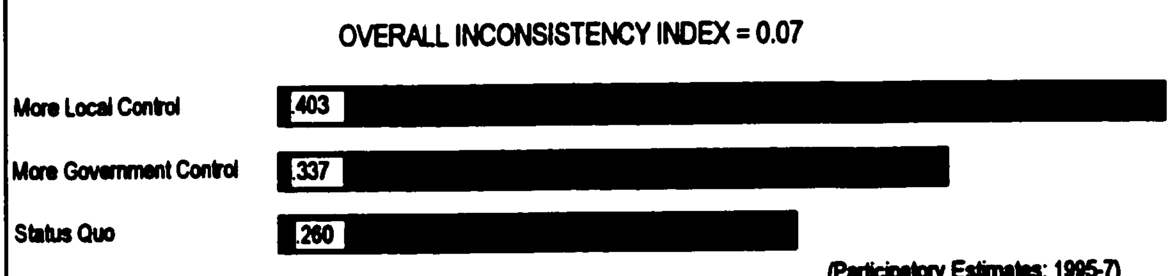
To realize the economic value of water, the NGO Workers very strongly supported the activities that improve and properly establish the sub-watershed community's ability to pay. Similarly, as regards to the mode of program implementation, they supported that the people in the sup-watershed must take a greater control of their water resources.

9.2.6 Overall Group Preference

The capability to synthesize overall group judgment is an important aspect of the AHP model application. The result draws the conclusion based on the individual preferences, actor group preference, factors and sub-factors preference and synthesizes the most preferred alternative. Thus, the result provides a consensus judgment of all actor groups having multiple and conflicting preferences to different factors and sub-factors.

The overall inconsistency index of the model is less than 0.1, which is lower than level of error allowed in the AHP simulation (Saaty: 1980). The model output also presents the degree of suitability of the alternatives. The overall judgment (Fig. 9.3) provides that the best alternative for the sustainable WRM in the sub-watershed is to implement the program by awarding a greater control of the water resource to the people. Similarly, the second best alternative is the government taking a greater control to manage the water resource in the sub-watershed area. Conversely, the current approach is not suitable and must be either immediately modified or abandoned. It can be loosely remarked that the people could reject the capacity building program at the very first stage, if the design of the implementation is not changed.

Fig. 9. 3: Synthesis of Overall Preference with respect to GOAL (Ideal Mode)



9.2.7 Syntheses of Factor and Alternatives

If the above analysis is carefully observed, it emanates a very important concern – is the preference for mode of implementation universal or does it vary with the specific activities? This research observed this aspect by synthesizing the factors vis-à-vis the preference of alternatives. Although the model permitted the synthesis of individual preference for different modes of implementation with respect to factors and sub-factors, it has been presented only for the sub-watershed and for the factors, which provides a concrete picture with potentiality of generalization. This analysis demanded calculation of geometric means of the preferences of all the actors under each factor and sub-factor and their analyses using the same model.

The outcomes of the factor vis-à-vis alternative analyses are presented in Table 9.12. As the figure suggests, except for activities that correspond to the finiteness of water, to maximize the rest of the factors, the sub-watershed community wishes to take greater control of water resource. This finding intimates two distinct perspectives.

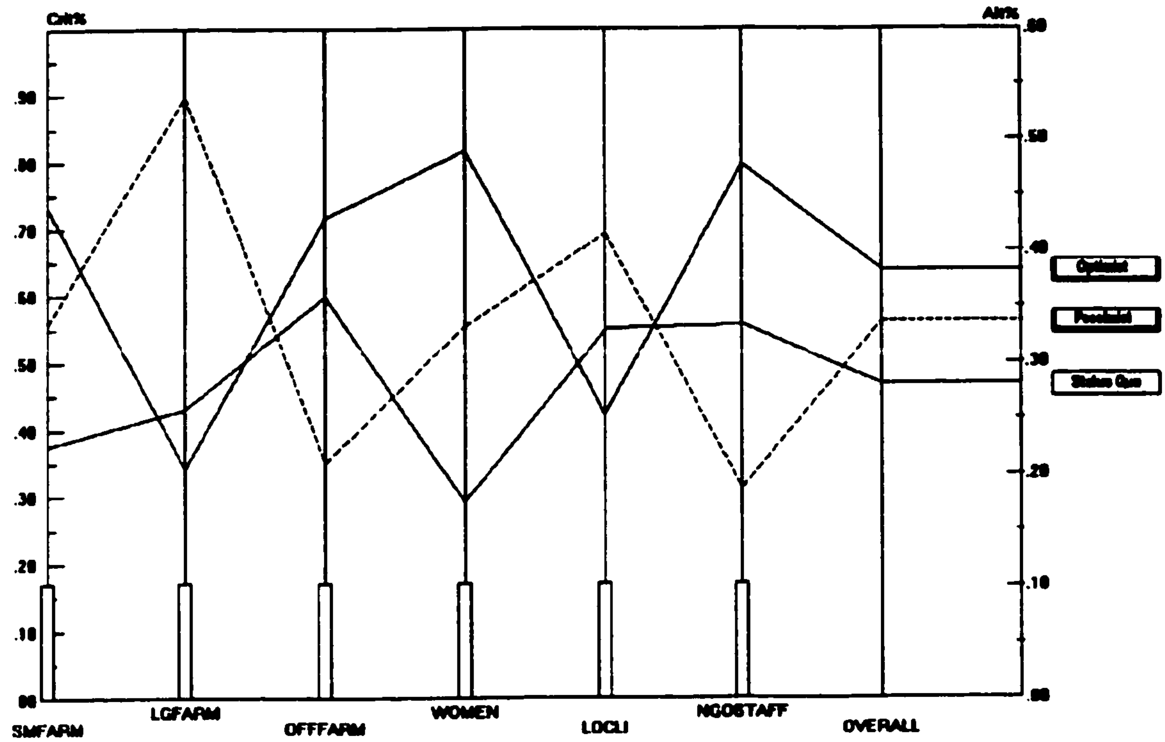
Table 9. 1: Diverse Choice –Synthesis of Factors with respect to the Alternatives						
Factor	More Local Control		Status Quo Approach		More Government Control	
	Score	Priority	Score	Priority	Score	Priority
Finiteness of Water	0.191	III	0.257	II	0.552	I
Participatory and More users' involvement	0.591	I	0.202	III	0.207	II
Women's Role in WRM	0.569	I	0.199	III	0.232	II
Economic Value of Water	0.468	I	0.308	II	0.225	III

(Participatory Estimates: 1995-7)

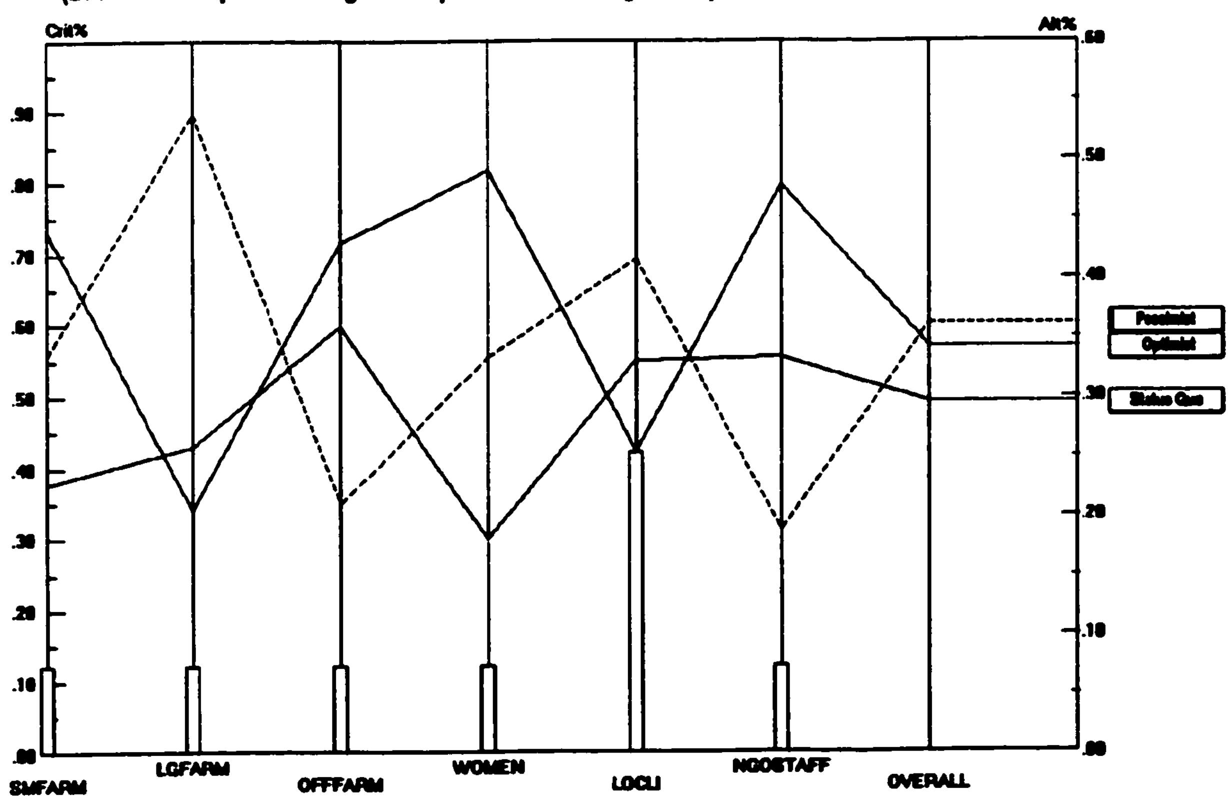
First, that the sub-watershed community's personal capacity to increase the total physical availability of water has reached its peak and can not be improved further. They have also realized that the current mode of implementation is also not going to benefit them much. This caused the farmers to opt for, may be unwillingly, the alternative that demands more governmental control, which indirectly mean that decisions can become more authoritative. Some of the current WRM practices recently implemented by the government, e.g., DANIDA sponsored Gerkhu Khola Watershed Management, or Trishuli Drinking Water projects, may have also been the reason for the sub-watershed community to acquiesce in to the government's control. This also supports the alienation, annexation, and arbitrariness theory presented in Chapter 7. Finally, this finding also substantiates the point made on the outset of the thesis that the local people's ingenuity and ability also are constrained by the socioeconomic and environmental limitations that are inherent to the mountain specificities (Jodha: 1991). The intensity to which the sub-watershed community has asserted this fact could be sensed through the comparison of Eigen Values of the alternatives with respect to the factor.

To implement the rest of the activities, the sub-watershed community definitely has the necessary capacity, knowledge, and locally evolved techniques. This provides a sense that the partnership of government and the local people is inevitable. Yet, they must complement each other rather than infringe into or distort a sustainable and soundly operating system. However, this marriage is constrained by factors presented in Chapter 7 (CATCH - 22) and are exacerbated by the perception variability presented in Chapter 8.

Fig.9.4: Performance Sensitivity with Respect to Goal for Nodes below Goal : Most Preferred Water Resource Management (Base Case)



(Local Level Implementers given 30 percent more weight compared to rest of the actor groups)



9.3 Sensitivity Analysis

The AHP model was also put through a logical sensitivity analysis to find out the changes in the overall preference by altering the current level of actor influence. The sensitivity was performed by increasing the relative importance of all actors and factors. This computer simulation provided that the changes in the relative importance to the factors do not affect the relative preference of the local level control to WRM in the watershed. However, a 30 percent change in the importance of Local-level Implementers from the base case makes the pessimistic approach more appropriate in the sub-watershed area (Fig. 9.4). Thus, if inferred in the perspective of present level of influence of the Local-level Implementers in WRM efforts, the participatory mode adopted by the government may appear irrational, as the sensitivity of relative importance provides that a relative power vested on the Local-level Implementers may make the programs more effective when the government takes the entire responsibility of implementing them.

9.4 Implications of Preference Assessment

The AHP analyses provided an insight into how the activities are preferred by the people in the sub-watershed. Overall syntheses of the individual, actor groups and overall group judgment provided that there exists a need to change the course of WRM in the sub-watershed area from its present mode.

All stakeholders wanted the people living within the watershed to take greater control of their water resources. There were definite indications that some activities were better received and overwhelmingly supported by the people and can provide maximum benefit to the sub-watershed. Similarly, there are others, which have been currently rejected or much less preferred. This, essentially, presents a very useful spectrum to maneuver the implementation modality of the WRM. WRM in small Himalayan watersheds is definitely not a "keep the hands off" affair, neither is it an issue of "just" encouragement, as this quote from the Nepalese environmental action plan consolidates:

> *"Future rural water supply projects will need to encourage community participation in project design and implementation, develop public education program that pertain to water resources... (HMG/NEPAP: 1994:29)*

There are obvious signs that in some of the aspects of WRM, people do require some assistance, and, in that, they have clearly spoken for the need to give the government a greater responsibility. The people's demands are visible only in the activities that are not supported by their vast knowledge and local ingenuity. This presents the sub-watershed community as cost and program sensitive. Thus, it is less important to design resource sensitive programs in the area and implement but than to internalize the cost and program sensitiveness of the people. This thesis could recommend, based on the foregoing analysis, that the best possible way to internalize such sense was to provide selective assistance wherever the community has demonstrated their real need.

The research also revealed the existing interlinkages between different factors and sub-factors. These interlinkages indicate that by addressing one factor, the goal of some of the other factors can be maximized. For example: the Small Farmers tend to maximize the goal related to the finiteness of water by demanding a program related to the participatory framework in water management. Such issues are essential to be considered in capacity building programs. This chapter has provided areas of activities where people have sought external assistance. This spectrum of activities may be put on the bargaining table to arrive at a logical partnership between the community and the external support agencies. Similarly, the analysis has also indicated the mode of implementation sought as the most appropriate in the sub-watershed area.

CHAPTER TEN

CONCLUSIONS

"Capacity building is foremost a global and a strategic element in the sustainable development of the water sector; it is a long-term, continuing process that has to permeate all activities in the sector. [It] also entails the application of a number of specific techniques to strengthen performance of sector and sector supporting organizations...with regard to a strategy for water sector capacity building, it must first of all be recognized that each country and region has its specific characteristics and requirements with respect to its water resource situation and ...[other associated realities]. Therefore, operational strategies must be tailor made. To achieve this it is [essential that] water resource assessments be initiated...(Delft Declaration: 1991 cf. Alaerts et al.: 1991: 17-18)

10.1 Synopsis

Although the current knowledge of Water Resource Management (WRM) is based on many years of theoretical and applied research, there are many areas – crucial to the successful implementation of WRM – where little effort has been made. This thesis explored one such area, *local-level capacity assessment, or assessment of the ability of the major stakeholders in a small watershed to cope with the problems related to water utilization and management*. The research had four objectives: a) to understand the local-level actions by analyzing both social and physical aspects of water use in the sub-watershed area, b) to understand the local-level attitudes and find perception variability among the actor groups, c) to identify local people's major preference for WRM and d) to synthesize the findings and present a conceptual framework for capacity assessment (Chapter 1).

The findings of this thesis are built on a systematic review of literature and a participatory research carried out in a small sub-watershed, Gerkhu Khola, in Nepal. The research primarily used the knowledge of local-level stakeholders to consolidate the concept, methodology, information, and synthesis of capacity assessment. Consolidated analysis of mutually observed (by the researcher and the local-level stakeholders) WRM phenomena indicated that the *people's knowledge in WRM could be best understood by assessing their actions, attitudes, and preferences*. Unfortunately, such processes are many and dynamic to be contained using a single analytical framework. Such dynamism arises out of the changes in human-water interaction processes, which are shaped by physical, environmental, socioeconomic, administrative, political process and transboundary riparian issues, and any changes recorded therein. Consequently, a series of iterations using separate analytical approaches to understand actions, attitudes, and preferences are desired. As much as the dynamism of capacity affects information generation and their analyses, it equally affects the use and generalization of explored results. Although the processes are mostly situated, some trends could be generated for future use or for the parallel applications in similar regions. Thus, this thesis does not provide any "*generalized-finding*," applicable to the entire Himalayan belt, but it provides an approach, which can be used, for similar works in the region. By an approach, this thesis implies refinement of the concept as well as methodical issues in capacity assessment, and a simple framework to operationalize it.

It must be made clear at the outset that the content of this chapter was discussed with the sub-watershed community and all suggested modifications were duly incorporated into the synthesis. Especially, the critical analysis of Sustainability, Knowledge, Attitude, Preference, and Evolutionary (SKAPE) issues in WRM vis-à-vis capacity assessment is an outcome of this exercise. It is believed that SKAPE would be useful for solution analysis and problem synthesis in the area of capacity assessment.

10.1.1 Objective of the Chapter

The main objective of this chapter is to synthesize the findings and provide the major conclusions of the thesis. Specifically, the chapter aims:

1. To provide the main conclusions and synthesis of the research.
2. to present a framework to summarize the actions, attitudes and preferences
3. To identify the research gaps and recommend the areas where further exploration would be needed to consolidate the concept of capacity assessment in WRM.

10.2 Conclusions

10.2.1 Capacity Assessment as the Missing Link

The introductory chapter of this thesis described that the local-level capacity and its use in WRM are becoming a major research focus in contemporary water management research (Alaerts et al.: 1991b, ICWE: 1991 Hartvelt: 1996). Chapter 2 of this thesis reflected that much of this interest has emerged due to a series of measures adopted during the past with little or no progress at the implementation levels (Alaerts et al.: 1991b, Okun and Lauria: 1991, Biswas: 1996, UNDP: 1997, Hopkins: 1997). It is now believed that the contemporary efforts focus more on theoretical consolidation rather than the practicability of the issue (Brikké et al.: 1998). However, such theoretical consolidations are often limited, and lack the required depth to make capacity assessment operational at the grassroots level (Hartvelt: 1996, Biswas: 1996, Hopkins: 1997, Najlis: 1997).

WRM efforts in the Himalayan region also suffer from these limitations (Cowater et al.: 1994, Neupane and Young: 1997, IIMI: 1997). Fortunately, there is a growing global attention, which regards capacity assessment as a breakthrough approach, and advocates the need to make it compatible and fitting to WRM exercises at the grassroots level (Hopkins: 1997, Serageldin: 1997b, UN: 1998). Similarly, on the other extreme, some village-based studies have argued that the use of local-level knowledge in WRM is very little (Butz: 1987, Butz et al.: 1991, Neupane: 1993, Smadja: 1994, Chene: 1997, Lane: 1997, Serageldin: 1997a). The conceptual convergence of these two perspectives shows that capacity assessment is one of the missing links to operationalize concepts such as *capacity building, participation, and indigenous knowledge.*

10.2.2 Addressing the Conceptual Complexity of Capacity Assessment

Chapter 2 of this thesis showed that the concept of capacity assessment is used extensively by a broad spectrum of individuals and authorities. The term can be found in everything from government policy papers to the professional literature. It has become an integral part of the WRM rhetoric, in part due to the conceptual complexity of the term and, in part, due to the appeal of the word to the academic and donor community. Yet, as it is presented in Chapter 2 that the existing concept, without a clearly attainable framework, is defined so loosely that it is open to multiple interpretations. It is clearly presented that a few efforts have been made to consolidate the theoretical aspect, but the practical use of such consolidations to design a WRM framework have not been attempted both by the organized (UN or bilateral agencies or individual countries) or unorganized (individuals and organizations) sectors.

Box 10.1: Main Conceptual Conclusions

- Capacity assessment is recognized as one of the most important aspects in WRM, yet it has received limited attention.
- There is a call for a paradigm shift and, in that, need for a design methodology. The envisaged paradigm shift is calling for not just to increase the participation of people in WRM, but to identify an entry point for the external efforts to operate better and participate in local-level WRM. *The call is more to design a reinforcement mechanism rather than to distort the local way of WRM.*
- Being a people-centred strategy, it is essential that the concept, definition and framework for capacity assessment are made *as simple as possible.*

Throughout this thesis, no effort has been made to complicate the concept of capacity assessment. The working definition, on which the argument of this thesis is built, was kept simple. It believed that, *like knowledge, capacity is also situated*, and the local capacity in WRM could be understood better by studying the situatedness of community vis-à-vis water. Thus, capacity assessment at the local-level is essentially a process of understanding from the local people how they manage their water, what they think about WRM and how they think WRM should be.

In practice, however, there are an immense variety of management activities conceptualized, formulated and implemented under the name of "capacity assessment." The elusiveness of contemporary WRM and the dominance of a certain ideologue are well understood and require little elaboration. Because, in theory, all WRM approaches, even those founded in complex engineering theory, present themselves to be "capacity oriented". Obviously, such affirmations are based on a conviction that no one has yet properly defined the concept of capacity assessment at the local level (Hopkins: 1997). Consequently, the use of words such as "participatory" or "indigenous technology" often appears appealing to fill this definition gap.

However, in practice, as this research has demonstrated, what may seem an easy way-out of a definition gap is, in fact, the most convincing starting-point for a difficult analytical task. The finding of this thesis has adequately proved that *anything concerning local-level capacity must directly involve local people*. Similarly, there is a need to simplify the definition for capacity assessment rather than make it complicated. Emphatically stated, without involving people, if a definition tries to pin down precisely what the concept of capacity assessment really is, it can easily lose what is its fundamental characteristic – its situatedness. Thus, the most useful definition of capacity assessment that may be made is: "*capacity assessment is not what a research/approach wants it to be, but it is a* <u>*process*</u> *of developing a sense and understanding of how the local people demonstrate their knowledge and what knowledge they demonstrate*".

10.2.3 Use of a Philosophy that is Situated and People Based

Chapter 3 of this thesis presented a view that the shifting and fudging of the aims of Himalayan WRM and its epistemological foundations are reflected in the shifting and fudging of its methodological principles. Thus, it is concluded that there exists a need to adopt a new philosophy based on denaturalization and humanization of the existing WRM phenomena in the Himalaya. The use of scrutinized a-posteriori truth, developing a high sense of empathy and respecting the human spirit are some of the important aspects that need to be considered. It is also essential that all perceived problems – which have given rise to Eckholmism (Guthman: 1997) and spiral down theory (Ives and Messerli: 1989) – are interpreted as specificities of the Himalaya (Jodha: 1990). It is concluded that rather than establishing what are the contexts of sustainability; it is much more relevant that the aspects of unsustainability are taken as the basis to understand sustainable WRM.

Admittedly, however, non-linear interrelationships between water and human beings are far too complex and can not be contained within any philosophical boundaries. Thus, deontology of epistemological foundation and reassertion of its inseparability from the people is essential. There may be other research approaches to tackle the problem, but the situatedness of the knowledge remains unquestionable. The role of people is fundamental to every aspects of capacity assessment, especially to covert a set of data into an approachable set of understandings. Thus, this thesis concludes that the *involvement of people in capacity assessment efforts is not just an ethical issue but also an indispensable strength* for sustainability.

10.2.4 Administrative Structure, Legislative Framework and Capacity Assessment

Chapter 4 of this thesis provided a review of administrative structure and legislative arrangements in Nepal. It demonstrated that many organizational structures are created at different levels of the government hierarchy, and most are founded on strong legislative structures. However, most of these do not operate properly at the grassroots level. Some of these arrangements have partly recognized the role of people to increase managerial and operational efficiency of WRM projects. However, the current efforts are not coordinated to well internalize the local knowledge. There is much confusion about the legal provisions, policy structure, and regulatory provisions. It is indicative that key water related organizations are beyond the reach of common people and this has seriously hampered the process of capacity development.

Based on the above discussion, it is not an aim of this thesis to deny the role of the organized sector in WRM, but to critique the existing thinking that supports the creation of an administrative body as a solution over more efficient use of the existing one. This issue is adequately substantiated in Chapter 4. In this context, this conclusion also serves as a critique to all on-going efforts geared to develop capacity assessment frameworks at the national level, e.g., UNDP and the Government of Netherlands' effort in capacity assessment. *Emphatically stated, even if these national level projects manage to realize their goals, there is a possibility that these will be superficial and nothing concrete would be achieved at the lower levels, where WRM are actually implemented.* This research concludes that the strength of the administrative structures and legislative framework depend on the degree of accessibility and understandability among the general people.

10.2.5 Process-oriented Research

Box 10.2: Methodological Conclusions
• There is no fixed methodological approach, conceptual framework, or tools to analyze capacity at the local level. • Deconstruction and deontology of external knowledge of local-level water management are essential. The design methodology must evolve from a collaborative effort of local-people-expert partnership. • The effort to assess capacity, or involve people must rely on locally evolved philosophy and situated knowledge. • A multiple-approach, multiple-attribute, and multiple-tool based study is essential for the proper assessment of local-level capacity. • True capacity assessment must explore the people's role beyond data collection to analysis and synthesis. • It is almost impossible to contain participatory research within a Hypothesis building and testing exercise.

Chapter 5 of this thesis elaborated on the research characteristics and methodological approach. This thesis is an outcome of three field seasons spent in Gerkhu Khola Sub-watershed in Nepal, between May of 1995 and November 1997. The research adopted a multi-approach, multi-actor and multi-tool approach to explore the issues of capacity assessment in Himalayan WRM. Using an iterative consultation with the sub-watershed community, this research selected Small Farmers, Large Farmers, Women, Off-farm Workers, Local Level Implementers (Government Officials) and I/NGO affiliated Workers as the main stakeholders. Similarly, this thesis used tools, such as, Participatory Rural Appraisal, Likert Technique of Behavioral Research, and Multi-attribute Analytical Hierarchy Process. However, the researcher concludes that *any methodology or tool, in which the identified stakeholders find most comfortable participating should be considered as useful for capacity assessment*. The adopted process and researcher's willingness to share the results with the local-level stakeholders is more important and crucial in capacity assessment than the type of tools, depth of information collection and extent of analyses. However, the role of scientific decision-making and the use of available tools must also be acknowledged as they help accelerate the problem solving and syntheses process.

In short, it is indicative that three main issues must be considered in capacity assessment. First, the selection and application of methodological tools should be both scientifically applicable and agreeable to the people. Second, it should rely on the people's knowledge for collection, analysis and synthesis of information. Finally, it should be both flexible and iterative.

10.2.6 The Case Study: Gerkhu Khola Sub-watershed

Using both primary and secondary data, Chapter 6 of this thesis presented the socioeconomic and physical characteristics of the study area. It also analyzed the detailed problem structure of the area using a framework developed by Adleman and Morris (1973).

- Inasmuch as Gerkhu Khola appears to be comparable to other small watersheds along the middle mountain belt, both physical, human systems and their interactions are different and difficult to be generalized. Such situated interrelationships, within the human-physical system, are characterized by a set of rules that is socially and culturally defined.
- Although Gerkhu Khola sub-watershed is geographically small (19.11 km^2), its socioeconomic and hydrological characteristics are extremely variable and uncertain. Water resource characteristics vary in both temporal and spatial scales. Some of the variables fluctuate annually by as much as 1200 percent. Both socioeconomic and ecological realities are influenced by the community's interaction with hydrological characteristics of the area.
- Locally evolved institutions like the Perma system, Aama Samuha are active on local-level WRM. However, a few local institutions have started to wither away and have given way to modern arrangements, e.g., NGOs. The functioning of these institutions is, however, alien to the local way of managing water[34].

This conclusion is contradictory to the assertion derived through the literature review. It was contended in the introductory chapters that when societies evolve (or modernize) their resource management strategies also evolve. However, it was observed that such evolution in management strategies might not always be as desired by the societies. Using various ethno-knowledge, the societies try to change the course of the evolution, if it begins to contradict with the desired resource conditions. It is only when they, individual or group, are unable to correct the course of evolution, they seek external support. Such plea for external support, however, should not be observed as "societies not having any sense of their resource conditions." It is an indirect expression of a very refined sense of care for the available resources. The deteriorating quality of water in Gerkhu Khola is a valid example of such unwarranted evolution.

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[34] The local way of WRM is observed here from the utility perspective, i.e., how people use water to maximize the total utility from the available supply sources, accepts tradeoffs and makes adjustments for it. The local way of WRM is described in detail in Chapter 7.

10.2.7 Applicability of the Dublin Principles

The research provided enough evidence that the principles of sustainable WRM (Dublin Principles: 1992) offer enough ground to be made operational at the grassroots levels. The evidence might be very useful to satisfy some of the major concerns about the Dublin principles raised by water resource scientists like Woods (1995) and Biswas (1997) (Chapter 2). The local-level analysis of the principles resulted into a total of 12 sub-principles. It is presented in Chapter 7 that the beneficiaries, *even of small sub-watershed in an underdeveloped country,* can not only understand, but also relate their actions, attitudes and preferences with the Dublin principles.

It can be concluded based on the findings of the case study that in order to recognize the finiteness of water, it is essential to put water in the centre of all resources, water quality must be maintained, and suitable technology must be adopted. Similarly, to recognize that WRM is based on participatory frameworks and that users are duly involved in them, it is essential for all of the users to have an understanding of the existing planning, budget and legal structures, the participation must be of a continuous nature, and equity and transparency must be maintained on every aspect. The analysis provided that in order to properly recognize women's role in WRM, their present level of involvement must be acknowledged, they should receive equal access in decision making and planning, and such access should be duly integrated with the empowerment programs. Finally, it is concluded here that the economic value of water can be properly realized, if the value of water is fixed on a collaborative basis, the equity in access is linked with cost sharing, and a progressive mode is introduced based on the quantity of the use and waste disposal practices.

10.3 Synthesis of the Case Study

10.3.1 Finiteness of Water

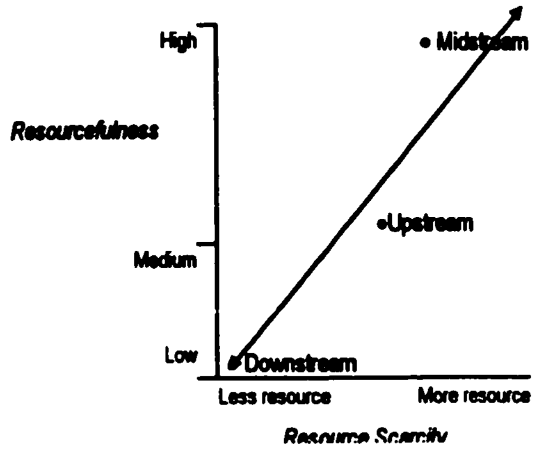
The finding of this research presented in Chapter 7 demonstrated that the sub-watershed community could identify, assess, and provide general cost-benefit of all the viable water sources present within the sub-watershed area. The local people know the local-level variability, fluctuation, and general cost-benefit associated with the use of water sources. Their knowledge about the mountain watershed is observed to be much more refined and up-to-date than the structured data collection and updating processes of the government and I/NGOs. This knowledge demonstrated by sub-watershed community can be used as a basis to conclude that the local people continuously monitor the water resources available in their area. The finding also supports the main argument of Huddleston's thesis that the local-level responses initiated by the rural poor are often the best and sometimes only available solution to cope with existing crises. It is because the local people tend to conduct an equivalent of scientific research, trials to select the best response to tackle a given set of problems. However, some limitations do require total replacement and that is where the external (scientific community) can be most effective.

It is presented in Chapter 7 that on average about 470 litres per person per day (lppd) of water is available in the sub-watershed. However, the qualitative scrutiny of the total discharge decreased the drinkable quantity to less than 12 lppd. It is far less than the villagers' average demand of 65 lppd of water. This indicates that the people have no choice but to use water of inferior quality. The statistics related to the water-borne diseases in the sub-watershed area corroborates this fact. This fact is also corroborated by the attitudinal and preference analysis presented in the thesis.

Out of the total water used in a household, only 53 percent of the water is brought home and the rest is used at the source. This observation confirms that all sources are used to some extent and they are all equally important to the villagers. This provides a general understanding that the management of water must be comprehensive in an area; and all those sources, where direct action of people is visible, should be included in WRM efforts.

It is observed that most of the sources dry up during the dry seasons, characterizing an extreme variability of hydrological characteristics in the sub-watershed area. The sub-watershed appeared to be fully prepared for the period of normal water stress. To avoid seasonal stress, the community adopts a number of activities and strategies. A detailed account of such strategies is provided in Chapter 7. Such strategies may not be scientifically proven for the area but are definitely preferred by the community. This is the reason why this thesis concludes that the sub-watershed appeared to be adjusting as well as accepting tradeoffs to balance irrigation and drinking water needs. The local-level adjustment methods may not appear financially feasible in terms of a modern definition of cost and benefit analysis. However, this research concludes that a long-range cost and benefit calculation is essential to justify the significance of such adopted technologies. Seemingly, the yield and monetary loss occurred in the short run will always be more than the immediate benefits. However, the longer-term assessment can truly indicate the significance of adopted strategies and also help to refine our knowledge of appropriate technology. The community's response during the times of extreme stress is reported to be entirely different from 'normal' times and it is applied on an 'as it comes' basis.

Fig 10.1: Relationship between Resource Scarcity and Resourcefulness



Based on the above observation, it can also be concluded that as resources diminish resourcefulness increases and vice-versa (Fig 10.1). It is indicative from the synthesis provided in Chapter 7 that the midstream area, where people experienced most severe problem of water resource, is, in fact, the most 'water-conscious[35].' Thus, the ability to cope is also greatly influenced by the resourcefulness. The water-scarce villages cope better than those receiving more water. The diminishing resource is often gradually felt, however, in extreme stress conditions (other than seasonal variability) the changes are characterized by surprises. Villagers' refined knowledge and ability to provide an assessment of the water demand based on the seasonal changes corroborate this assessment.

It is presented in Chapter 8 that, attitudinally, the community groups strongly regard water as central to all other resources. This issue, however, is not much appreciated by those who are considered responsible for implementing WRM in the sub-watershed; and their perceptions contradicted with the community groups.

Except for women and the NGO groups, other actor groups only moderately support the significance of the quality in the total availability of freshwater. This issue is characterized by a strong degree of perception variability. Similarly, the limit to technology is still to be properly realized by both the community and facilitator groups. Small improvement in technology is rarely considered as helpful. The stakeholders demonstrated similarity in their perceptions, which makes technology a viable ground for external intervention and capacity building.

Similarly, the analysis provided in Chapter 9 demonstrates that the sub-watershed is suffering from both water resource shortages and quality degradation. Consequently, they strongly demanded activities that can increase the total availability and quality of water in the sub-watershed area.

10.3.2 People's Participation and User's Involvement

It is presented in Chapter 7 that the informal methods of information dissemination are much more effective in sub-watershed than formal methods. In this context, the villagers demonstrated a very high sense of mutual sharing of

[35] Water conscious is expressed in terms of ability to cope with water problems and adopted WRM actions.

ideas and responsibilities. The information flow from the formal sources is generally slow and inadequate. This is supported by the finding that only less than a quarter of the population are knowledgeable about the existing planning and budgeting processes of the government and NGOs. Consequently, the rate of participation is observed to be minimum in such planning and budgeting processes. This observation, therefore, warrants a further inquiry into the 'participatory WRM framework' of the government and NGOs.

Although the use of water is legally defined in Nepal, most of the people in the sub-watershed do not know about water rights. It is observed that except for the Muluki Ain, 1963, other legal provisions and water right, which are much more recent, are unknown to the community. Women and Small Farmers were absolutely unaware of current planning structure, but individuals belonging to higher strata were. Such discrepancy may be attributed to a natural alliance existing among the groups belonging to higher status and reluctance of the government and NGOs to maintain transparency.

The need for continuous participation is highly supported by women and the facilitator groups. The rest of the intervening sectors poorly or moderately support the notion of continuous participation. This issue is observed to be very controversial and indicates that there is a limit to participation. The finding confirms that the users would greatly appreciate, if a value of their participation were negotiated up-front before initiating any WRM program in the area.

Adherence analysis presented in Chapter 8 demonstrates that the need for equity and transparency in WRM is only moderately supported by the facilitator groups (Local level Implementers and NGO Workers), while the community groups (the rest of the groups) highly support this issue. Normally, the facilitator groups tried to keep the programs to themselves. This finding demands that the reliability of I/NGOs as viable means to implement WRM programs be further explored. This research concludes that I/NGOs are definitely functioning better than governmental systems. However, their functioning in mountain WRM is not totally free from bureaucratic rigidity and lower levels of transparency.

Based on AHP analysis, it is concluded that, although stakeholders demonstrated a high degree of internal controversies in giving equal opportunities to everyone in WRM, it is regarded as the most appropriate activity to enhance users' involvement in WRM and to make it truly participatory.

10.3.3 Women's Role in WRM

Women in the sub-watershed spend more than one-third of their day in collection and management of water, and cover as much as 85 percent of the total water related tasks of the household. The majority of the people (men) in the watershed do not appreciate women's role in water management. It is widely perceived that all water management tasks performed by women is their fair share and is based on social division of labor. Women are given very few opportunities to attend meetings and training programs compared to men. The lower responsibility and opportunities given to women is clearly visible in their performance in formal WRM activities.

Only Women and NGO Workers support the need for women's involvement, empowerment, and giving more responsibility in WRM. Rest of the actor groups poorly supported these sub-principles. The recent mode of channeling of the programs through women appears to have sparked a sense of competitiveness and jealousy among males. Women in the sub-watershed could be efficient partners in program design and implementation, but they are not allowed to mingle with outsiders, visit the offices and participate in anything occurring outside the Gerkhu Khola sub-watershed. It is demonstrated in Chapter 9 that the empowerment is the most preferred activity to improve women's involvement in WRM.

10.3.4 Economic Value of Water

The people in the sub-watershed are aware of the economic value of water. On an average, every household annually suffers from almost six cases of water-borne diseases, which collectively inflicts an average annual per capita loss of $ 20 or 10 percent of the national per capita income (Chapter 7). Due to the medical expenses, loss of work and time spent in collecting water, per household monetary loss is more than US $ 250. The people realize the opportunity cost, and a few have made several personal and group initiatives.

It is observed that people expressed the value of water by integrating it with the economic activities. It must be because of this that the demand of water for livestock raising is considered more important than the need for drinking. Similarly, the gross margin analyses confirm that the selection of a particular crop is motivated more by the availability of water than the availability of other inputs. It is observed that people tend to reduce their economic status while expressing their opinion on economic valuation of water resource.

The community strongly feels that not only them but also those who are responsible to implement formal WRM must understand the economic value of water. Small Farmers, Local-level Implementers and NGO Workers highly regard the economic value of water, while the rest of the groups do not consider it as an important issue. The significance of maintaining equity in cost and water sharing is moderately to strongly supported by the actor groups. Except for Large Farmers, all actor groups overwhelmingly support the progressive system of cost sharing.

The analysis in Chapter 9 shows that the activity to improve the ability to pay for the use of water must be adequately established before the notion of economic value is instituted. This supports the findings of Cowater et al. (1994), which argued that if water management in Nepal were integrated with economic activities, the users would better receive them.

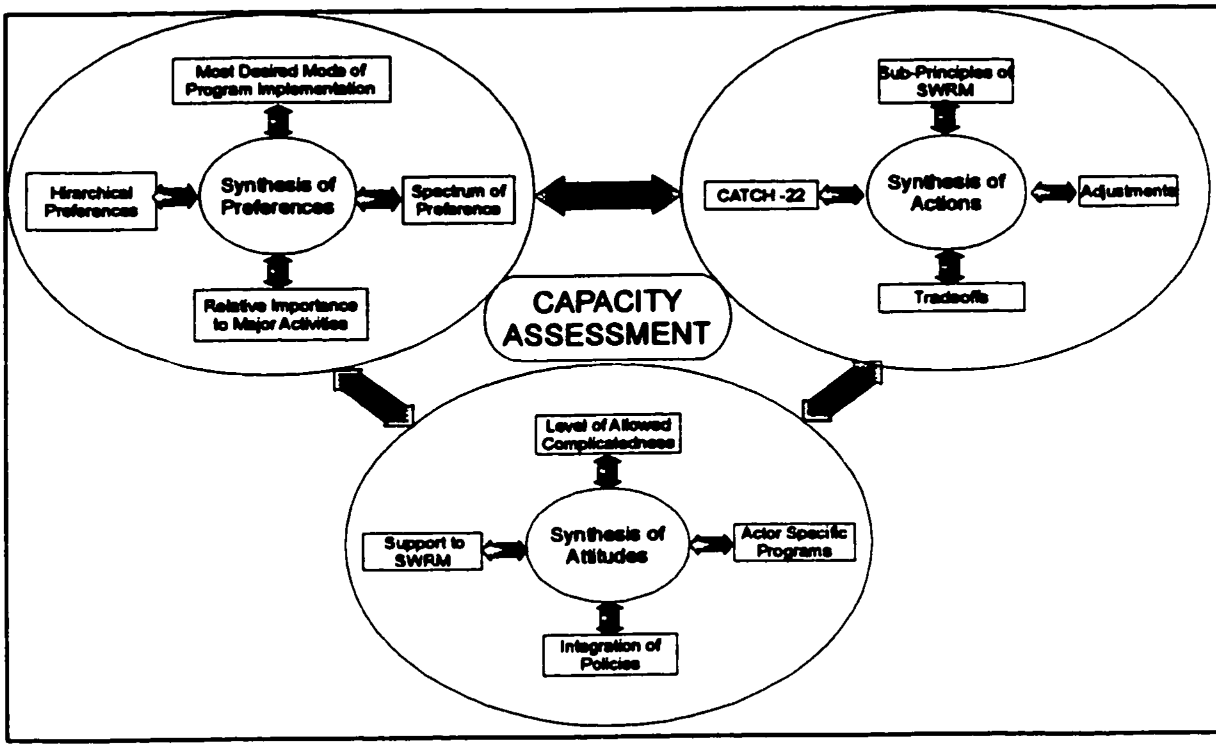
10.3.5 Collective Assessment

The collaborative assessment of the findings show that the sub-watershed does suffer from physical reduction of water, quality degradation and the affect of both on economic activities. It is evident that, at the operational level, the core of the solution is ignored in WRM. By an ignored core, this research implies that the people of the sub-watershed are much less involved in WRM activities. It is observed and also confirmed by the people in the sub-watershed that the ongoing WRM efforts are mostly arbitrary. The programs appeared to be planned without any agenda, solid database or interaction with the community members. The Gerkhu Khola sub-watershed is often regarded as an annex of the greater Langtang-Trishuli-Narayani River basin. Without a defined identity, most of the programs implemented in the area are either beyond the reach of common people or not directly concerned with them. Consequently, the people tend to ignore their WRM responsibilities or simply ignore them. The ignorance can also be attributed to the fact that the community is often deprived of their right to use water, which is both unconstitutional and against the legislative framework in WRM (Chapter 4).

Similarly, the thesis observed that the ongoing efforts often regard people without having any capacity (Chapter 2, 4, and 7). Ostensibly, this thinking not only creates, although inadvertently, a "capacity-vacuum", but also a situation where the programs are duplicated or made so simple that people loose interest to participate in them. Consequently, many examples of haphazard planning are clearly visible. Equally, the WRM in the area suffered from a clear definition on what to do and dual objective-functions of major variables (bipolar distinction).

The syntheses of adherence analysis show that the finiteness of water is highly supported by all groups. However, it is also revealed that the *aggregation of sustainability criteria often conceals its internal differences and variabilities*. Thus, it can be concluded that capacity assessment should be based on an inductive framework.

Fig 10.2: Synthesis of the Outcome

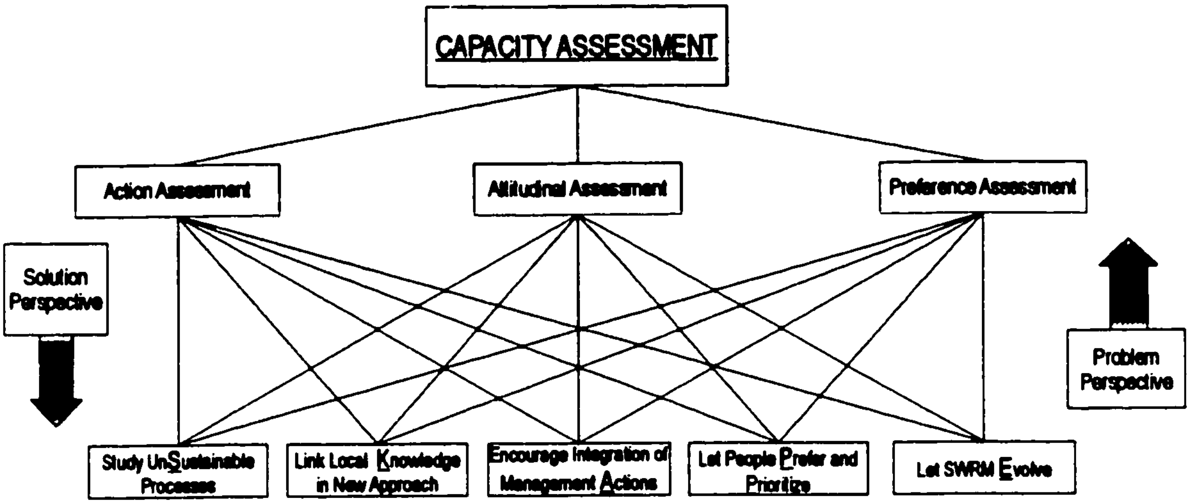


The syntheses of AHP analysis demonstrate that the most important factor for all stakeholders is the finiteness of water and the most important sub-factor is the quality of water (Chapter 9). Similarly, the most influential actor group is the Local-level Implementers, the most vulnerable, but most concerned of all groups, is the women's group, the actor group with the most diverse answer is the Large Farmers; and the actor group with most innovative ideas is the NGO Workers. The overall synthesis of the individual, actor groups and overall group judgment demonstrates that the on-going approach to WRM is not preferred in the sub-watershed area and the people showed interest to take a greater control in local WRM. In Figure 10.2, the major outcome of the research is presented. The figure conceptually presents the interrelationship and dependence among different modes of assessment.

10.4 SKAPE

This acronym was conceived after the villagers and the researcher met to synthesize the findings. It is construed that if there exists a relevance of Sustainability, Knowledge, Attitudes, Practices and Experiences (SKAPE) in WRM, and if capacity assessment also has significance in WRM, then there has to be a definable linkage between SKAPE and capacity assessment. The same perspective also explains that capacity assessment can be looked at as a problem or a solution. Figure 10.3 conceptually presents this perspective. If the contents in the bottom boxes are rephrased and stated negatively, they all become central problems to current WRM efforts. Similarly, the capacity assessment itself has been considered as a promising solution for sustainability in WRM.

Fig. 10.3: Perspective of Capacity Assessment

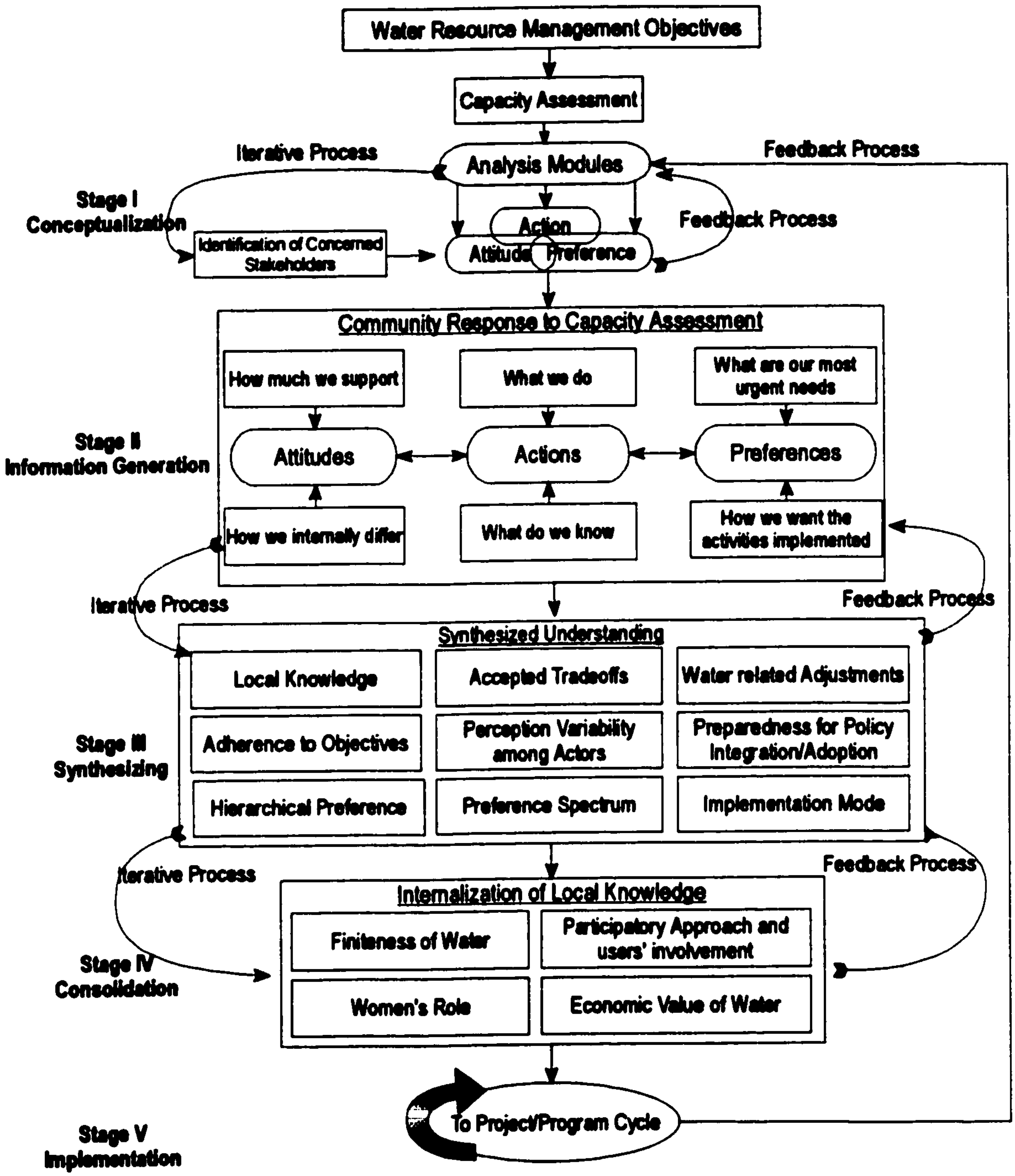


If capacity assessment in WRM is seen as a solution, it can provide an insight that can help in the sustainable evolution of management approaches, to link the local knowledge in a new (external) approach, and to integrate management actions. Similarly, it can provide local people with an opportunity to express their personal preference and priorities. If capacity assessment in WRM is seen as a problem, it can help to find the where, how and what kinds of capacity building or program modifications are necessary.

10.5 Defining a Framework for Capacity Assessment

Considering the syntheses presented above, this thesis proposes a five-step framework for capacity assessment (Fig: 10.4). While outlining the framework, it has been attempted to use minimum linkage-arrows, so that it would look as simple as possible. In essence, the framework demonstrates why capacity assessment should be regarded as the first step when an idea for a water resource project or an activity is conceived. It also demonstrates that capacity assessment should aim for outcomes. The framework has emphasized more on outcomes than processes because all along in this thesis it has been argued that capacity assessment is a process-bound approach. However, the processes required for capacity assessment are mostly context specific and should evolve based on the interaction of WRM objectives with the immediate stakeholders' understanding of water resources set-up in any given area. Moreover, if the framework would concentrate more on processes, it could give an impression of extra rigidity.

Fig 10.4: A Framework for Capacity Assessment in WRM



It is argued in the framework that the first step, conceptualization stage, should be capable of developing an, or a combination of analytical module(s) that is comprehensive and able to grasp the contexts of actions, attitudes and preferences of the people. It is argued that such analytical module should be iterative and feedback-based. Here, the feedback is referred as the refinements deemed essential in the analysis and better selection of concerned stakeholders. The analysis module is then fed into the information generation stage, which is the second step in capacity assessment.

The information generation stage should be capable of generating responses from the stakeholders those, in essence, should explain how people manage water; what do they know about water management; to what extent they are already knowledgeable of the WRM objectives; what is the pattern of internal disagreement among the identified stakeholders; what are the immediate priorities and preferences of the people and how they seek the WRM objectives to be implemented in the area of concern. The generated data is then fed to the third stage. At synthesizing stage, which is perhaps the most crucial, the framework should be able to synthesize the following:

Required Synthesis	Synthesis as an outcome of :
Accepted Tradeoffs	Participatory examination of all accepted tradeoffs in existing WRM. Examination should be from both demand and the supply sides and the seasonal nature should be taken into consideration.
Water Related Adjustments	Critical Examination of the nature of stakeholders' adjustments vis-à-vis water. Examination should be from both demand and the supply sides and the seasonal nature should be taken into consideration.
Local Knowledge	Participatory examination of local knowledge, its structure and content.
Adherence to WRM Objectives:	Critical examination of how people accept the WRM objectives, that would be proposed in the area.
Perception Variability among Actors/Stakeholders	Examination of how much and why stakeholders' perceptions differ in how water should be managed.
Preparedness for Policy Integration/Adoption	Examination of preparedness for policy integration or adoption, analysis of readiness to accept policies (in practice, the perception variability test should provide answers to this effect).
Preference Spectrum	Examination and enlisting of main preferences and priorities of the people in WRM.
Hierarchical Preference	Examination of what is more or less important, in terms of priorities and preferences.
Implementation Mode	Examination of the mode of program implementation as desired by the people.

The third stage is also based on an iterative process, where all feedbacks are put through logical analysis until all information is synthesized to a required level of precision. All synthesized information is then fed into the fourth stage. At the consolidation stage, all synthesized information is internalized into the broad water resource principles, or, if need be, into the sub-principles. This process should be iterative and all feedback must help to isolate and correct any shortcomings in the process of syntheses. Finally, at implementation stage, the refined WRM objectives should be used in the context of program or project planning. In this stage, the consolidated understanding is fed into the program/project cycle. This stage is also iterative and all relevant information should be used to further refine and strengthen the analysis module.

This framework simply provides a guideline and, therefore, the action, attitude, and preference assessment modality do not have to be exactly the same as the ones used in this research. A point must be noted that a capacity assessment process does not contradict with the management framework that exists in the background. This research used the principles developed through the Dublin process, but other research may decide to use different approach to define how an ideal water resource management should be.

10.6 Understanding the Limitations

It is important to mention that there were a few limitations of this study. It is believed here that the account of limitations can be useful to future studies in capacity assessment to take corrective actions. It has been experienced that participatory research by its nature of human centricism, although carried out in a very familiar socioeconomic setup, becomes an information optimization and constraint reducing exercise. In such situations, what needs to be covered are more logically scrutinized and the possible problems are tried to limit to their possible lowest levels (Kranzer: 1980, Powell: 1991, Neupane: 1992, Frideres: 1992, Gale: 1992, Neupane and Young: 1997). This research was not an exception to it. Despite every possible effort made, it is not any exaggeration to say that every field visit, observation, interview and group discussion produced its own set of enigma of practical and theoretical importance. The following are the major limitations of the research:

Aspects of Analysis and Their Order

Another general point, which was only indirectly explained in the thesis, is the order of analysis. Conceptually, one could argue that attitudes and preference must have preceded the action analysis. However, in this thesis the sequence adopted was just the reverse. It is definitely not an ill sequencing. It must be clarified that the current order evolved during the course of the study. The participatory framework adopted in the thesis, which started from an action analysis, led into attitude and then to preference analyses. Admittedly, however, the study of attitudes and preferences before actions could have given an opportunity to counter-question the reasons for adopting a particular action. The research did such investigations in the group meetings; however, the backward exploration was only limited due to time constraints.

Sampling Basis

The landholding size was taken as the major variable for stakeholder classification. The size of the land holding, nevertheless, sometime failed to identify a household into the right stratum. It was one of the reasons why two previously identified actor groups, middle and small farmers, were merged. It was observed that often it is not the size of the land but the effectiveness in management, which determined the resourcefulness. It was also revealed during the course of the study that *the nearness to the water source is one of the best indicators to stratify the households.*

Sensitive Information

It was frustrating on the part of the researcher, when people responding to the questionnaire refused to talk about the issues they perceived to intrude into their personal life. It is no exaggeration to say that the entire behavioral probe was of such nature. Often it was experienced that the willing discussant retracted from statements earlier made. For some information, the researcher decided to make funnels to the questions. However, this increased the total time required for information collection. Increased time for discussions often led to a reduced level of interest of participants and respondents. Normally, the interviews were conducted with the household heads. Soliciting any kind of information with anybody other than the household head, although desired, was often socially unacceptable. Interviewing and soliciting data with women was most difficult.

Communication Problem

Despite the fact that the researcher, field assistants and sociologist spoke Nepali, given the local vernacular, particular accent and vocabulary in the area, it was very difficult to establish a communication rapport with them. Since some ethnic groups spoke languages other than Nepali, the problem was intensified. Similarly, this research must have been among the forerunners of its kind that decided in using, sharing and synthesizing information with the people. Indirectly, this may have provided a justification to the people to act "good" or "less rational." A great deal of flexibility was called for in the choice of words and expressions to evade these problems, possibly at the cost of scientific rigour and precision.

Nature of the Research

The extent to which the researcher could generate reasonably accurate information depended on the willingness of the respondent. Unwillingness to participate in an "unyielding academic research" like this one is understandable. This depended on a whole host of factors, not least of which was the people's perception of the study objective. The researcher had nothing to present to the villagers. The researcher spent almost 11 months, as part of the rural families, in the village. This was helpful in earning the trust of the people. However, a study that did not render any direct significance to the respondents, raises little expectation. The unwillingness to participate in the research would have been lower if the conditions were otherwise.

Record Keeping Systems

Most of the information received at the community was based on the actions, observations, attitudes, and preferences of people in the sub-watershed area. These collectively provided the basis for synthesis. The synthesized information was shared with the farmers to arrive at the conclusions of this study. Almost the entire discussion with the villagers was recorded, which later was used to contest some of the information provided during the individual interviews. Thus, most of the information gathered is entirely based on the community people's recollections. There was no hard record for anything, and that included the basic economic activities. Retrieving these items of information entirely depended on the memory of the individual or the group being interviewed, which was subjected to some form of memory bias.

Measurement Errors

Finally, a cross-sectional research covering a wide range of informants cannot be free from measurement errors and non-sampling errors. Alternatively, even if there were not any, it can not be completely free from criticism that the "data do not represent the reality." The measurement errors could have been corrected largely through a more rigorous cross-validation and multiple triangulation. Regarding non-sampling errors, these could have been further reduced by adopting a few more analytical tools perfected in terms of language and partnership.

10.7 Suggestions for Future Studies

Any attempt to discern facts through research having time and resource constraints leaves a few major issues unanswered. This research was not an exception. Despite interrelationships being visible among variables, they could not be studied at a greater length or depth. Some of the major issues requiring further exploration to expand the discipline of capacity assessment are presented below:

10.7.1 Changes in Capacity

One of the fundamental characteristics of capacity is that it changes constantly. If the findings of this thesis are carefully analyzed, all of them appear to present a static scenario. In as much as the understanding of what people can offer is important, it is equally important to understand how would they react once an intervention is made. There are four benefits to study such responses. First, it can generate a sense of when to stop intervening, or changing the course of intervention or withdrawing from the area. Second, it can also provide an understanding of how the management responses evolve in response to an intervention. Essentially, it can help to tighten some of the loose arguments in the conceptual framework developed in this thesis.

Thirdly, it can demonstrate the ability of the presented framework to adapt to other sub-watershed conditions of different temporal and spatial contexts. In turn, it can help in singling out those aspects that can be generalized and those that require to be explored in more detail. Finally, this study can help to refine the sub-principles, and phrase them more meaningfully to reflect the dynamism of capacity.

10.7.2 Conceptual Complexity of the Dublin Principles

This study should be regarded as an important step in consolidation and scaling-down of the Dublin principles. However, a few important issues in the scaling down process remained unanswered. It will immensely improve the applicability of the Dublin principles, if they are seen at different levels of administrative hierarchies. Young et al. (1994) have structured a process which can provide a meaningful conceptual backstopping. A study covering all possible tiers of government hierarchies to generate a detailed understanding of information collection, information sharing, definition, translation and linkage development could provide an operational framework for The Dublin Principles from international to local levels. Such study must also focus on horizontal linkages between and among watersheds, basins, and countries.

10.7.3 NGO and Government

The study could not establish a clear understanding on whether the role of NGO or the government is more critical in capacity assessment. Globally, the context of WRM is changing, and more responsibilities are being given to the non-governmental bodies. Yet, in geographically and socioeconomically complex areas, such as that of Gerkhu Khola, the efforts of NGOs may not yield the same results. It was demonstrated in the research that the NGOs' operational modality was equally rigid as that of governmental entities. It may be possible that such rigidity and lowered transparency are fundamental to the successful implementation of WRM activities. However, nothing can be concluded unless a deliberate exploration is made. An AHP based study can be conceived to explore this issue.

10.7.4 Extreme Stress and Local Capacity

The research adequately demonstrated that the sub-watershed community prepared itself during the condition of normal and seasonal stress. It was also indicative that the community demonstrated a very high sense of disaster preparedness. However, it was not possible to cover the farmers' response in extreme events. Analysis of people's response in such extreme events can provide a comprehensive understanding of local response. The findings can be used to make necessary adjustment in the external efforts, and to add or drop activities that may complement or be counter productive during such periods.

10.7.5 Technological Audit

One of the most crucial, but least studied aspects in this thesis relates to technology. Although the relevance of adoption of a particular technology was studied in the light of water demand and supply structures, it could not explore what actually triggers adoption of a particular technology. It was not possible to identify the context of appropriate technology. There must be something inherent to a technology that triggers its adoption. The exploration and identification of this issue can help in better administration of external technologies and their logical integration with the existing local technologies.

10.7.6 Conflict and Resolution

The sub-watershed area suffers from a number of conflicts resulting because of water-scarcity of or the pattern of water use. Although researchers have characterized such conflicts as the expression of democratic process (Gupta: 1993, Chambers: 1997), there exists a need to further explore this area. The research must go beyond finding the dynamics of conflicts established by the contemporary research frameworks and establish the interaction between water, its use, conflict, and the threshold of the local arbitration.

10.8 Concluding Remarks

Seemingly, the vast knowledge accumulated through generations of trial, tradeoffs, adjustments and interactions with water can not be contained within the pages of this or any research. A wide range of socioeconomic, historical and political changes influences the local-level capacity. A detailed analysis of all causes and their effects in local capacity, although essential to understand, would not have been possible to cover in a study of limited scope.

Admittedly, this study has simply scratched the surface. It is the first step. There is a need to learn more, and that may be learned by designing a project based on the findings or replicating the findings in an actual situation. Definitely, the concept of capacity assessment in WRM still leaves a number of unexplored and unanswered issues, both on its theoretical level and in its operational basis.

> *Gerkhu Khola is a part of my life. I was born here. I know every inch of Gerkhu Khola. Yes, we do need help and we know what kind of help we need. I may not be able to operate that machine [computer], but I know what is needed here. I do not say that I should be involved in everything [WRM efforts], but, for god's shake, let me and other people know what you or other people are doing here. Our livelihood depends on this [the Gerkhu] Khola, if you make mistakes, nothing will happen to you, but how about us? (A villager of Gerkhu Khola: 1997, translated)*

No statement can better justify the conclusion of this study, as that made by one villager in Gerkhu Khola. The villager's question is most simple, yet it puts a question mark to widely used words, like participation, capacity assessment, and capacity building. It is justifiable to say that these words are components of science, a broad understanding of the solution, involving a number of interrelated issues. Capacity assessment, on the other hand, is a research method that can enhance existing understanding of local knowledge, operationalize sustainable and integrated WRM, and answer the villager's question. Apparently, *the finding of this thesis is still incomplete*, as the thesis is based on a single case study and the analysis is relatively static in its coverage. A paradigm shift can not be established through a single research project. However, this limitation reflects that much more still needs to be done. A direction is set that the local potentials or problems can be learned by using locally evolved concepts, methods, and techniques. Even if the outcomes of this thesis encourage reconsidering the capacity of people, it will fulfill the researcher's goal.

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APPENDIX

Sample Questionnaires

Questionnaire for Attitudinal Assessment

Wilfrid Laurier University

Water Resource Management: A case Study of Nepal Himalaya

Researcher: Bhanu Neupane **Advisor: Prof. Gordon J. Young**

Interviewer: .... **Date of interview:...............**

Information given for this study is strictly for the purpose of student-research and will not be disclosed in this form. (Record all responses in the questionnaire and tape it for future use. Make clear to the respondent that s/he will be approached again to solicit information using the same questionnaire)

1. Water is central to all other resources and, in that, its availability depends on the entire resource structure, necessitating that the unsubstitutability of water is duly realized

1.1 What do you think water really is:

1.2 Could you tell us what affects the availability of water in your area

1.3 Can water be substituted with another thing?

1.4 Given these responses could you please consider the sub-principle discussed at the group meeting, and tell how much you support this argument ?

Very Strongly Support	Support	Neutral	Reject	Very strongly Reject
+2	+1	0	-1	-2

if inapplicable, please use the Pie Method

2. Quality of water affects the total availability and, in that, it must be recognized that if deteriorated it is only partly reversible.

2.1 View on water quality:

2.2 Do you consider the quality of water in this area as good or bad?

2.2 If you think water is not suitable for drinking, how much do you think can be restored back to normal drinkable quality?

2.3 Given these responses could you please consider the sub-principle discussed at the group meeting, and tell how much you support this argument ?

Very Strongly Support	Support	Neutral	Reject	Very strongly Reject
+2	+1	0	-1	-2

if inapplicable, please use the Pie Method

3. Finiteness of water is not technologically dependent but on the appropriate technology that the immediate-users can locally manage, necessitating that the limits to technology are duly realized.

3.1 How do you view a technology as appropriate to you?

3.2 Should a technology be built in the watershed or it should be brought from outside?

3.3 To what extent do you think the technology can solve the problems in the sub-watershed area?

3.4 Please tell us if the technology can be managed locally?

3.5 If not, why?

3.6 Given these responses could you please consider the sub-principle discussed at the group meeting, and tell how much you support this argument ?

Very Strongly Support	Support	Neutral	Reject	Very strongly Reject
+2	+1	0	-1	-2

if inapplicable, please use the Pie Method

4. Knowledge about the current planning structure is uniformly available to all and, in that, all have been given an equal opportunity to contribute

4.1 Are you aware of how water management plans are developed for the sub-watershed area?

4.2 Are you aware of how the budget is prepared for water resource sector in the sub-watershed?

4.3 Do you know anything about rules, regulation and water right ?

4.4 Given these responses could you please consider the sub-principle discussed at the group meeting, and tell how much you support this argument ?

Very Strongly Support	Support	Neutral	Reject	Very strongly Reject
+2	+1	0	-1	-2

if inapplicable, please use the Pie Method

5. Continuous participation is key to the success of water resource management programs.

5.1 What much do you think the people in this watershed should contribute in water resource management?

5.2 Is it Feasible to participate, pay money, contribute labor all the time?

5.3 How would you like to participate in Water management programs?

4.5 Given these responses could you please consider the sub-principle discussed at the group meeting, and tell how much you support this argument ?

Very Strongly Support	Support	Neutral	Reject	Very strongly Reject
+2	+1	0	-1	-2

if inapplicable, please use the Pie Method

6. Equity and transparency, especially for cost sharing and allocating access, are adequately maintained in all water resource management initiatives.

6.1 Do you think that everyone in the sub-watershed has equal access to water resource management initiatives?

6.2 Please give your impression on level of transparency maintained in Water resource planning and management?

6.3 Given these responses could you please consider the sub-principle discussed at the group meeting, and tell how much you support this argument ?

Very Strongly Support	Support	Neutral	Reject	Very strongly Reject
+2	+1	0	-1	-2

if inapplicable, please use the Pie Method

7. Realization that women are being over burdened in terms of water resources use and management.

7.1 Whether men or women should contribute more in water resource management?

7.2 Do you think that women are doing more work than men do?

7.3 Given these responses could you please consider the Sub-principle discussed at the group meeting and tell us how much you support it ?

Very Strongly Support	Support	Neutral	Reject	Very strongly Reject
+2	+1	0	-1	-2

if inapplicable, please use the Pie Method

8. Women should have equal access in Decision Making and Planning and should receive greater responsibilities in water resource management.

8.1 What do you think, are women really left behind in water resource management?

8.2 We talked about equal access before, in your observation is it necessary to give women equal access in Decision-Making?

8.3 Given these responses could you please consider the sub-principle discussed at the group meeting, and tell how much you support this argument ?

Very Strongly Support	Support	Neutral	Reject	Very strongly Reject
+2	+1	0	-1	-2

if inapplicable, please use the Pie Method

9. Empowering women to participate in all levels of water resources programs.

9.1 Do you regard that women should receive extra benefits and opportunity to participate and contribute in water resource management programs prepared for the watershed area?

9.2 Given the exiting thinking in the sub-watershed area would you think special programs for women would be a good idea?

9.3 Given these responses could you please consider the sub-principle discussed at the group meeting, and tell how much you support this argument ?

Very Strongly Support	Support	Neutral	Reject	Very strongly Reject
+2	+1	0	-1	-2

if inapplicable, please use the Pie Method

10. Water must be treated as an economic good having an economic value.

10.1 Do you consider water as a free good or a good with some value?

10.2 If you think water has some value, could you please justify that statement based on the ongoing water resource planning in the sub-watershed area?

10.3. Could you tell us a condition in what circumstance you would pay for the use of water?

10.3 Given these responses could you please consider the sub-principle discussed at the group meeting, and tell how much you support this argument ?

Very Strongly Support	Support	Neutral	Reject	Very strongly Reject
+2	+1	0	-1	-2

if inapplicable, please use the Pie Method

11. Equity in distribution and cost sharing is essential and, in that, a participatory mode of assessment of true value of water and contribution is essential.

10.1 How do you think the value of water can be determined?

10.2 Would you consider the need of external valuators and arbitrators for the distribution of responsibility for and the benefits from water resource management effort?

10.3 Are you capable of doing that in the village?

11.3 Given these responses could you please consider the sub-principle discussed at the group meeting, and tell how much you support this argument ?

Very Strongly Support	Support	Neutral	Reject	Very strongly Reject
+2	+1	0	-1	-2

if inapplicable, please use the Pie Method

12. Progressive system of cost sharing based on the amount of use and total waste disposal is essential.

12.1 Do you consider everyone equally sharing the cost for water resource development feasible?

12.2 What are your views on those households using more water contributing more for water resource development?

12.3 Given these responses could you please consider the sub-principle discussed at the group meeting, and tell how much you support this argument ?

Very Strongly Support	Support	Neutral	Reject	Very strongly Reject
+2	+1	0	-1	-2

if inapplicable, please use the Pie Method

Questionnaire for Preference Assessment

Wilfrid Laurier University

Water Resource Management: A case Study of Nepal Himalaya

Researcher: Bhanu Neupane **Advisor: Prof. Gordon J. Young**

Interviewer: .... **Date of Interview:...............**

Information given for this study is strictly for the purpose of student-research and will not be disclosed in this form. Record all responses in the questionnaire and tape it for future use. The questions in this questionnaire have been designed to assess the pair-wise relative importance of one aspect over the other. Please, carefully consider the options provided and consider the demonstration given to you on the September 7, 1997 group meeting. Please, note that the judgments will be reevaluated again in two weeks interval.

The main objective of this model is to determine the most appropriate water resource management mode in the sub-watershed, and to achieve that prioritized various activities and conditions.

1. Relative Importance of Main factor

☑ the right box	Absolute		Very Strong		Strong		Weak		Equal		Weak		Strong		Very Strong		Absolute	
Finiteness of Water																		Participatory Approach
Finiteness of Water																		Women's Role
Finiteness of Water																		Economic Value
Participatory Approach																		Women's Role
Participatory Approach																		Economic Value
Women's Role																		Economic Value

if inapplicable, please use the Pie Method

2. Sub-factors

☑ the right box	Absolute		Very Strong		Strong		Weak		Equal		Weak		Strong		Very Strong		Absolute	
Water Quality																		Water Quantity
Water Quality																		Technical Suitability
Water Quantity																		Technical Suitability

if inapplicable, please use the Pie Method

☑ the right box	Absolute		Very Strong		Strong		Weak		Equal		Weak		Strong		Very Strong		Absolute	
Political Suitability																		Equal Access
Political Suitability																		Equal Opportunity
Political Suitability																		Conflict
Political Suitability																		Significance
Equal Access																		Equal Opportunity
Equal Access																		Conflict
Equal Access																		Significance
Equal Opportunity																		Conflict
Equal Opportunity																		Significance
Conflict																		Significance

if inapplicable, please use the Pie Method

☑ the right box	Absolute		Very Strong		Strong		Weak		Equal		Weak		Strong		Very Strong		Absolute	
Empowerment																		Responsibility
Empowerment																		Access
Responsibility																		Access

if inapplicable, please use the Pie Method

☑ the right box	Absolute		Very Strong		Strong		Weak		Equal		Weak		Strong		Very Strong		Absolute	
Willingness to Pay																		Ability to pay
Willingness to Pay																		Need for Better Assessment
Ability to pay																		Need for Better Assessment

if inapplicable, please use the Pie Method

3. Relative Importance of alternatives with Respect to

☑ the right box	Absolute		Very Strong		Strong		Weak		Equal		Weak		Strong		Very Strong		Absolute	
More Local Control																		More Government Control
More Local Control																		Status Quo
Status Quo																		More Government Control