VOLUME II

PAPER VIII

INSTITUTIONAL STRENGTHENING

FINAL REPORT

MARCH 2004

WUP-JICA TEAM

TABLE OF CONTENTS

1. INTRODUCTION VIII-1

1.1 Rationale VIII-1

1.2 Institutional Strengthening VIII-2

1.3 Composition of Paper VIII VIII-2

2. FRAMEWORK OF FORMULATION AND IMPLEMENTATION OF THE WATER UTILIZATION RULES VIII-4

2.1 General Agreements and Agreements for Specific Rivers VIII-4

2.2 Instruments of Frameworks for Universal Application VIII-5

2.2.1 The Helsinki Rules on the Use of Water of International Rivers VIII-5

2.2.2 Draft Articles of the Law on Non-Navigational Uses of International River Courses (International Law Commission of the United Nations, Geneva, 17 July 1980) VIII-6

2.2.3 Agreement on the Convention Regarding the Law on Non-Navigational Uses of International Watercourses (21 May 1997, New York, the Resolution of the General Assembly of the United Nations) VIII-7

2.3 Agreement on the Cooperation for Sustainable Development of the Mekong River Basin VIII-9

2.4 Existing Agreements for Specific Rivers VIII-11

2.4.1 Amazon Cooperation Treaty VIII-11

2.4.2 Agreement on the Utilization of Water in the Boden Lake VIII-12

2.4.3 The Columbia Treaty VIII-14

2.4.4 Convention Regarding the Regime of Navigation on the Danube VIII-15

2.4.5 Agreement Among the Government of the Republic of Austria, the Government of the Federal Republic of Germany, and the Free State of Bavaria Concerning the Danube Power Plant and the Jochenstein Stock Company VIII-17

2.4.6 Protocol Regarding Water Regulation of the Tigris and Euphrates (The first annex to the Treaty of Friendship and Good Neighbor) VIII-18

2.4.7 Agreement Between His Majesty's Government of Nepal and the Government of India on the Gandak Irrigation and Power Project VIII-20

2.4.8 Agreement Between the Government of the Peoples Republic of Bangladesh and the Government of the Republic of India on Sharing of the Ganges Water at Farrakka and on Augmenting Its Flows VIII-21

2.4.9 Agreement Between the Government of the Union Soviet Socialist Republics, the Government of Norway and The Government of Finland Concerning the Regulation of Lake Inari by Means of the Kaitakoshi Hydroelectric Power Station and Dam VIII-23

2.4.10 The Indus Waters Treaty Concluded between India and Pakistan VIII-24

2.4.11 Treaty of Peace Between the State of Israel and the Hashemite Kingdom of Jordan (Article 6: Water) VIII-26

2.4.12 Agreement for the Full Utilization of The Nile Waters VIII-27

2.4.13 Treaty Between Austria and Liechtenstein Regarding the Regulation of the Rhine and Tributary Waters VIII-28

2.4.14 Protocol on Shared Watercourses in the Southern African Development Community VIII-30

2.4.15 Agreement Between the Republic of Syria and the Hashemite Kingdom of Jordan Concerning the Utilization of the Yarmuk Waters VIII-31

2.4.16 Agreement Between the Republic of Russia and the Republic of Azerbaijan Concerning the Utilization of the Samur River VIII-32

2.5 Examples of Dispute Concerning the Management of the International Rivers VIII-33

2.5.1 Introduction VIII-33

2.5.2 Examples of Dispute VIII-34

2.6 Interpretation of Concepts and Principles to Apply to the Water Utilization Rules VIII-39

2.6.1 Concept of River Basin VIII-39

2.6.2 Principle of Common Property VIII-42

2.6.3 Principle of Reasonable Water Use VIII-44

2.6.4 Principle of Equitable Use VIII-50

2.6.5 Principle of Sustainable Development VIII-55

2.6.6 Principle of Risk Management VIII-56

2.6.7 Principle of Exchange of Data and Information VIII-64

2.6.8 Principle of Not Causing Harmful Effect to Others VIII-66

2.6.9 Principle of Cooperation VIII-67

2.6.10 Principle of Compensation VIII-71

2.7 Examination on the Consistency of Domestic Laws to the Concepts and Principles VIII-72

2.7.1 Targets of Assessment VIII-72

2.7.2 Examination of Consistency and Interpretation of Each Law VIII-73

2.7.3 Response to International Agreement VIII-86

3. WATER UTILIZATION RULES VIII-88

3.1 Rationale VIII-88

3.2 Preparation of the Rules VIII-89

3.2.1 Organization for the Preparation VIII-89

3.2.2 Present Status of Rule Preparation VIII-89

3.3 Outline of the Rules and Preliminary Assessment VIII-90

3.3.1 Procedure for Data and Information Exchange and Sharing VIII-92

3.3.2 Procedures for Notification, Prior Consultation and Agreement VIII-93

3.3.3 Procedures for Water Utilization Monitoring VIII-94

3.3.4 Rules for Maintenance of Flows VIII-95

3.3.5 Rules for Water Quality VIII-96

4. WATER UTILIZATION RULES AND HYDRO-METEOROLOGICAL MONITORING SYSTEM VIII-97

4.1 Water Utilization Management and The Water Utilization Rules .. VIII-97

4.2 The Implementation of Rules to Utilize the Waters in a Reasonable and Equitable Manner VIII-99

4.3 The Required Functions to the Hydro-Meteorological Monitoring System to Secure Effective Implementation of the Rules VIII-100

4.3.1 Human Resources and Organization VIII-100

4.3.2 Facility VIII-101

4.3.3 Budget VIII-105

5. EXISTING HYDRO-METEOROLOGICAL MONITORING SYSTEM AND THE IMPLEMENTATION OF THE RULES VIII-106

5.1 Surveys VIII-106

5.2 Human Resources for Hydro-Meteorological Monitoring VIII-107

5.3 Facilities for Hydro-Meteorological Monitoring VIII-108

5.3.1 Facilities for Precipitation Gauging VIII-108

5.3.2 Facilities for Water Level Gauging and Discharge Measurement VIII-109

5.3.3 Facilities for Sediment Discharge Measurement and Water Quality Analysis VIII-109

5.3.4 Facilities for Communication and Data Transmission VIII-110

5.4 Budgetary Constraints and Other Issues VIII-111

6. SUGGESTIONS AND RECOMMENDATIONS VIII-112

6.1 Findings and Conclusions VIII-112

6.2 Conclusions Related to Rule Preparation VIII-112

6.3 Conclusions Related to Rule Implementation VIII-113
6.4 Conclusions Related to Organization VIII-114
6.5 Suggestions and Recommendations for Preparation and Implementation of the Rules VIII-115
6.5.1 Procedures for Exchange of Data and Information and Shares VIII-115
6.5.2 Procedures for Notification, Prior Consultation and Agreement VIII-115
6.5.3 Procedures for Water Use Monitoring VIII-115
6.5.4 Rules for Maintenance of Flows and Water Quality VIII-116
6.5.5 Some Issues to Note with Regard to Domestic Water Related Laws VIII-117
6.6 Suggestions and Recommendations for the Strengthening of the Organization for Hydro-Meteorological Monitoring VIII-117
6.6.1 Strengthening of Human Resources VIII-117
6.6.2 Strengthening of Facility VIII-119
6.6.3 Strengthening of Budgetary Arrangement and Related Recommendations VIII-120

LIST OF TABLES

Table 1	Allocation of Water Use (Nepal, India)	VIII-21
Table 2	Effects of Each Component (Flow Control)	VIII-41
Table 3	Effects of Each Component (Control of Land Use)	VIII-42
Table 4	Static Parameter	VIII-45
Table 5	Flow Variabilities	VIII-46
Table 6	Flow Variability in April	VIII-47
Table 7	Statistics (April)	VIII-47
Table 8	Variability Along the River	VIII-47
Table 9	Optimum Use of Water Resources in Critical Case (1)	VIII-49
Table 10	Optimum Use of Water Resources in Critical Case (2)	VIII-50
Table 11	Equivalent Balance	VIII-50
Table 12	Water Related Hazard and Cause (Quantity)	VIII-57
Table 13	Water Related Hazard and Cause (Quality)	VIII-57
Table 14	Possible Impact of Flood Disaster Mitigation	VIII-59
Table 15	Possible Impact of Surface Erosion Disaster Mitigation	VIII-59
Table 16	Possible Impact of Slope Collapse Disaster Mitigation	VIII-60
Table 17	Possible Impact of Water Shortage Disaster Mitigation	VIII-61
Table 18	Possible Impact of Saline Water Disaster Mitigation	VIII-61
Table 19	Possible Impact of Channel Impediment Disaster Mitigation	VIII-62
Table 20	Impacts of Chemical Concentration Disaster Mitigation	VIII-62
Table 21	Impacts of Toxic Matter Disaster Mitigation	VIII-63
Table 22	Impacts of High COD and BOD Disaster Mitigation	VIII-63
Table 23	Use of Data and Information	VIII-65
Table 24	Details of Data and Information	VIII-65
Table 25	Principle of Not to Cause Harmful Effect in the Agreement	VIII-66
Table 26	Quantitative Harmful Effects	VIII-66
Table 27	Qualitative Harmful Effects	VIII-66
Table 28	Measures to Alleviate Harmful Effects	VIII-67
Table 29	Average Monthly Distribution of Precipitation	VIII-102

LIST OF FIGURES

Fig. 1	Structure of Institutional Strengthening	VIII-2
Fig. 2	Structure of River Basin Management	VIII-40
Fig. 3	Conceptual Illustration of Water Balance	VIII-44
Fig. 4	Contribution of Monthly Discharge	VIII-46
Fig. 5	Frequency of Monthly Flow Exceeding Annual Average	VIII-48
Fig. 6	Appeared Available Water at Each Reach	VIII-52
Fig. 7	Average Monthly Discharge (April 1991)	VIII-53
Fig. 8	Example of Equitable Right	VIII-53
Fig. 9	Example of Reasonable and Equitable Shares (Samur River)	VIII-55
Fig. 10	Structure of Risk Management (Flood Control)	VIII-58
Fig. 11	Stages of Risk Management	VIII-64
Fig. 12	Principle of Cooperation Stipulated in the Agreement	VIII-68
Fig. 13	Various Fields that Require Cooperation (Development and Conservation Project)	VIII-69
Fig. 14	Various Fields that Requires Cooperation (Risk and Harmful Effects Management)	VIII-69
Fig. 15	Cooperation in Projects for Development and Conservation	VIII-70
Fig. 16	Project for Risk and Harmful Effect Management	VIII-71
Fig. 17	Damageable Deed to be Compensated	VIII-71
Fig. 18	Major Objects to be Compensated	VIII-72
Fig. 19	Organizational Structure for Rule Preparation	VIII-89
Fig. 20	Water Utilization Management Cycle and Roles of Rules	VIII-97
Fig. 21	Block Diagram of Scenario for Management Operation	VIII-99
Fig. 22	Season of Precipitation in the Mekong River Basin	VIII-100
Fig. 23	Coefficient Variability of Precipitation	VIII-103

1. INTRODUCTION

1.1 Rationale

Water resources are no doubt one of the basic human needs and a natural resource with special behaviors of mobility in the drainage area and in the hydrologic cycle, and probabilistic uncertainty of the occurrence. An exploitation of the resource in the upstream reach, unlike other resources, affects the water resources in the downstream areas even trespassing a border due to the spatial mobility. The available water resource at a site varies from year to year along the occurrence probability of precipitation in the watershed area. Thus proprietary rights of water in a shared watercourse have been one of the most significant and common problems in the world. The wisdom of human beings have succeeded to avoid the foreseeable such conflicts through providing agreements for management of river basin, water and water courses such as the Agreement for the Mekong river signed in 1995.

The Mekong River Commission (MRC) legally provided by the Mekong Agreement for the sustainable development of the Lower Mekong River Basin has contemplated the strategic core programs to achieve the development of the river basin in a coordinated manner in 1999. The basin development plan (BDP) envisions, rather than otherwise, the possible development of land resources in the lower Mekong river basin. Meanwhile, the Water Utilization Program (WUP) is another development program specific to the use of the water resources in the river basin including the water related disaster management. The environment program (EP) is the other core program to conserve the environment in the Lower Mekong Basin. Those core Programs are supported by various Supporting Programs and Sector Programs.

Pursuant to the stipulation in Article 26 of the Mekong Agreement, WUP is to formulate and implement appropriate Rules that secure the reasonable, equitable and sustainable use of the water and related resources of the Mekong River basin without being affected by significant water related disaster. In October 1999, the MRC fully endorsed the WUP to formulate sets of rules as the procedures to use water as follows:

(1) Procedures for data and information exchange

(2) Procedures for monitoring existing water uses

(3) Procedures for notification, consultation and agreement

(4) Rules for maintenance flows

(5) Rules for water quality

The MRC through its Secretariat (MRCS) requested the JICA to cooperate in the works of WUP for the formulation and implementation of the water utilization rules being formulated in relation to hydro-meteorological monitoring system in 2000.

In compliance with the request from the MRC, JICA organized and dispatched in May 2001 a Study Team to the Mekong River Committee Secretariat, Phnom Penh, Cambodia, to assist in the activities of the WUP of MRC as the WUP-JICA Project. The Scope of Work of the WUP-JICA Project Study includes institutional strengthening in view of the preparation and implementation of the Rules for Water Utilization to be laid down particularly in relation to the hydro-meteorological monitoring system.

1.2 Institutional Strengthening

The WUP-JICA duly established the necessity to carry out the following two folds of works, namely legal and organizational aspects, to achieve the assignment of institutional strengthening for formulation and implementation of the Water Utilization Rule as specified in the Scope of Works.

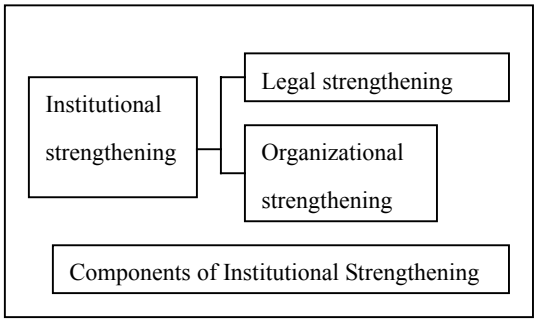


Fig. 1. Structure of Institutional Strengthening

In this Study, legal aspects are mainly the provisions of the rules and procedures being formulated by the MRC through the activity of the WUP. Meanwhile the defined organizational aspects to be studied are hydro-meteorological monitoring systems of member countries and the MRC. Consequently, the Institutional Strengthening is to provide the MRCS with suggestions and recommendations on the preparation and implementation of rules and procedures as legal strengthening and to provide suggestions and recommendations on the enhancement of the monitoring systems as the organizational strengthening to secure the smooth and effective implementation of the rules and procedures.

The JICA collected and reviewed existing general frameworks of agreements for the management of shared watercourses and international agreements on the management of specific rivers as a reference for the formulation of Rules by the WUP. The JICA compiled the collected existing frameworks and agreements in another volume with the title "EXISTING AGREEMENTS FOR WATER UTILIZATION" and submitted it in March 2002.

1.3 Composition of Paper VIII

This Paper VIII, Institutional Strengthening, comprises six chapters prescribing the legal strengthening and organizational strengthening studied under the WUP-JICA Project.

Chapter 2 and 3 describe mainly discussions on legal strengthening. Chapter 2 presents the frame works to be reflected in the formulation and implementation of water utilization rules such as the Mekong Agreement, the water resources laws of each country and other international agreements and resolutions such as the Helsinki Rule. The Chapter abstracts and presents the concepts and principles commonly applied in these frame works and emphasizes that the Rules being formulated shall conform to the concepts and principles to secure smooth implementation among four countries. The Chapter presents concrete technical interpretations of such concepts and principles taking account of the special behaviour of water resources, mobility and uncertainty.

Chapter 3 reports the present situations of the Rule formulation at its beginning half. The preliminary assessment of Rules being prepared in the light of the concepts and principles as identified in the Chapter 2 is the main subject in the latter half of the Chapter. Since the Rules are under preparation, the Study employed several assumptions and prejudices attributable to the assumptions are not avoidable in the assessment. The assessment is expected to provide some sort of guidelines or references to the Rule preparation although it is premature.

The other institutional strengthening, organizational strengthening, is the main subject of Chapter 4 and 5. Chapter 4 proposes the required functions of the monitoring system on the basis of the assumed rules and the implementations thereof. The discussions in the Chapter identify the items of data and information required to implement each Rule. The quantity and quality thereof are specified in the Chapter together with the interval of monitoring. The Chapter prescribes the required data transmission and data processing as well.

Chapter 5 presents the inventory of the existing hydro-meteorological monitoring systems of four countries in view of organizational study based on the results of the surveys conducted. The organization of the custodian, MRCS, is another substantial issue discussed in the Chapter. To describe the observations on the existing monitoring system is another objective of this Chapter with reference to the required functions as specified in the Chapter 4.

The suggestions and recommendations are Articles of the last Chapter for the institutional strengthening. Suggestions and recommendations on the formulation and the implementation of Rules are the conclusions of the study on the legal strengthening derived from the preliminary assessment as mentioned in the descriptions of chapter 3. Meanwhile suggestions and recommendations on the enhancement of the hydro-meteorological monitoring systems are the conclusions of the study on the organizational strengthening. The preliminary observations as described in the chapter 5 as above are the basis of the suggestions and recommendations on the system enhancement.

2. FRAMEWORK OF FORMULATION AND IMPLEMENTATION OF THE WATER UTILIZATION RULES

2.1 General Agreements and Agreements for Specific Rivers

Agreements or protocols of two different types are in place for the management of shared watercourse or river. One is a general agreement or protocol, which is agreed by various countries without specifying river such as the resolutions of the general assembly of the united nation. The other type is an agreement for the management of a specified internationally shared river, such as the agreement of the lower Mekong river, the agreement of the Nile river and the agreement of Rhine river.

The JICA study team has collected the existing agreements for the management of international river basins since June 2001 pursuant to the scope of works assigned to the study team. The collected agreements are 3 general agreements and 15 specific agreements including multi-lateral and bi-lateral agreements or protocols in the various areas in the world. There are some that being signed at the older time when social and political situations and requirements are different from ones presently prevailing. There are some agreements for the rivers in the semi-arid zone or in the areas where flooding of river are very seldom as compared with the Mekong river basin. There are some that were signed by countries with different religions. The differences in backgrounds of agreement might have more or less affected the provisions thereof.

Chapter 2.2 presents the outlines of Helsinki Rule, 1970, Draft Articles on the Law of Non-Navigational Uses of International River Course, Geneva in 1980 and the Resolution of the General Assembly of the UN; the Agreement of Convention on the Law of the Non-Navigational uses of International Watercourse (21 May 1997, New York). Those are recognized as the frameworks of a rule on the utilization of international river basin for universal application. The construe of the Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin is the main subject of the description in Chapter 2.3. In Chapter 2.4, examples of agreements and protocols on the international river basins are summarized and listed collating with the principles and concepts emerged and prescribed in the frameworks presented as above. As mentioned before, the presented 15 examples are the Agreements of the rivers located in the different areas in the world. An appropriate assessment of the difference in the background thereof is necessary. Chapter 2.5 briefs the situations and conclusions of the filed cases of dispute concerning the management of the international rivers. Some of the arbitraments therein might not be acceptable in the light of the concepts and principles for the modern comprehensive river management.

The last chapter presents the concepts and principles abstracted from the general agreements. Those concepts and principles are to be reflected in the Water Utilization Rule to be formulated because they are applied and prescribed in the Agreement of the Mekong River Basin. The concepts and principles are all accepted ones by the modern agreements and policies. However they are somewhat controversial in their terminology. The chapter provides the interpretations on the basis of hydrology and water resources engineering viewpoint. The preliminarily proposed interpretation high lights the uncertainty and mobility of water resources in terms of quantity and quality as the prominent difference from other natural resources. This uncertainty and mobility would make the roles of the theories of probability, hydrology and hydraulics vital in the formulation of water utilization rules.

2.2 Instruments of Frameworks for Universal Application

2.2.1 The Helsinki Rules on the Use of Water of International Rivers

The International Law Association formulated the Rules on the use of the waters of international rivers at Helsinki, Finland in 1966. The Rules comprises six chapters as follows;

Chapter 1 General

Chapter 2 Equitable Utilization of the Waters of an International Drainage Basin

Chapter 3 Pollution

Chapter 4 Navigation

Chapter 5 Timber Floating

Chapter 6 Procedure for the Prevention and Settlement of Dispute

Each chapter contains several articles and the Rules comprise 37 articles in total.

One of the highlights of the Rules is the concept of International River Basin instead of international river, which appears in Article □. The concept envisages a broader spatial area of a united body of draining area, river channel and water. The concept takes forest areas and slopes of mountains that receive precipitation into consideration as well. Likewise it encompasses river channels to drain the consequent runoff and flood plains in alluvium in its vision. As such the concept introduced the scope of the spatially integrated hydrologic cycle.

The Rule is prominent for the principle of reasonable and equitable utilization of water although no detailed definitions thereof are given. The criteria to be applied to reasonable and equitable share of water are briefly discussed in its Article V and VI. The factors to be encompassed in the criteria are enumerated as follows;

- Geography of a sub-basin including its drainage area
- Hydrology of a sub-basin and its contribution
- Climate
- Existing utilization
- Economic and social needs
- Population
- Alternative cost
- Alternative resources
- Rationalization of water use
- Practicability of compensation
- Degree of satisfaction

The Rule was duly amended to prescribe the risk management in 1972 when Articles for flood control are added.

The Rule recommends the exchange of relevant data and information to prevent disputes regarding legal rights among basin states in Article 29. The Rule specified data and information to be exchanged as waters of a drainage basin, use of water and activities regarding such waters.

In Article 10, the Rule stressed the necessity of prevention of any new form of water pollution in an international drainage basin which causes substantial injury in the territories of a co-basin state. It prescribes to take all reasonable measures to abate existing pollution as well.

Another duty enunciated in its Article 29 is to furnish any other state with notice of any proposed construction or installation that would alter the regime of the basin. The notice should include such essential facts as will permit the recipient to make an assessment of the probable effect of the proposed alteration.

In order to refer question or dispute in future the Rule recommends the establishment of a Joint Agency in its Article 31. The functions of the Joint Agency are to survey the international drainage basin and to formulate plans or recommendations for the fullest and most efficient use thereof in the interest of all basin states.

2.2.2 Draft Articles of the Law on Non-Navigational Uses of International River Courses (International Law Commission of the United Nations, Geneva, 17 July 1980)

Articles are the first United Nations prescription that provides the utilization of an international water or river. The United Nation had promoted several sessions on the use of international water and watercourse and reached the Agreement of convention in 1997 as presented in the following paragraphs.

Article defines the related countries as the system states in its Article 2 as follows:

> "For the purposes of the present articles, a State in whose territory part of the waters of an international water course system exists is a system States."

The Draft Articles define the water to which Articles apply in Article 3 as follows:

> "A system agreement shall define the waters to which it applies. It may be entered into with respect to an entree international water course system, or with respect to any part thereof or particular project, programme or use provided that the use by one or more other system states of the waters of an international water course system is not, to an appreciable extent, affected adversely."

In its Article 4, it stipulates that use is affected by others, as follows:

> "A system state whose use of the waters of an international water course system may be affected to an appreciable extent by the implementation of a proposed system agreed that applies only to a part of the system or to a particular project, program or use is entitled to participate in the negotiation of such an agreement, to the extent that its use is thereby affected, pursuant to Article 3."

The Draft Articles prescribes the cooperation in its Article 3 as follows:

> "Insofar as the uses of an international watercourse system may requires, System State shall negotiate in good faith for the purpose of concluding one or more system agreements."

It prescribes the shared property in its Article 5 as follows:

> "To the extent that the use of waters of an international water course system in the territory of one system state affects the use of waters of that system in the territory of another system state, the waters are, for the purpose of the present articles, a shred natural resources."

Article 3 provides that a water use of a country shall not incur any significant adverse effect to the water resources of others no matter how the use may be in the main stream or in a tributary. The phrase an international watercourse system herein defines the river including its tributaries.

Article 5 enunciates that water resources of shared watercourse are the shared property of the system states.

2.2.3 Agreement on the Convention Regarding the Law on Non-Navigational Uses of International Watercourse (21 May 1997, New York, the Resolution of the General Assembly of the United Nations)

The International Law Commission had held a series of conventions on the law of non-navigational uses of international watercourse in New York initiated on 9 Dec. 1994. The convention concluded the Agreement as the Resolution of the General Assembly of the United Nations. The Agreement forms a part of the framework of international river basin management for universal application. The 37 articles prescribed are summed up in 7 parts.

PART 1: INTRODUCTION

PART 2: GENERAL PRINCIPLES

PART 3: PLANNED MEASURES

PART 4: PROTECTION, PRESERVATION AND MANAGEMENT

PART 5: HARMFUL CONDITIONS AND EMERGENCY SITUATIONS

PART 6: MISCELLANEOUS PROVISIONS

PART 7: FINAL CLAUSES

The Agreement provides the rule concerning the water utilization of the international watercourse instead of river basin as stipulated in Article 2. Watercourse appears not to concern the land use in the river basin area. The use of an international watercourse herein contemplates the utilization of river channel, surface water and groundwater.

In Article 5, the Agreement provides the necessity to be reasonable together with equitable participation in the management of water and watercourse. Article prescribes both the rights to utilise watercourse and the duties to cooperate in the protection or conservation and in the development thereof in its provision. The utilisation of watercourse in an reasonable and equitable manner requires, as stipulated in Article 6, to take into account all relevant factors and circumstances, including,

(1) Geographic, hydrographic, hydrological, climatic, ecological and other factors of a natural character

(2) The social and economic needs of the watercourse states concerned

(3) The population dependent on the watercourse in each state

(4) The effect of use or uses of the watercourses in a state on other watercourse states

(5) Existing and potential uses of watercourse

(6) Conservation, protection, development and economy of use of the water resources of the watercourse and the costs of measures taken to that effect

(7) The availability of alternatives, of comparable value, to a particular planned or existing use

The cooperation in the water resources development might implicate the co-finance views.

The Agreement shows the concern for the promotion of optimal and sustainable utilisation for present and future generations in its Preface. Article 24 envisions the sustainable development of the watercourse. Article encompasses the future generations as one of stakeholder to grant equitable rights.

Article 5 provides the necessary cooperation of the watercourse states in the protection of the international watercourse from any harmful situation. Article 25 coordinates to this principle providing the obligations of watercourse states to cooperate to regulate the flows in the watercourse using hydraulic works. The regulation herein means the use of measures to alter, vary or otherwise control the flow of waters of an international watercourse.

Article 9 recommends the exchange of data and information among the watercourse states. It provides that such exchange shall be regular base and be readily and easily available. The items specified in Article are as follows:

- Information on the conditions of the watercourse
- Meteorological and hydrologic data and information
- Hydro-geological data
- Data on ecological nature
- Water quality

The related forecasts are matters to be exchanged as well.

The agreement strictly prescribes that water utilization shall not cause any harm to other riparian countries. A state that intends to use water shall take all the appropriate measures to prevent the causing of significant harm to other watercourse states. To take the measures to abate the damage and to prepare compensation thereto are the obligations of the state that use the water (Article7).

Notification of water use plans in an appropriate timing is one of the fundamental duties of a state that intends to use water (Article 11 and 12). Protection and preservation of ecosystem in

addition to prevention, reduction and control of pollution are other obligations of the state that intend the use of water (Article20 and 21)

The watercourse states should cooperate each other in the management of the watercourse pursuant to the stipulations in Article 8. In order to coordinate the cooperative activity, the Agreement suggests the establishment of joint mechanism or commission in Article. It further provides the assignment of the joint mechanism (Article 24) as follow;

- Planning the sustainable development of an international watercourse
- Implementation of any plans adopted
- Promotion of rational and optimal utilization, protection and control of the watercourse

The agreed Resolution proposes the establishment of joint mechanism to plan, implementation and operation of development project to coordinate a cooperative activity.

2.3 Agreement on the Cooperation for Sustainable Development of the Mekong River Basin

In the preparation of the Agreement, the Helsinki Rules and the Draft Articles on the Law of the Non-Navigational Uses of International River Course, the then only comprehensive frameworks for the management of international river basin and watercourse, were the basic guidelines to be referred to. The formulation of the agreement on the Convention on the Law on Non-navigational Uses of International Watercourse, the other framework, was 21 May 1997 at New York or about two years after the signing of the Mekong Agreement. During the course of time, various concepts and principles have been consolidated in this field reflecting the technical improvements and changes in social requirements although most of them have once emerged in both the Rules and the Agreements.

The Agreement aims at the cooperation of riparian countries in the sustainable development of the river basin as provided in Article 1, Area of Cooperation. Article stipulates as follows:

> "To cooperate in all fields of sustainable development, utilization, management and conservation of the water and the related resources of the Mekong River Basin."

Attention should be paid to the phrase "related resources of the river basin" because the development, utilization and management of land resources are closely related with and imperative to both the water requirement and disaster prevention. The water utilization of the Mekong River, therefore, should be planned with comprehensive approaches and with the linkage with land use management.

Chapter 1 of the Agreement manifests the recognition that the Mekong River Basin and the related natural resources and environment are natural assets of immense value to all the riparian countries for the economic and social well being and living standards of their peoples. The Agreement adopts the principle that water and related resources are common property of all riparian countries. A country may utilize resources within its sovereignty at its discretion as far as the use will not cause any harmful effect to other riparian countries.

One of the highlights is the provision of the principle of reasonable and equitable use of water resources as stipulated in Article 5. The utilization shall be pursuant to all relevant factors and circumstances. The factors and circumstances are not specified in this Agreement. The Rules for Water Utilization and inter-basin diversion to be formulated by the Joint Committee should clarify the specifications as provided in Article 26.

All the riparian countries agreed to promote, support, cooperate and coordinate in the development of the full potential of sustainable benefits to all riparian States. In this respect, the states agreed to promote, cooperate and coordinate in categorizing and prioritizing joint and/or basin-wide plans and programs for implementation at the basin level to secure a sustainable development of the basin as provided in Article 2.

All the riparian countries agreed to cooperate in managing flood and harmful effects that might result from natural occurrences and man-made activities as prescribed in Article 1. In this article the minimization of harmful effect of water is provided as one of the areas of cooperation among the riparian countries. Consequently, the areas of cooperation might encompass watershed management, construction of flood control dam and sabo works, conservation of natural retarding basin and control of land use in alluvial floodplains of the Mekong river basin. Although no definition of flood season is given in the Agreement, the average daily peak flows in a flood season is to be controlled not to exceed what naturally occurs on the average during the flood season according to the prescription in Article 6.

Notification and consultation are necessary prior to implementation of a development plan (Article 5). The Joint Committee should set up the mechanism for monitoring water use pursuant to the provision of Article 26. The Joint Committee is responsible for the exchange of data obtained through the mechanism as provided in Article 24. A permanent implementing agency might be necessary to carry out data collection, collation and distribution under the supervision of the Committee in addition to the monitoring mechanism. To entrust data exchange to the monitoring mechanism might be an alternative measure to implement the assignment of the Joint Committee in this respect. The rules to be established for water utilization would specify the necessary institutional and technical details of the monitoring and the exchange of data and information

Article 3 provides that protection of the environment and ecological balance is one of the duty of the state who use the water. Meanwhile the water utilization should be in line with the provision in Article 7, prevention and cessation of harmful effects. Maintenance of flows in the mainstream in dry and wet seasons is another duty prescribed in Article 6. The stipulation implies that the discharge, after the completion of the river works should be controlled to be within the levels to be designated on the basis of natural flows.

The Agreement prescribes the institution for cooperation and coordination among the riparian countries. The highlight of the institution is the hierarchical structure of the Mekong Commission, the Joint Committee and its secretariat. The institution and the organization are specified in the series of articles from 11 to 33 together with each function. It is noteworthy that the provision in Article 24 assigned project implementation to the Joint Committee. The Joint Committee may become the implementing agency of the approved joint project and program.

The Agreement might be the world first comprehensive agreement for the management of an international river basin. All the basic principles provided in the framework agreements or protocols are fully incorporated in the prescriptions of certain article therein. The agreement provides modern water resources issues such as environmental conservation and watershed management. The agreement does not envision a specific water use such as hydropower generation project at a specific site along the river. The agreement provides the whole conceivable water use comprehensively. This is a reason that makes the formulation of water utilization rule much complicated and difficult. Further the agreement envisions two stages of water use project; planning and design stage and operation stage. While planning of a water use project requires a static water use rule assuming the degree of water use dependability, a reasonable, equitable and optimum use may require adaptable or dynamic water utilization rule for the operation of the project availing the monitored data.

Since the agreement is comprehensive, there some terms the expression thereof are general and require more concrete definition or interpretation to apply to formulate the water utilization rule. The examples of such terms are as follows;

- River basin development
- Reasonable development
- Equitable use of water
- Sustainable development
- Wet season and dry season
- Acceptable minimum monthly natural flow
- Surplus water
- Harmful effect

2.4 Existing Agreements for Specific Rivers

2.4.1 Amazon Cooperation Treaty

(1) Date Signed

3 July 1978

(2) Participants

The republic of Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Surinam and Venezuela

(3) Objective

To take joint actions and efforts to promote harmonious development and to achieve preservation of the environment through producing equitable and mutually beneficial results taking account of conservation and rational utilization of the natural resources.

(4) Outline of the Treaty

Article 1 specifies that the target areas of the Treaty are the respective Amazon territories. In Article 2 the appeared words are, Amazon Basin and any territory closely connected with the basin. The treaty envisages the linkage of water use and land use manifesting the river basin concept.

The exclusive use of natural resources is recognized as a right inherent in the sovereignty of each state within own territory. The riparian right might be adopted in the treaty.

(a) Principle of reasonable and equitable utilization

Article 1 provides that the international basin countries shall undertake joint action and effort to promote a harmonious development to produce

equitable and mutually beneficial results. To encourage the development of retail trades will contribute to realize equitable and mutually beneficial conditions (Article11). This stipulation may be the implicit expression of joint investment to secure equitable share of benefit.

(b) Principle of sustainable development

Article 7 implicitly stipulates the necessity of the ecological sustainability.

(c) Exchange of information

The riparian countries agreed to exchange information to realize joint action to promote harmonious development as prescribed in Article 1. Article 7 provides to establish a regular system for the proper exchange of information to afford the exploitation of natural resources to maintain the ecological balance. Article 15 stipulates that the contracted parties are obliged to seek to maintain a permanent exchange of information.

(d) Duties provided in the Agreement

The contracting parties shall make effort to achieve the rational utilization of water resources (Article5). The contracting parties shall take other appropriate measures to improve the sanitary conditions in addition to the promotion of coordination in health services in line with the provision in Article 8. Article 10 recommends the contracting countries to create infrastructure for transportation and communication.

(e) Institution and organization

The treaty specifies the Amazonian Cooperation Council to be formed by the foreign affair ministers as the top decision making organization (Article11).

The role of the secretariat of the Council is played by a state in turn (Pro Tempore) as provided in Article 12. Each party has to establish Permanent National Commission to enforce the provisions set out in the Treaty (Article 13). Whenever it is necessary, the Contracting Parties may set up specific commissions to study specific problems (Article 14).

2.4.2 Agreement on the Utilization of Water in the Boden Lake

(1) Date Signed

6 September 1967

(2) Participants

Austria, Germany and Switzerland

(3) Objective

To establish the Rule to utilize water more than 60 lit. per second in the Boden lake paying appropriate consideration to the proper benefit of other riparian countries

(4) Outline of concept and principle

(a) Concept of river basin

Article 2 defined the basin area of the lake through specifying the watershed areas of rivers drain into the lake.

(b) Principle of reasonable and equitable utilization

In case a water use has a possibility of causing a significant impediment to the benefits of other riparian countries, any effective measure to abate the impediment or appropriate indemnity should be imposed to secure the equivalent benefits of the countries to be affected. If the measures do not work well, an appropriate method should be introduced to make both benefits equivalent (Article 3). In order to evaluate the benefit accrued by other than the utilization, the following factor should be contemplated;

- Navigation,
- Fishery,
- Scenic view and
- Energy management

(c) Principle of Sustainable development

Sustainable development of the living standard of the people in the Boden region and the preservation and development of the regional economy are the most important factors to be considered in balancing of benefits (Article 3). The sustainable development or continuous improvement of the living standard of the people in the region is contemplated in principle in the plan.

(d) Exchange of information

A State who has the plan to use the Water in the Boden lake shall inform the plan to other riparian countries (Article 6). Any riparian countries have rights (Article 7) to manifest ones opinions regarding

- Use and inter-basin diversion of water more than 750lit/s
- Use and intra-basin diversion of water more than 1500lit/s

(e) Duties provided in the Agreement

The sanitary management of the Boden Lake should comply with the stipulation of the agreement on the pollution control of the lake signed on 27 October 1960 (Article 3). The consent of the riparian countries is necessary to compensate the unexpected damage incurred by the water use to the countries (Article 4). If multiple uses have brought the damage, the compensation should be shared in proportion to the volume used (Article 5).

(f) Institution and organization

The riparian countries establish a commission to discuss the water use of the Boden Lake (Article 8).

2.4.3 The Columbia Treaty

(1) Date Signed

17 January 1961

(2) Participants

Canada and USA

(3) Objective

The objective is to share the costs to be incurred and the benefit to be accrued by the development of the water resources of the Columbia River in a reasonable and equitable manner at the optimum.

(4) Outline of Concept and Principle

(a) Concept of river basin

River basin concept is not considered in the target of development and three dam sites are specified instead in Article 2.

(b) Principle of reasonable and equitable utilization

No terms of reasonable and equitable use are applied in the treaty. The rights and the duties of both sides are, however, specified concretely and be well balanced with regard to the construction of three multi-purpose dams in Articles 2 to 6. The treaty contemplates the terms implicitly.

(c) Principle of Sustainable development

The life of the project is set at 60 years from ratification date of the Treaty as prescribed in Article 2 and 14.

(d) Concept of risk management

Flood control is one of the objectives of the dam development projects.

Article 18 provides the liability for injury, damage and loss occurring in the territory of the other caused by any act, failure to act or negligence.

(e) Exchange of information

Neither exchange of data nor information is stipulated in the Treaty. However, the establishment of a hydro-meteorological system is provided on the Annex to the Treaty in order to facilitate the operation. The information is to be made available to the entities in both countries.

(f) Duties provided in the Agreement

(i) Canada Duties

- Construction of three dams (Mika, Libby and Arrow Lake)
- Provision of storage of 15.5mil acre-feet in total
- Operation of reservoir
- Provide flood control space 0.8~1.3mil acre-feet
- Flood control operation
- Pay 1.5USD/Kw/year to US for the use of transmission

(ii) Canada Right

- a half of increase in power generation in the US
- Flood control cost from 1.2~11.1 mil USD
- Other use of stored water

(iii) The US Duty

- Installation of additional generator
- Construction of power transmission line
- Share the half of generated power
- Flood control cost as above

(iv) The US Right

- Additional power generation
- Flood mitigation in Dallas, Oregon

(g) Institution and organization

Both countries designate each entity or entities as the implementing bodies.

Both countries entrust the works assigned to each country to the designated entity.

A permanent Engineering Board is established consisting of four members, two to be appointed by Canada and two by the US. The Board is responsible to the technical matters as well as reporting of the record of operation.

2.4.4 Convention Regarding the Regime of Navigation on the Danube

(1) Date Signed

18 August 1948

(2) Participants

The union of Soviet Socialist Republic, the Peoples Republic of Bulgaria, the Hungarian Republic, the Peoples Republic of Romania, the Ukrainian Soviet Socialist Republic, the Republic of Czechoslovakia and the Federal Peoples Republic of Yugoslavia.

(3) Objective

To provide free navigation on the Danube River in accordance with the interests and sovereign rights of the Danubian states and to strengthen the economic and cultural relations of the Danubian states among themselves and with other nations.

(4) Outline of concept and principle

(a) Concept of river basin

River basin concept is not considered in the agreement. The target area is specified to be the Sulina navigational channel between Ulm and The Black Sea in Article 2.

(b) Principle of common asset

Water of the river is not the issue of the convention for its nature. However Article 1 provides that Navigation on the Danube shall be free and open for the nationals, vessels of commerce and goods of all states on a footing of equality.

(c) Principle of reasonable and equitable utilization

No terms of reasonable and equitable use are applied in the treaty. In Article 24 provide the equitable right of vessels belong to the Danubian states to navigate. Sanitary and police regulations in force on the Danube shall be administered without discrimination as regard to nationality of vessels (Article 26). The authorities of Danubian state concerned shall collect port dues levied on vessels without discrimination (Article 40).

(d) Principle of Sustainable development

No provision with regard to sustainable development appears in the convention. However, Articles 3 and 34 through 43 provide the maintenance, pilot services including charging of cost, fee and the method of levy collection.

(e) Exchange of information

No exchange of data nor information is stipulated in the Convention. However, the coordination with hydro meteorological service on the Danube is mandated to the Joint Commission. The information is to be made available to the riparian states.

(f) Duties provided in the Agreement

Navigational management pursuant to the adopted administration (Article27)

Hydraulic works to maintain navigability in the responsible section (Article34)

(g) Institution and organization

Article 5 stipulates the establishment of Danube Commission. The substantial mandates are presented in Article 6 through 8. The Commission shall have own secretariat recruiting staff according to the stipulation in Article 9. Further, in order to represent the lower Danube riparian countries, Article 20 provide the necessity of the establishment of a Special River Administration.

2.4.5 Agreement Among the Government of the Republic of Austria, the Government of the Federal Republic of Germany, and the Free State of Bavaria Concerning the Danube Power Plant and the Jochenstein Stock Company

(1) Date Signed

13 February 1952

(2) Participants

Republic of Austria, Federal Republic of Germany and Free State of Bavaria

(3) Objective

To establish a joint venture (Danube Power Plant and Jochenstein Joint Stock Company) to promote an efficient hydropower generation in the Danube river.

(4) Outline of concept and principle

(a) Concept of river basin

The concept of river basin is not contemplated in the Agreement. The Agreement specifies the target area between the site affected by the backwater of the proposed reservoir and the site affected by the tail water of the power generation in Article 2.

(b) Principle of common asset

The Agreement does not provide the asset. However Article 16 thereof stipulates that water rights granted by both Governments shall be equal. The stipulation implies the concept of common asset.

(c) Principle of reasonable and equitable utilization

Article 13 provides the equal contribution of shareholders of two groups. Meanwhile Article 14 provides the equal allocation of power generated and the production cost. Further, Article 20 stipulates the equivalent employment of the staff for operation and maintenance.

(d) Duties provided in the Agreement

Both parties shall endeavour to make available as soon as possible exchange permits necessary for giving effect to the Agreement (Article 18).

(e) Institution and organization

Article 25 provides the appointment of Arbitrator to negotiate and settle the problems arisen. It provides an employment of umpire from third party to adjust the opinion.

2.4.6 Protocol Regarding Water Regulation of the Tigris and Euphrates (The first annex to the Treaty for Friendship and Good Neighbor)

(1) Date Signed

29 March 1946

(2) Signed by

Iraqi and Turkey

(3) Objective

To secure the mutual benefit from the construction of flow regulating works in the territory of Turkey

(4) Outline of concept and principle

(a) Concept of river basin

No terms of river basin appear in the Protocol. The provision, however, does not limit the target to the mainstreams of the Tigris and Euphrates rivers.

In Articles 1 and 5, the provisions encompass the tributaries of both rivers.

(b) Principle of common asset

No explicit statement is made regarding the principle. However, the agreement is based on the understanding that water once trapped by Turkey shall turn in the territory of Iraqi according to the preface of the Protocol.

(c) Principle of reasonable and equitable utilization

According to the preface, both governments recognized that the construction of a dam on either river or tributary thereof benefit to both countries.

Turkey agreed to permit the survey team of Iraqi to enter the territory of Turkey to investigate hydrology, geology and other appurtenant survey. The survey is to attest the reasonability and equitable of a project (Article 1).Article 5 provide that the government of Turkey agreed to construct any project planned on both rivers and on the tributaries thereof to be able to render services in the interests of Iraqi and Turkey.

(d) Concept of risk management

For flood forecasting, the water levels at 8;00 in the morning in the following sites shall be transmitted to Iraqi (Article 3) ;

(i) Euphrates river

- Keban
- Etc.

(ii) Tigris river

- Tigre
- Diyarbakir
- Cizre
- Etc.

(e) Exchange of information

Article 3 prescribes that Turkey shall install water level gauges at strategic points along the mainstreams and tributaries in connection with the planned dams. Turkey carries out the observation and data collection. Water level data are to be transmitted to Iraq by telegram.

(f) Duties provided in the Agreement

Iraq: Shoulder the cost incurred by survey (Article 1)

Shoulder the cost for data transmission (Article 3)

Turkey: Accept the survey team of Iraq (Article 1)

Extend cooperation to the survey team (Article 2)

Install observatories for water levels (Article 3)

Operation and maintenance of the Observatories (Article 3)

Data transmission to Iraq (Article 3)

(g) Institution and organization

Both parties shall designate representatives to communicate and coordinate the activities (Article 6)

2.4.7 Agreement Between His Majesty's Government of Nepal and the Government of India on the Gandak Irrigation and Power Project

(1) Date Signed

4 December 1959

(2) Participants

India and Nepal

(3) Objective

In order to develop irrigation and power generation, both Governments agreed to construct a dam, irrigation canals and hydropower stations and to designate the monthly discharges allocated to both countries for their use

(4) Outline of concept and principle

(a) Concept of river basin

The concept is not provided in the Clause of the Agreement. It manifests the right of Nepal to use water in the river or in the tributaries in Clause 9.

(b) Principle of common asset

Clause 9 manifests the protection of the riparian right of Nepal. And the Agreement does not express the Principle explicitly. However the same clause provides that the Government of Nepal agreed to exercise the right not to affect the water requirement of the Project. The agreement was prepared pursuant to the principle.

(c) Principle of reasonable and equitable utilization

The allocations of the project costs to be shared by the both governments are stipulated in Clauses 3,4,5,6,7 and 8. Meanwhile the allocations of water are specified in Clause 9 as follows:

Table 1 Allocation of Water Use (Nepal, India)

(Unit: cusec)

Month	Nepal	India	Total
Jan.	6960	4550	11500
Feb.	6100	3900	10000
Mar.	5960	3690	9650
Apr.	5760	4340	10100
May	8270	7980	16250
June	11190	14000	25190
July	15240	13980	29220
Aug.	14980	14600	28980
Sept.	14980	14000	28980
Oct.	16060	14110	30170
Nov.	11070	13240	24310
Dec.	10410	9290	19700

(d) Concept of risk management

Clause 2 specifies the responsibility of India in case of danger during the construction. India shall take appropriate measure to restore the damage to be incurred by the conduct and shall pay the compensation.

(e) Duties provided in the Agreement

The Acquisition of the right-of–way is the responsibility of Nepal. The Government of Nepal shall make legal arrangement for the permission of Indian staff to perform their activities in Nepal according to Clause 2.

2.4.8 Agreement Between the Government of the Peoples Republic of Bangladesh and the Government of the Republic of India on Sharing of the Ganges Water at Farrakka and on Augmenting Its Flows

(1) Date Signed

5 November 1977

Date of expiration: 5 November 1982

(2) Signed by

Bangladesh and India

(3) Objective

To make the optimum utilization of the water resources of their region by joint efforts

(4) Outline of concept and principle

(a) Concept of river basin

No terms of river basin appear in the Agreement. The Agreement high light the diversion weir site and the provision thereof stipulates the

quantum to be released to Bangladesh from Farrakka during the designated period as provided in Article 2. The phrase " the water resources of their regions " in the preface, however, implies that the Agreement pays certain attention to the river basin as the effective area of the riparian right.

(b) Principle of common asset

No explicit statement is made regarding the principle. However, the agreement is based on the understanding that water once controlled at Farrakka shall be shared fairly to both countries as stipulated in the Preface. Article 2 provides the Schedule, which specifies the quantity to be withdrawn by India and released to Bangladesh

(c) Principle of reasonable and equitable utilization

According to the descriptions in the preface, both governments recognized that the construction of the diversion weir at Farrakka is beneficial to both countries if water is shared fairly by the countries.

Both countries agreed the quantum to be withdrawn by India and released to Bangladesh at Farrakka based on the flow recorded during period between 1984 and 73 as specified in the Schedule provided in Article 2. The schedule specifies the shares of both countries for each 10-day from the 1st of January to the 31st of May every year. It should be noted that the recorded flow is the remnant of the natural flow less water used in the upstream reach areas. Further the release includes the necessary water to conserve the riverine environment. The shares of India vary from 40% to 42% to secure the equity.

(d) Principle of Sustainable development

The explicit sustainability principle does not appear in the Agreement. Article 8 manifests the recognition of both Governments to find a solution to the long-term problem on the augmentation of dry season flow.

(e) Concept of risk management

No article provides this principle. However it is doubtless that the Government of India agreed to share water as the trade-off of the implementation of East Pakistan Ganges Barrage Project, which will submerge a considerable area of India during high water period. Along this line, the Agreement is a partial result of the risk management.

(f) Exchange of information

The Joint Committee set up an observation team to measure and record the daily flows at the ollowing sites (Article 4):

- Farrakka
- Hardinge bridge
- Feeder canals

(g) Conditions or duties provided in the agreement

Article 8 stipulates that the two Governments recognize the need to cooperate with each other in finding a solution to the long-term problem of augment the flow of the Ganges during the dry season. Meanwhile both parties shall implement the provisions of the Agreement in good faith (Article 12).

(h) Institution and organization

A committee consisting of the representatives nominated by the two Governments shall be constituted (Article 4). Article 4 stipulates the establishment of observation team as well. The joint river committee is mandated to carry out investigation and study of schemes related to the augmentations of river flow

2.4.9 Agreement Between the Government of the Union of Soviet Socialist Republics, the Government of Norway and The Government of Finland Concerning the Regulation of Lake Inari by Means of the Kaitakoski Hydroelectric Power Station and Dam

(1) Date Signed

29 April 1959

(2) Participants

Union of Soviet Socialist Republics, Finland and Norway

(3) Objective

In order to control the water level of the Inari Lake and to secure the favourable water use thereof, the three governments agreed to implement the Kaitakoski hydroelectric project

(4) Outline of concept and principle

(a) Concept of river basin

River basin concept is not provided in the agreement. Article 4 mandates the Government of Finland to manage the river basin for maintaining the hydrologic regime of Lake Inari.

(b) Principle of common asset

No explicit expression can be found in the Agreement. However, all the participants acknowledges the principle and the lake water level, discharge and generation of power are to be controlled in accordance with the Regulation although the operation of the proposed dam is entrusted to the Union of Soviet Socialist Republics as prescribed in Article 2. Said Regulation prohibits operation in prejudice of private and public interests.

(c) Principle of reasonable and equitable utilization

No terms of reasonable and equitable use are prescribed in the Agreement. The utilization or the operation of the proposed dam shall accord to the Regulation (Article 2). The Regulation should be established on the basis of the Principle.

(d) Principle of Sustainable development

No provision with regard to sustainable development appears in the Agreement. However, Articles 3 provides the amendment of the Regulation as may be required in connection with the new hydropower or other water resources development.

(e) Concept of risk management

The Regulation referred to in Article 2 stipulates that in case the lake water level reaches 117.98m above mean sea level, the discharge from the lake may be increased up to 500 CMS to protect the riparian areas from submergence.

(f) Exchange of information

All the Governments are responsible to monitor the climate and hydrologic conditions in the respective territories according to the Regulation. The obtained data shall be exchanged and recommendations in connection to the discharge shall be made from the downstream country to upstream country. Further, the Regulation stipulates that measurement of precipitation is necessary to forecast runoff.

(g) Institution and organization

Each Government shall appoint a representative to implement the Agreement (Article 5). In order to settle any dispute, a Mixed Commission is formed consisting of six members, two from each country.

2.4.10 The Indus Waters Treaty Concluded between India and Pakistan

(1) Date Signed

19 September 1960

(2) Participants

The Government of India and the Government of Pakistan

(3) Objective

To attain the most complete and satisfactory utilization of water of the Indus River and to fix and to delimit the right and obligation concerning the use of the river water.

(4) Outline of concept and principle

(a) Concept of river basin

The Agreement envisages the Indus system of rivers as described in the Preamble. Further, Article 1 implies that the Agreement covers the water of all tributaries. The Agreement substantially adopts the concept. Article 4 provides the restriction on the alteration of catchment area.

(b) Principle of common asset

Riparian rights are granted to both countries on condition that water use is reasonable. A country may withdraw a part of river water allowing the remaining water to be released to the downstream reaches according to Articles 2 and 3. The Agreement provides for the use of river channels as well. The upstream country is entitled to drain excess water through the river channels belonging to the downstream countries as stipulated in Article 4.

(c) Principle of reasonable and equitable utilization

It is not confirmed that the allocations of water are equitable or not; the quantities to be tapped by each country are designated for each season. The cost incurred by the management is allocated to each country as provided in Article 5.

(d) Principle of Sustainable development

No provision with regard to sustainable development appears in the convention. However, Article 7 provides for the future water resources development together with the future cooperation in river management.

(e) Concept of risk management

Article 4 provides for the flood control works and watershed management in the river basin. The same article prescribes for he alteration of the catchment area and the capacities of the drainage channels in view of flood control.

(f) Exchange of information

Article 4 provides for the monitoring method for water utilization and the operation of storage dams. The exchange of the monitored data is stipulated in the same Article. Article 6 specifies the data to be exchanged between the two countries.

(g) Duties provided in the Agreement

The details of the duties are provided in Annexures A to G.

(h) Institution and organization

Article 8 stipulates the establishment of the Permanent Indus Commission. The substantial mandates are presented in Article 8. Each government shall appoint a Commissioner to represent the Government.

Each government shall bear the expenses for the Commissioner and his ordinary staff.

2.4.11 Treaty of Peace Between the State of Israel and the Hashemite Kingdom of Jordan (Article 6: Water)

(1) Date Signed

26 October 1994

(2) Participants

The Hashemite Kingdom of Jordan and State of Israel

(3) Objective

To use the water of the Jordan River and the groundwater in the river basin effectively and peacefully for the socio-economic development of the both countries.

(4) Outline of concept and principle

(a) Concept of river basin

The river basin concept does not appear in the Agreement. However the Agreement touches upon the development plan in the basin in general. Further it provides the shares of the groundwater in the river basin. It is obvious that the Agreement envisions the river basin as the target area.

(b) Principle of common asset

The Agreement does not provide explicitly that water is a common asset of both countries. However, Article 2 of the Annex stipulates that the concrete water projects are to be carried out in common by both countries. Jordan shares the water in her territory to Israel as common asset. No provision stipulates the share of water in Israel. The principle is not supposed to be even for both countries.

(c) Principle of reasonable and equitable utilization

Paragraph 1 of Article 6 provides for mutually recognizing rightful allocation of surface and subsurface waters. The Annex II of the Treaty stipulates the water share as follow:

Article 1: Allocation of water from the Jordan and Yarmouk rivers

Article 2: Storage and diversion facilities

Article 3: Protections of water quality

Article 4: Allocation of ground water in the Arava Valle

It should be noted that general understandings do not judge the agreed share is not reasonable and not equitable. Occupation of land as territory might be the fundamental to assess the reasonability and equity.

(d) Principle of sustainable development

No provision with regard to sustainable development appears in the Treaty. However, Article I provides for future water resources development. The provision is considered as a declaration of intent.

(e) Exchange of information

Article VI of the Annex enforces the obligation to exchange data and to cooperate.

(f) Duties provided in the Agreement

Article 6 of the Treaty binds both sides not, in any way, to harm the water resources of the other party.

(g) Institution and organization

Article 7 of the Annex envisions the establishment of a Joint Water Committee to pursue and supervise the implementation of the Annex.

2.4.12 Agreement for the Full Utilization of The Nile Waters

(1) Date Signed

8 November 1959

(2) Participants

United Arab Republic and Sudan

(3) Objective

To construct the Sudd el Aali at Aswan to use the water of the Nile River through regulating the flow in the over-year storage providing the proposed dam

(4) Outline of concept and principle

(a) Concept of river basin

The Agreement does not manifest the terms of river basin. The plan encompasses the development of swamps located in the basin and the Blue Nile River, jointly instead of sole development of the Sudd el Aali (Article 2).

(b) Principle of reasonable and equitable utilization

Each existing use of water, which when agreed is deemed to be the acquired right of the relevant country. According to Article 1 such uses are:

Sudan: 4,000 MCM

UAR: 48,000 MCM

The increase of available water accrued by the proposed project is to be shared in equitable manner. The naturalized river yield affords both countries to be reasonable in the estimation of the increase. Naturalization of the river yield is estimated based on the data recorded in 20th century as stipulated in Article 2.

The naturalized river-yield after the completion of the project of 84 Milliards is equitably distributed as follows:

Usage	Sudan	UAR	Loss	Total
Existing usage (MCM)	4,000	48,000		52,000
New share (MCM)	14,500	7500		22,000
Over-year storage loss (MCM)			10,000	10,000
Total (1,000 MCM)	18.5	55.5	10.0	84.0

The augment of river yield to be accrued and the cost to be incurred by other projects such as the development of swamps are to be allocated evenly (50%) to both countries (Article 3).

(c) Exchange of information

Both countries carry out the gauging and observation in Sudan and in the UAR under the supervision of the Joint Technical Commission (Article 3).

(d) Duties provided in the Agreement

UAR pays 15 million Egyptian Pounds to Sudan to compensate for the damages resulting from the project (Article 2).

Sudan undertakes to arrange before July 1963 the final transfer of the population of Halfa and all other Sudanese inhabitants whose lands will be submerged by the stored water (Article 2).

(e) Institution and organization

In order to ensure the technical co-operation between two countries, a Permanent joint Technical Commission shall be formed of an equal number of members from both parties.

2.4.13 Treaty Between Austria and Liechtenstein Regarding the Regulation of the Rhine and Tributary Waters

(1) Date Signed

23 June 1931

(2) Participants

Austria and Liechtenstein

(3) Objective

To regulate the construction of the Liechtenstein inland canal the erection of drainage works within range of the Austro-Liechtenstein boundary

(4) Outline of concept and principle

(a) Concept of river basin

The target area is specified in Article 1 as the weir site and the river banks of the Rhine River from the mouth to the uppermost of the Ill.

(b) Principle of common asset

No explicit expression on this matter appears in the Agreement. However the principle is envisaged and both countries agreed to carry out all the works under mutual control as prescribed in Article 12.

(c) Principle of reasonable and equitable utilization

The utilization is a matter of decision to be made by the Technical Authority assigned by both countries, and the duty to keep reasonability and equity in the usage of water is vested to the Authority (Article 12).

(d) Principle of Sustainable development

Article 3 stipulates that both countries shall keep in good condition at all times the weir and banks. The government of Liechtenstein is mandated to arrange the maintenance thereof in order.

(e) Exchange of information

Article 1 stipulates that both countries shall communicate with each other their building and repair programs annually for approval. Further, Article 4 provides that every fundamental alteration of the projects requires discussion. The monitoring of hydrologic and hydraulic conditions is provided in Article 1.

(f) Duties provided in the Agreement

The duty to shoulder the project cost are specified in Articles 7 and 9.

(g) Institution and organization

Article 12 stipulates the establishment of a Technical Authority. Arbitral tribunal will be held to settle problems. Both Governments shall jointly designate the umpire.

2.4.14 Protocol on Shared Watercourses in the Southern African Development Community

(1) Date Signed

7 August 2000

(2) Participants

The Heads of State or Government of The Republic of Angola, Botswana, The Democratic Republic of Congo, The Kingdom of Lesotho, The Republic of Malawi, The Republic of Mauritius The Republic of Mozambique, The Republic of Namibia, The Republic of Seychelles, The Republic of South Africa, The Kingdom of Swaziland, The United Republic of Tanzania, The Republic of Zambia and The Republic of Zimbabwe

(3) Objective

To foster closer cooperation for judicious, sustainable and co-ordinated management, protection and utilization of shared watercourses and advance the SADC agenda of regional integration and poverty alleviation.

(4) Outline of concept and principle

(a) Concept of river basin

No terms of river basin appear in the Protocol. However, Article 1 takes the concept into consideration defining the term Watercourse. Article 3 shows the recognition of the concept specifying the meaning of the utilization of the resources of the watercourses as well.

(b) Principle of reasonable and equitable utilization

Article 3 provides that watercourse states shall in their respective territories utilize a shared watercourse in an equitable and reasonable manner. The Article further provides factors and circumstances to be taken into account to utilize water.

(c) Principle of Sustainable development

Article 3 clearly prescribes the necessity to keep the balance of development and conservation to promote sustainable development. Environmental protection is provided in Article 4 for this purpose.

(d) Concept of risk management

The State Parties are requested to take all appropriate measures to prevent or mitigate harmful conditions (Article 4). The examples of such harmful conditions are prescribed in the Article as flood, waterborne diseases, erosion etc. The Article prescribes the actions to be taken in such emergency case.

(e) Exchange of information

Article 4 provides the duty to exchange information and consultation on the planned measures for the watercourses. Such notifications are one of the substantial subjects of the Article.

(f) Duties provided in the Agreement

State parties shall strive to resolve all disputes regarding the implementation of the provisions of this Protocol (Article 7).

(g) Institution and organization

Article 5 stipulates the institutional frameworks for implementation. The institutional mechanism responsible for the implementation of the Protocol established by the Article is:

- Committee of water minister
- Committee of water senior officials
- Water sector co-ordinating unit
- Water resources technical committee and sub-committee

2.4.15 Agreement Between the Republic of Syria and the Hashemite Kingdom of Jordan Concerning the Utilization of the Yarmuk Waters

(1) Date Signed

4 June 1953

(2) Participants

The Governments of the Republic of Syria and the Hashemite Kingdom of Jordan

(3) Objective

To strengthen the bond of the two countries and friendly relations through sincere cooperation in the water utilization of the Yarumuk River for irrigation and power generation.

(4) Outline of concept and principle

(a) Concept of river basin

River basin concept is not considered in the agreement. The target area is specified to be the area related to the Yarmuk scheme in Article 2. The scheme has relation with the substantial drainage area of the Yarmuk river basin.

(b) Principle of common asset

No explicit term of common asset is found in the Agreement. However both countries agree to use the water for irrigation in Jordan although a substantial watershed area is located within the territory of Syria (Article 8). The prescription in Article 8 might be based on the principle.

(c) Principle of reasonable and equitable utilization

No terms of reasonable and equitable use are applied in the treaty. The shares of the generated power are specified in Article the expediency of joint use of the river water and the facilities.

(d) Exchange of information

The Joint Commission shall monitor the river flow in the main course and the tributaries to estimate the inflow to the Maqarin reservoir. Article 7 provides forthe exchange of such hydrologic data.

(e) Duties provided in the Agreement

Each country shall secure the land necessary for the project. Each country shall settle any right, which affects the Maqarin installation (Article 4). Both countries shall shoulder the OMR costs in proportion to the rates to be defined by the Joint Commission (Article 9). Both countries shall undertake the measures to mitigate silting in the reservoir complying to the recommendation of the Joint Commission (Article11).

(f) Institution and organization

Article 10 stipulates the establishment of the Syro-Jordanian Joint Commission. It shall be a body corporate (Article 10). It may seek advice from experts and consultants. The Joint Commission shall draw up its own rules of procedure.

2.4.16 Agreement Between the Republic of Russia and the Republic of Azerbaijan Concerning the Utilization of the Samur River

(1) Date Signed

7 October 1967

(2) Participants

Republic of Russia (Dagestan) and Republic of Azerbaijan

(3) Objective

To use water of the Samur river jointly and cooperatively with sustainable manner at Samur Headworks

(4) Outline of concept and principle

(a) Concept of river basin

No river basin concept appears in the Agreement although more than 90% of the watershed area of some 3,000km^2 belongs to Russia.

(b) Principle of common asset

No explicit term of common asset is found in the Agreement.

(c) Principle of reasonable and equitable utilization

No terms of reasonable and equitable use are applied in the Agreement. The Agreement specifies the shares of both countries for each 10-day starting from January 1st for the year of 4-year drought. The Agreement provides that the shares in other hydrologic conditions are to be defined applying the same proportions as specified in case of 4-year drought. The extreme average monthly shares are shown below.

Difference in shares	Month	Russia		Azerbaijan	
		m^3/s	%	m^3/s	%
Min. difference	February	5.10	34	10.05	66
Max. difference	June	10.22	19	44.10	81

The headwork is situated at the top of the alluvial delta of the Samur River that empties itself into the Caspian Sea. The proportions of territory in the delta for Azerbaijan and Russia are around 70:30.

(d) Exchange of information

Both countries share the information on river flow observed at about 120km upstream from the headwork to predict the inflow to the headwork site and prepare the intakes. The actual diversions are reported later.

(e) Duties provided in the Agreement

No special prescription is provided.

(f) Institution and organization

No special prescription is provided.

2.5 Examples of Dispute Concerning the Management of International Rivers

2.5.1 Introduction

Agreements, Treaties or Protocols have functioned well to manage and use water in international rivers in cooperative ways and the principle or spirit of good neighbours have governed the management to eliminate the seeds of frictions among the related states.

Consequently compromise has been usual solution of the conflicts and the tribunal cases are not plenty. However there are several cases in which the states concerned could not reach agreement and filed cases with the international courts or organizations to settle the problems. The main causes thereof are ignorance or negligence of uncertainty and mobility of hydrologic phenomena in the stage of formulation of the agreement although they are inherent to water resources. If a party does not pay attention to the principle of common asset and equitable share with the other party, the problem becomes rather serious.

Some typical examples are presented in the following subsection.

2.5.2 Examples of Dispute

(1) Lake Lanoux case

(a) The states concerned

France and Spain

(b) Situation

Lake Lanoux is located in the territory of France being fed by the water from the watershed areas in France. The only outlet of the lake is the Fontvive River, which join the Carol River that crosses the border and drains the territory of Spain. Both States signed the Bayonne Treaty for the use of the water along the river on 26 May 1866.

France Electricity Corporation constructed a hydropower station availing the water of the lake through inter-basin diversion. The water once used for hydropower generation is returned to the Carol River before it crosses the border.

(c) Matter in dispute

Spain claimed that France violated the Bayonne Agreement, because of the following: (i) No provision of the Treaty allows change of flow by inter-basin diversion without agreement; (ii) Prohibition of creation of possible inequality in water right through changing conditions without agreement.

(d) Arbitral Tribunal

The Arbitral Tribunal of Geneva concluded that the diversion with restitution envisaged in the French project was not contrary to the Treaty. The reasons were: (i) diversion does not change its quality in regard to human needs; (ii) diversion with restitution does not change the state of affairs for the working of the requirements of social life.

(e) Observation

The concept of River Basin might be able to avoid such dispute.

Prior notification, exchange of information and consultation are useful to solve such argument.

The establishment of an organization for the joint development of the river basin might be one of the solutions.

The effects of the diversion on the flow regime of the river in Spain should be examined more in detail in respect of the principle of common property because:

- The traveling time of the diverted water is different from that of river flow.
- The diverted flow might be regulated constant flow.
- There are seasons when the diverted flow overlay on the natural discharge from the lake.

(2) Gut Dam case

(a) The states concerned

Canada and the United States of America

(b) Situation

The Saint Lawrence River emerge at the north-east of Ontario Lake which collects the water from the Great Lakes. The upper reach of the river forms a portion of the border between Canada and the US for about 114 miles. The river empties into the Saint Lawrence Bay and plays an important role as navigation canal that connects the Great Lakes with the Atlantic Ocean. The Government of Canada constructed Gut Dam on the river to maintain the water level thereof after obtaining the consent from the US. In 1951 and 1952, the water levels of the Great Lakes and the river had risen extraordinarily and substantial riparian areas had been submerged and damaged significantly.

(c) Matter in dispute

Both sides signed to establish an Arbitral Tribunal chaired by Dr. Lambertus Erades, vice-president of the district court of Rotterdam for the Compensation to the Great Lakes Areas on 25 March 1965.

Canada stated that the responsibility to compensate was extinguished by prescription in 1908 when the guaranty period expired, but agreed to compensate only the people who reside in the island of the abutment of the dam. The United States of America demanded to compensate all those affected.

(d) Arbitral Tribunal

The tribunal arbitrated as follows:

Canada shall comply with the claim of the US as far as the request payments for 1951 and 1952 because the Canadian government once admitted the obligation for the payment officially. What shall be clarified is whether Gut Dam really caused the damages as claimed and the amount of damages.

(e) Observation

Hydrologic and hydraulic studies are indispensable to guide the tribunal in forming conclusions agreeable to all the parties. In this connection, monitoring of the river and operation of hydraulic facilities are fundamental. Principle of risk management would have been effective to mitigate the so-called damage to be incurred by the dam construction and minimize the compensation amount.

(3) Farrakka Weir case

(a) The states concerned

The Peoples Republic of Bangladesh and the Republic of India

(b) Situation

The partition of India in 1947 is the origin of the Ganges dispute. Before the partition, India had developed irrigation tapping water from the upstream reach of the Ganges. An extensive irrigation development had been implemented since partition in the Indian territories. The water tapping in the upstream reaches had decreased dry season flow in the downstream reach of the river remarkably. The decrease had exaggerated the silting in the Hooghly River, the western branch of the Ganges in its delta. In 1961 the government of India announced the plan to divert water from the Ganges at Farrakka to the Hooghly to flush out the silting therein to save the Port of Culcatta. The diversion affects the water use in Bangladesh apparently but India would not recognize that Bangladesh had any claim on the water of the Ganges. India should have noticed that the Ganges is an International River and both countries should share the water thereof equitably as claimed by Bangladesh. Farrakka Weir was completed in 1975 together with the related structures before both countries reached the agreement. The massive diversions at the weir induced a crisis situation in Bangladesh in the dry season in 1976.

(c) Matter in dispute

Bangladesh claimed the situation but failed to suspend the water withdrawals of India through the diplomatic channel. Bangladesh went to the United Nations to bring an action. While Bangladesh asserted the claim for the equitable share of water, India stated that augmentation of dry season flow is required to share the water. The Consensus Statement in the UN urged both countries to sit down together at the table for dialog. Both countries resumed the talk in December 1976.

(d) Arbitral Tribunal

Detailed negotiations at official level resulted in the Agreement of 5th November 1977 as described in Chapter 5. Since both countries could reach an agreement, arbitration was not necessary in this case. The Agreement settled the two substantial matters of dispute as follows:

Share of water: The share of water of each country is designated presented in the attached table to the Agreement.

Augmentation: Bangladesh proposed the water resources development in the upstream reach of the river near Nepal. Meanwhile India asserted the diversion from the Brahmaputra River. The Agreement does not specify the method to augment the dry season flow but provided the implementation of the study on the augmentation.

(e) Observation

The dispute might have been raised because of the absence of the considerations on the concepts and principles discussed in the Second Chapter. In order to assess the dry season flow in the downstream reach, the water resources and water use in the whole river basin of the downstream reach should be contemplated. Without common property principle, share of diversion water may not be designated in an agreeable manner by both countries. At least, India should have understood that the water tapped in the upstream reach should otherwise be able to augment the discharge at Farrakka. The same should have been reflected in the equitable shares of dry season flow in the Table. Flood mitigation should be incorporated in the study on the augmentation because the regulation of flood discharge by means of impounding dam might be one of the most promising plans. There remains a question to utilize such valuable freshwater to flush out the silting and secure the navigable channel. There are several conceivable alternative ideas to alleviate the silting: Lessen the production of sand, control the secondary movement of sand once deposited, and remove or arrest the sand before it flows into the Hooghly River. All these ideas are closely related to the land use in the river basin and to the risk management principle.

(4) Jordan Valley case

(a) The states concerned

Jordan, Lebanon, Syria, Israel and Palestine

(b) Situation

After 1967, Israel occupied the Golan Heights, South Lebanon, the West bank of the Jordan Valley together with Gaza area and a part of the Yarmuk river basin. Israel developed the occupied lands for agricultural production using the water resources in the occupied areas. Israel is conveying the Jordan spring water to the north of Israel. It is diverting the water of the Yarmuk River to Galilee Lake to use the water in the southern areas of Israel. It has a plan to divert the water in the Litani River to its territory.

(c) Matter in dispute

International Treaties (Geneva and others) prohibit the alteration of the rights of occupied residents in general. However the occupants have relocated farmers from Israel and resettled them in the occupied areas to promote agriculture. Israel deprived the original residents of the water sources, transferring the water to their farmer. All these deeds are

recognized to be in violation of international laws not only by Arabic countries.

(d) Arbitration Tribunal

The first Israeli-Palestinian International Conference on Water proposed the arbitration as follows:

The border of the territories shall be the ones before 1967. Settle the Jordan, the Yarmuk and the Litani water on the basis of the Johnston project.

(e) Observation

The principle of equitable share among the riparian countries should be observed. If a state suffers from water shortage due to a desire to use water exclusively, the situation of its neighbour should be the same. The principles of common asset and reasonable and equitable use are imperative to secure the peaceful life of nations. The water is basic human needs and if a state needs more water than that allocated to her, the state may obtain the water by means of compensation or swapping through a dialog based on the spirit of good neighbour. Pillage backed by the force of arm leaves a global serious problem. In this respect, joint investment or joint implementation of a project might be an effective procedure to realize reasonable and equitable use. The Joint Commission with monitoring function is indispensable for the mutually agreeable operation of the joint scheme.

(5) Maintenance of the Rhine River

(a) The states concerned

France, Germany, Netherlands and Swiss

(b) Situation

Silting of the downstream reach of the Rhine River is significant and the operation of the Port of Rotterdam is affected to some extent. Rotterdam City, responsible to maintain the port, has been dredging about 10 million m^3 of deposited material a year. The dredged materials have been utilized for embankment of land reclamation and the city has not encountered any problem finding a spoil bank. However, chemical matters and heavy metals have contaminated the silted material. The dredged material could no longer be used for the embankment due to the deterioration of quality. The City of Rotterdam constructed an offshore spoil bank yard of 260 ha to accommodate the dredged material. The agency of the city has evaluated the extent of the contamination and classified the material into 4 grades in accordance with their qualities. The city constructed a plant to process the materials classified into committee for the processing of the dredged material (SGBB) cooperating with the Ministry of Transportation and Public Works, tand he provinces of South Holand and Helderland to manage the dredging works jointly in 1985.

(c) Matter in dispute

Some effluent sources are scattered source such as agricultural lands and acid rainfall. However the SGBB could identify the specific effluent sources of the pollutant since 1986. The specific sources distribute to the wide areas in France, Germany, Netherlands and Swiss. Some factories shall decrease the effluents by 70 to 90%. Most of factories are reluctant to admit their responsibilities until the public manifests its concern on the environment of the river. The City of Rotterdam has claimed that it is not fair to be charged all the cost to be incurred by the works.

(d) Arbitration Tribunal

The Government of the Netherlands has signed a bilateral Agreement on the pollution control of the Rhine River with each riparian country in 1987. It also established The Rhine Action Program, which envisions the reduction of contamination to the level of 50% of the ones in 1985.

(e) Observation

The acknowledged principles of common property and equitable share might contribute much to reach agreement together with the polluter pay principle. In this respect, a part of responsibilities of discharges of flood, sand and silt should be vested to the riparian countries located in the upstream reach areas. Such discharges are to be mitigated by these countries to some extent by means of watershed management and hydraulic works. The investment for those activities by them may ease the dredging works of Rotterdam City. Perhaps geographic and hydrologic conditions might not highlight this matter unlike the cases in monsoon regions.

2.6 Interpretation of Concept and Principle to Apply to the Water Utilization Rules

2.6.1 Concept of River Basin

(1) Structure of the management under the River Basin Concept

The management of water resources under River Basin Concept might implicate the management of watercourse as well as the management of whole drainage area. While the former management is the control of river flow, the latter management is the control of land uses in the river basin. Both controls affect the hydrologic and environmental conditions significantly. Accordingly the river basin concept should be high lighted and contemplated in formulating water utilization rule for the sustainable development of the Mekong River Basin. There are several conceivable and practically being applied measures to control river flow and control land use. The river basin concept for the management of water resources has a structure shown below.

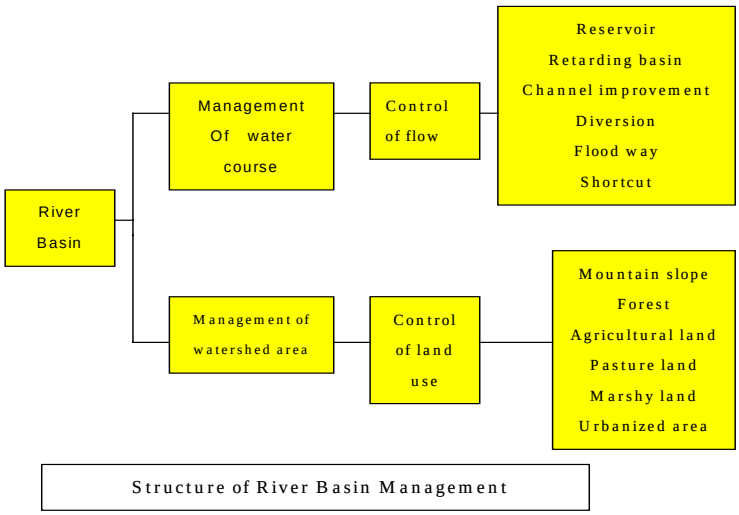


Fig. 2 Structure of River Basin Management

(2) Possible effects of the development of each component (control of flow)

The hydrologic and environmental conditions are susceptible of the effect of river flow control through the provision of each component measure. River basin concept in the management of the Mekong River Basin is, in a way, to amplify the conceivable positive effects of the measures to control flow to secure the mutual benefit of the related countries. Meanwhile the river basin management is to impose appropriate control measures to avoid the possible negative effects not to cause harmful effect to the riparian countries. The positive and negative effects of controlling measures in general are as shown in Table 2.1.

(3) Possible effects of the development of each component (land use)

The hydrologic and environmental conditions are susceptible of the effect of the change in land uses. River basin concept in the management of the Mekong River Basin is, in a way, to amplify the conceivable positive effects of the land use to secure the mutual benefit of the related countries. Meanwhile the river basin management should avoid the possible negative effects not to cause harmful effect to the riparian countries. The positive and negative effects in general are as shown in Table 2.2.

The water utilization rule to be formulated shall reflect the river basin concept and the assessment of positive and negative effects of a proposed project are necessary prior to consultation and agreement.

Table 2 Effects of Each Component (Flow Control)

Control Measure	Positive Effects	Negative Effects
Reservoir	-Lessen flood peak discharge -Increase in discharge in dry period by regulation -Recharge of groundwater -Stabilization of maintenance flow -Decrease in sediment load	-Increase in evaporation -Decrease in discharge in dry period by impounding -Increase in infiltration loss -Preclude of fish migration -Exaggeration of river channel erosion
Retarding basin	-Lessening of flood peak discharge -Recharge of groundwater -Decrease in sediment load	-Increase in evaporation -Increase in infiltration loss -Exaggeration of river channel erosion
Channel improvement	-Mitigation of submergence -Removal of impediment for flow -Secure of flow depth	-Increase in flow velocity -Increase in peak discharge in the downstream reach -Heightening of flood water level due to backwater -Impingement of river morphologic tendencies -Deterioration of the environment for riverine habitat -Ease the intrusion of saline water
Diversion (weir)	-Maintenance of water level in low flow period -Lessening of flood peak discharge -Increase in soil moisture by the diverted water -Impediment for saline water intrusion	-Heightening of flood water level in the upstream reach -Decrease in discharge in dry period -Preclude of fish migration
Floodway	-Lessening of flood peak discharge -Mitigation of submergence	-Impingement of river morphologic tendencies
Shortcut	-Increase in discharge in dry period -Stabilization of river channel	-Increase in downstream flood peak discharge -Increase in flow velocity

Table 3 Effects of Each Component (Control of Land Use)

Land use	Positive effect	Negative effect
Slope of mountain	-Slope stabilization works mitigate landslide, mud and debris flow and incidentally lessen sediment load	-A cut of slope trigger landslide and collapse of slope to increase sediment load
Forest	-Mitigation of surface erosion -Lengthening of the time of concentration to decrease peak discharge	-Increase in evapotranspiration
Agricultural land	-Increase in drainage capacity	-Increase in evapotranspiration -Increase in surface erosion -Increase in storm water discharge -Deterioration of draining water
Pasture land	-Mitigation of surface erosion -Increase in drainage capacity	-Increase in evapotranspiration -Deterioration of drainage water -Increase in storm water discharge
Marshy land	-Decrease in flood peak discharge -Provision of habitat for aquatic life	-Increase in evaporation loss -Increase in infiltration loss
Urbanized land	-Improvement of the efficiency in water supply	-Increase in water consumption -Increase in storm water drainage -Deterioration of drainage water quality -Decrease in the habitat for natural life

2.6.2 Principle of Common Property

(1) Water resources and hydrology

Precipitation water received at a land surface may partly infiltrate into deeper soil and another part may evaporate into the space directly. However the remaining substantial part thereof moves downward along the land surface as a runoff. Water thus concentrated in a depressed area form a stream, hamlet or pond. Partial evaporation and infiltration occur during the course of concentration or flowing in a stream and the retention in a pond. Meanwhile the exudation or spring out of water once moistened the soils supplement the water in the stream and pond. The water in the stream flows from upstream to downstream joining the waters from other tributaries to meet the main river. The Mekong river crosses the borders among 6 different countries until it empty itself in the South China sea. This hydrologic mobility of water is one of the conspicuous attributes of water as a natural resource.

(2) Stakeholders

The river water is one of the properties of the peoples and ecological lives in the river basin. According to the provisions of water or water resources laws, the state represents the peoples in the river basin to manage the water resources in all the riparian countries along the Lower Mekong River. The stakeholders of the water resources of the lower Mekong river basin are defined to be all the relevant States of the riparian countries and ecological lives in the basin.

(3) Logical appropriateness of the Principle

There is no arbitration in the assertion that water is the basic human needs and that everybody has right to utilize it freely if the utilization thereof does not cause any significant harmful effect to others. These understandings are the virtual basis for the principle that water resources are a common property of the related human beings and ecological lives. The Principle is provided in Articles of the Helsinki rule, the Draft Agreement of International Law Commission of the United Nations and the Protocol of the International Conference of the Association of Law (United Nation).

Following deliberation on the hypothetical example may interpret logically the appropriateness to adopt the Common Property Principle, which is tend to be accepted intuitively, in the management of the water resources of an international river basin;

A water balance of total inflow to the territory less total out flow therefrom (expressed by B) in a territory may be a synonym of the property of the territory as the available water resources if this understanding does not cause any harmful effect to others. Where the water balances of the territories 2 and 3 (B2 and B3) in the figure shown below are given by the following formulae along line with the simplified Equation of Continuity;

$$B2 = O1 + T2 - E2 - L2 - O2$$

$$B3 = O2 + T3 - E3 - L3 - O3$$

Where;

O1 : Inflow from the upper-reach

O2 : Compulsory discharge to downstream for the ecological lives as stakeholders

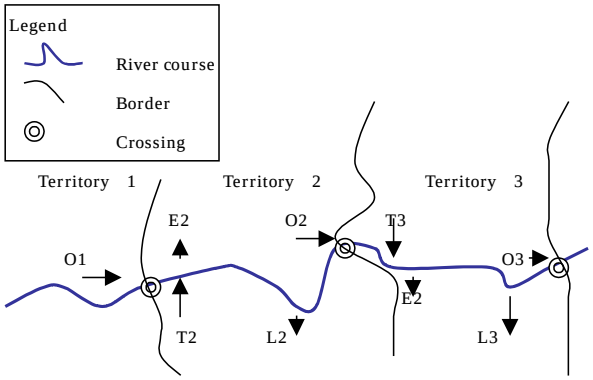
O3 : Compulsory discharge to downstream for the ecological lives as stakeholders in addition to the politically defined required discharge

T2 and T3 : Inflow from tributaries

E2 and E3 : Evaporation and transpiration

L2 and L3 : Infiltration and other loss

Where *L* do not include any manmade loss because a manmade loss shall be born from the property of a territory. Accordingly *L* accounts only the natural losses in this discussion.



Conceptual Illustration for Water Balance

Fig. 3 Conceptual Illustration of Water Balance

The formulae presented as above generate the following formula

B2 = O1+ K2+ K3- O3- B3

Where

K2 = T2- E2- L2, K3 = T3- E3- L3

In the naturalized condition, runoff, evaporation and infiltration depend on the natural conditions of the territory and O1, K2 and K3 are the given conditions depending on the inherent natural features of the river basin and O3 is given condition as well since it is defined in advance. And the formula manifest that the water balance of a territory (B2 or B3)is depending on one of the other territory (B3 or B2). In other word, B2 and B3 fall on the relation of tradeoff and to assert a certain amount of property in a territory is prejudicial to the other property. A given natural conditions in both territories designate the overall property for both territories. Along this line, water resources should be considered to be the Common Property of both territories. And the allocations thereof to territories should be carried out in line with the equitable use principle.

The balance may be utilized or consumed in a territory as its property. In case of wet season, however, the balance in a territory frequently exceeds what is required for consumptive use therein. The excess water flow down the river channel and crosses the border into the next territory. The next territory receives the water transgressed the border without any impediment because the water is a property of the territory as well.

2.6.3 Principle of Reasonable Water Use

A use of water resources should take account of the hydrologic behaviours of water resources, economic effectiveness, and technical appropriateness if the use be reasonable. The

followings are several substantial subjects to be deliberated to formulate a reasonable water use rule.

(1) Variability in water resources between years

The available water resource varies from year to year depending on the meteorologic and hydrologic conditions of the river basin. The "n" in the following equation represent the variability;

$$X = M + n \cdot б$$

Where

X *average flow in a year*

M *mean of average annual flow*

n *index showing distance from the mean*

б *standard deviation*

In hydrology, various probabilistic distributions are introduced in the analysis of the water resources such as Pearson Ⅲ type distribution, Iwai distribution and others. In order to simplify the discussion, however, the normal distribution is assumed in the following deliberation because the objective of the discussion is not to assess the values of the average and the standard deviation. The objective of the discussion is to confirm the relative differences in various variabilities in terms of "n" of an event.

The following Tables show the estimated "n"s on the basis of the data recorded at Pakse with a catchment area of 545 000 km^2 and with a long recording period of 40 years from 1961 to 2000. The figures may represent the hydrologic features of the Lower Mekong River basin since Pakse is located at the middle reach of the LMRB. In the following tables, while April is the lowest, September is the month when the flow becomes highest. The estimated coefficient of variability for April, September, and annual flows fall in the narrow range between 0.15 and 0.21. The similar coefficients of variability in the different months shown above indicate that flows in April, September and annual fluctuate within similar distances from the relevant average flows on an average although they are not necessarily synchronous.

Table 4 Static Parameter

Parameter	Unit	April	Sept.	Ann.
Mean	m^3/s	1,819	26,225	9,741
St. Deviation	m^3/s	271	5,581	1,473
Coefficient of Variability	-	0.15	0.21	0.15

The average annual flow in 1978 of 12677m3/s was the maximum at Pakse. Meanwhile that of 1998 of 6877 was the minimum. The average annual flow of 9797m3/s was the closest to the mean annual flow of 9741m3/s. The ns in the following table show the variability of the average annual flows in those years together with those of April and September.

Table 5 Flow Variabilities

Year	Unit	April	September	Ann.
1978 (maximum)	m3/s	1,795	32,333	12,677
	n	- 0.09	1.09	1.99
1973 (average)	m3/s	1,751	32,207	9,797
	n	- 0.25	1.07	0.04
1998 (minimum)	m3/s	1,881	20,111	6,807
	n	0.23	- 1.10	- 1.99

The annual average runoff has showed the variability of almost ±2σ within 40 years.

(2) Variability in water resources within years

The river flows fluctuate from month to month and form the wet to dry periods as shown in the table presented as above and the following figure.

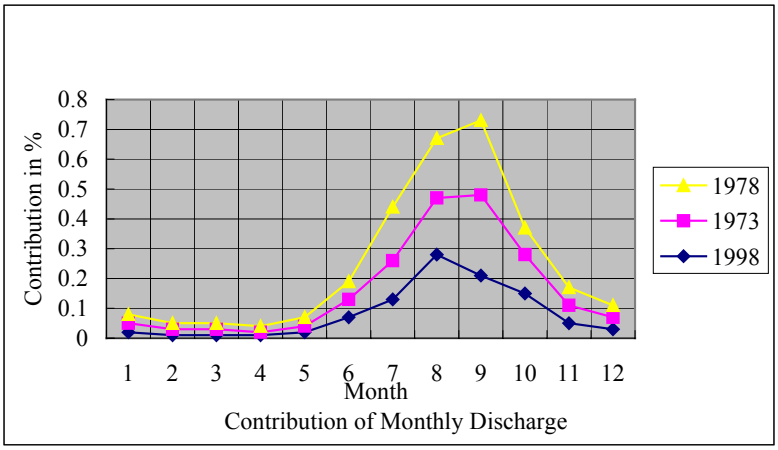


Fig. 4 Contribution of Monthly Discharge

The fluctuations in dry period might be the first concern in water utilization. Meanwhile that in wet period affects flood. The fluctuations in the dry period appear small as compared with that in wet period. Actually the contributions of flows in April, the lowest month, to annual flows are 1 to 2% regardless the magnitude of annual flow as follows:

1978 maximum average annual flow of 12,677 m^3/s: 1%

1973 approximately mean of AAF of 9,797 m^3/s: 1%

1998 minimum AAF of 6,807 m^3/s: 2%

Consequently it seems natural that there are a considerable difference between n of April and that of the average annual flow. However, in 1973, the contribution of the flow in September to the average annual flow is 27%, which is far larger than that of April of 1%. Nevertheless the difference in the

n of September from the n of average annual flow is as large as 1.03, which is larger than the difference of April of 0.29.

The second table shown as above presents the different figures of "n" of April. The ns fall in the wide range of 0.23 and –0.25 although only three years are in question. The flows at Pakse in April fluctuate from 1282 m^3/s to 2427 according to the recorded data in the 40 years period from 1961 to 2000. The parameters and statistics estimated are as follows:

The statistical parameters: M = 1819 m^3/s, σ = 271 m^3/s and C = 0.15

Table 6 Flow Variability in April

Magnitude	Year	Flow (m^3/s)	n
Maximum	2000	2427	2.24
Average	1991	1827	0.03
Minimum	1963	1282	-1.98

(3) Variability in water resources along the river stretch

The flow of a river at a site is more or less dependent on the flow at adjacent up-and downstream sites along the stream. The influences of the flows in the adjacent sites are, however, partial and stochastic because of the noise from the remnant catchment areas. The river flows recorded at Chiang Saen, Vientiane and Pakse may be an example to show this stochastic behaviour of river flow. The following table present the statistics of the flow at each sites;

Table 7 Statistics (April)

Item	Chiang Saen	Vientiane	Pakse
Catdhment area (km^2)	189,000	299,000	545,000
Average monthly runoff (m^3/s)	915	1,194	1,819
Standard deviation (m^3/s)	127	168	271
Recorded years	39	40	40
Coefficient of variability	0.14	0.14	0.15

It should be noted that the estimated coefficients of variability of all the sites fall in the extremely narrow range of 0.14 and 0.15. Eventually, if the influence of deterministic part is significant and the period of the occurrence of noise is synchronous, n of each site should appear to be the similar figure.

The following table enunciates the flow variability along the river in the month of April.

Table 8 Variability Along the River

Magnitude of flow	Unit	Chiang Saen	Vientiang	Pakse
The 2nd maximum at Pakse (1997)	m^3/s	1,012	1,119	2,402
	n	0.76	-0.40	2.15
Average at Pakse (1991)	m^3/s	1,051	1,274	1,827
	n	1.07	0.48	0.03
The minimum at Pakse (1963)	m^3/s	642	969	1,282
	n	-2.15	-1.34	-1.98

The "n" of the same event varies from site to site as can be seen in the table shown above. This indicates that the noise from remnant catchment area is significant and the occurrences thereof are not synchronous. A reasonable water utilization rule should account this variability to secure the equitability among the riparian countries.

Likewise, the assessment of occurrence probability of hydrologic features is necessary to define the wet and dry seasons, which are stipulated in Article 5 of the Mekong Agreement. In this connection, to assess the occurrence probability of flow exceeding the annual average is crucial because the Agreement provides water use dividing a year into two seasons. The following figure shows the frequency in % of each average monthly flow exceeding the average annual average at Pakse. In this figure 100% means that all of the average monthly flows in 40 years exceed the average annual flow of 9741 m^3/s. A certain month, say June, may have both years of exceeding and not exceeding. In case the exceeding is 16 years out of whole recording period of 40 years, the frequency is defined as 40%.

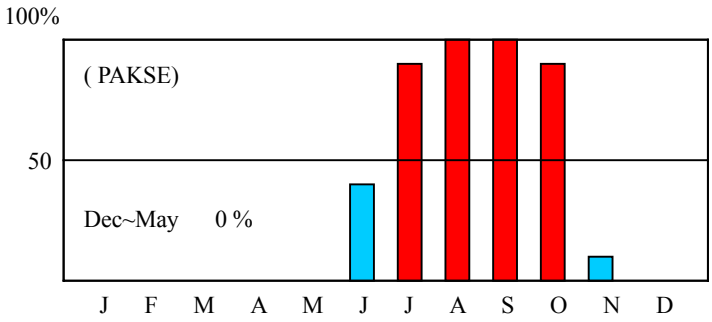


Figure Frequency in % of Monthly Flow Exceeding Annual Average

Fig. 5 Frequency of Monthly Flow Exceeding Annual Average

As can be seen in the figure, the average monthly flows of more than 50 % or in more than 20 years out of 40 years exceed the average annual runoff of 9741m3/s in the months of July, August, September and October. If the criteria to define a season adopt 50% or more, the month in the wet season turn to be the series of months enumerated as above. There might be other criteria to adopt 30% instead of 50% or to adopt mode or median in stead of average annual flow or other flow. The objective of definition is a key factor for the criteria.

Further, the actual start of a season varies from site to site since the Lower Mekong river basin extends from the area with latitude lower than 10 degree to the area of more than 20 degree. Accordingly the definition of the basin wide seasons requires taking account of spatial variability of season.

(4) Naturalized flow and effective rainfall

The recorded flows are eventual results of human activities such as diversion for irrigation, return flow thereof, retention in a storage dam or discharge therefrom. The water resources in natural condition should be the basis to contemplate the management and utilization rule of water. Naturalization of manipulated flow data may be necessary prior to materialize them for the formulation of water utilization rule. In general it is difficult to obtain pure

natural flow since human activities are extensive and most of river basins have been developed. Hence the water use records are necessary to estimate the natural flow on the basis of the observed flow.

In this respect, the Agreement on the use of the Nile River signed between Sudan and the UAR in 1950 is suggestive. The Agreement provides that the flow records before 20th century are assumed to be the natural flow and these thereafter shall be subject to the naturalization processing.

In most case the evapotranspiration in an existing manmade farmland should be supposed to be the natural hydrologic phenomenon.

(5) Optimization of water use

The water resource is variable in time and space as discussed in 1 through 3. The water utilization rule should reflect the probability theory to be reasonable. And an introduction of occurrence probability in the water utilization rule may, eventually, have possibility to cause ineffective water discharge in the low flow period when the value of water is high and yet the possible range of "n" is large. A water utilization scheme with the 80% dependability accepts ineffective discharges for 4 times out of 5 for instance. In case the water resources in the upstream reach is rather sufficient and that of the downstream reach is not sufficient, water use in the upstream reach under rigid water rights may worsen the situation in the downstream reach through over consumption, over storing and diversion. On the contrary, in case the water is not sufficient in the upstream reach, the rationalized storage or diversion may cause ineffective spill out from the down stream reach. A reasonable rule should afford the optimum use of water especially in low flow period minimizing ineffective discharge. The effects of optimum use of critical water resources are summarized in the following table:

Table 9 Optimum Use of Water Resources in Critical Case (1)

Case	Action	Effects
Upstream reach: Just sufficient Downstream reach: Not sufficient	Upstream reach: Rationalize use, Store and divert	Upstream reach: Decline dependability Downstream reach: Not worsen water shortage
Upstream reach: Not sufficient Downstream reach: Sufficient	Upstream reach: Use, store and divert to the maximum (?) extent	Downstream reach: Minimize ineffective spillout

(6) Adaptable rule

As reiterated, flow varies from a month to the next, from a year to the next and from a stretch to the next. Consequently the utilization of water in accordance with the provisions of a Rule in a period may be advantageous to a user but disadvantageous to other users in other stretch. Unreasonable control of water use in a stretch may cause ineffective water discharge to the downstream reach

as described above. The Rule should allow the users in the downstream reach to avail the incidental spilled water. And the Rule should be adaptable to the fluctuating flow to compensate the upper stretch user in the next term. In this connection, the imperative is the assessment of water resources in every stretch on the basis of real time monitoring.

Table 10 Optimum Use of Water Resources in Critical Case (2)

Case	Action	Effects
Upstream reach: Just sufficient Downstream reach: Not sufficient	Upstream reach: Rationalize use, Store and divert	Upstream reach: Decline dependability Downstream reach: Not worsen water shortage
Upstream reach: Not sufficient Downstream reach: Sufficient	Upstream reach: Use, store and divert to the maximum (?) extent	Downstream reach: Minimize ineffective spillout

2.6.4 Principle of Equitable Use

(1) The definition of Equity

Equity means the same amount or balance of right and duty. While the right means the allowable amount (of water) to use, the duty means generation and conservation (of water). The balance is given by the following equation:

B = R – D

Where B: balance

R: right

D: duty (conservation of water)

The following assumption may explain equity simply.

While User A generate 20 m3/s releasing water from a dam, User B consume 10 m3/s, which is considered as the conservation of –(minus) 10m3/s, for irrigation. The equivalent balance in question defines rights as follows;

Table 11 Equivalent Balance

User	Conservation (D)	Right (R)	Balance (B)
A	20 m^3/s	120 m^3/s	100 m^3/s
B	- 10 m^3/s	90 m^3/s	100 m^3/s
Total	10 m^3/s	210 m^3/s	200 m^3/s

The incidental respective rights in this assumption are 120m^3/s for User A and 90 m^3/s for User B.

Conservation is nil in case of naturalized flow and the equivalent division of existing naturalized water less water to protect environment gives the rights for each user.

(2) Equitable right on naturalized flow

Since water flows along river channel, water flowing at a section, is to appear in the next stretch as discussed in Common Property if it is not tapped during its travel. Along this line, the people living in the downstream reach area may claim the ownership of the water in the upstream reach. On the contrary, the people in the upstream reach may claim the even ownership of the water in the downstream reach. In the light of this, the rights on the travelling water of the peoples in up- and downstream areas should be equivalent.

In connection to this, water in a tributary that join with the water in the main stream at the confluence is controversial because the tributary water do not flow in the upstream reach therefrom. May the people living in the upstream areas claim the ownership over the water of such tributaries? If a tributary discharges plenty of water to the main stream, the people in the upstream area may consume much water without prejudicing the needs of the people in the downstream area. Consequently, the right of the people in the upstream area should be designated taking account of the amount of the tributary water. In the light of this, it is recommendable to adopt the principle that water utilization rule should be such that grant the equivalent water utilization right to the peoples in the up- and downstream areas no matter how the water in the main stream or in tributary. The principle divides the waters in both mainstream and the remnant catchment area equivalently to allocate them to all the people. The principle of equivalent share might be effective to share the floodwater equivalently.

The following figure shows the appeared available naturalized water for each stretch assuming the same required water for each stretch to conserve ecological lives.

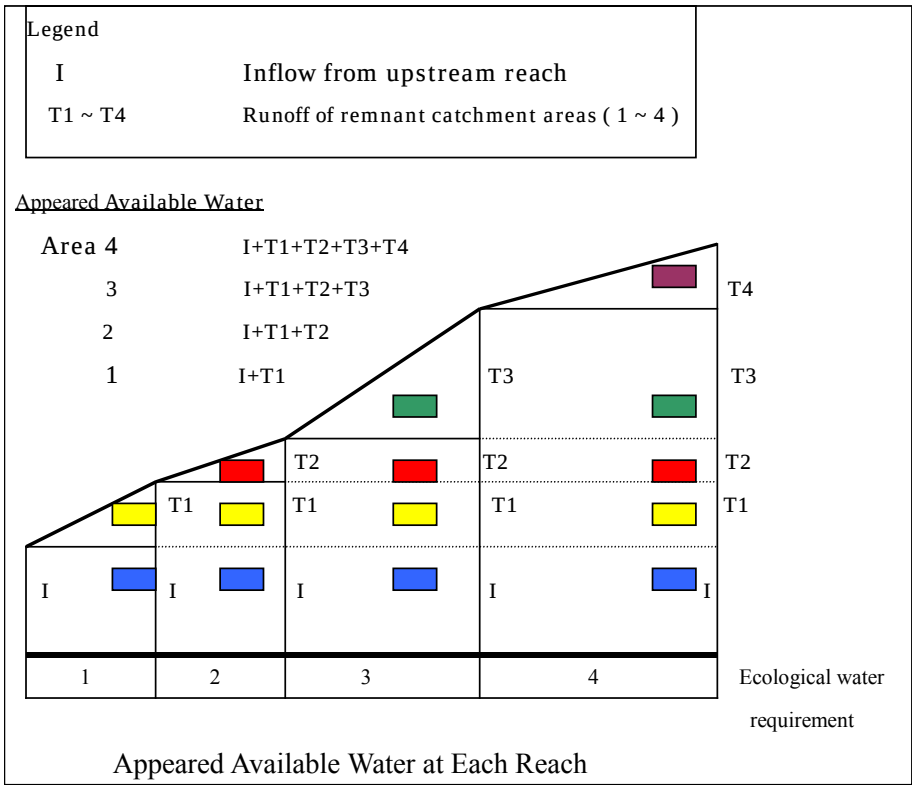


Fig. 6 Appeared Available Water at Each Reach

The available water at the stretch 3 appears to be I+T1+T2+T3. It should be, however, noted that I, T1, T2 are the water to be accounted for as the available water in the upper stretches. The river stretch 4 may claim the share of I, T1, T2 and T3 as well. The principle of Equitable Water Use, therefore, is to divide I, T1, T2, T3 and T4 into four according to the agreed proportions. In the case of the most simple proportions of 1 : 1 : 1 : 1, the shares of each stretch become the same amount of one fourth of (I+T1+T2+T3+T4) or 0.25 · (I+T1+T2+T3+T4). In this respect, the amount expressed by I+T1+T2+T3+T4 is the appeared available water in the 4th stretch under the condition that the ecological water demand is same through out the stretches. If the ecological demand in a stretch varies one another, the maximum demand may govern the actual available water but the appeared available water in the last stretch is the key factor to designate the equivalent right of water utilization. The procedure mentioned above should be referred to in the adoption of guideline to define the locations and levels of flow pursuant to the provision in Article 6 of the Mekong Agreement.

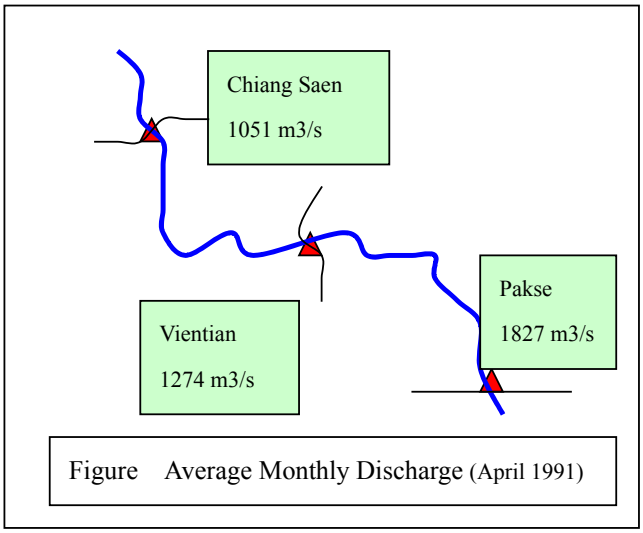


Fig. 7 Average Monthly Discharge (April 1991)

The average monthly discharges recorded at Chiang Saen, Vientiane and Pakse are 1051, 1274 and 1827 m3/s in April 1991. The said equitable rights for two areas extend between Chiang Saen and Vientiane and between Vientiane and Pakse are to be obtained as follows assuming that the recorded discharges are naturalized flow, the proportion to allocate is 1:1 and the water use in the area in the downstream from Pakse is none.

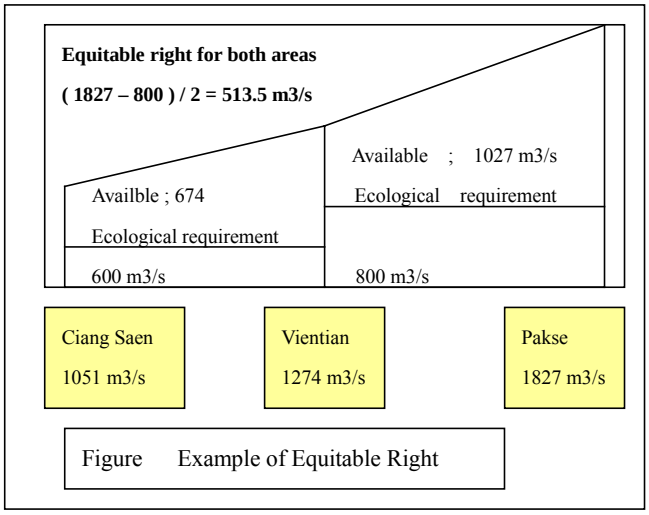


Fig. 8 Example of Equitable Right

Assuming that the ecological requirement is 600 m3/s in the upper area and 800m3/s in the down stream area, the appeared available waters are 674m3/s and 1027m3/s for the upper and down stream areas respectively. Because the total discharge in the upper stream area is 1274 m3/s and that in the downstream area is 1827 m3/s including the runoff from the respective remnant catchment areas. However it should be noted that a considerable parts of the appeared available flows are double accounted in the both areas. For instance the inflow from Chiang saen of 1051 contributes both the flows of 1274 at Vientian and 1827 at Pakse. It might be natural for both areas to share

at least this amount evenly along the principle of common property as discussed in 2.6.2 in this paper.

The figure shown above explains the example of the equitable right.

The equitable water right is given as 1,027 ÷ 2 = 513.5 m^3/s for both upper and downstream areas. The upper stream area is not allowed to utilize the appeared available water of 674 m^3/s and the area shall reserve and release the water of 160.5 m^3/s to the downstream area. The use of water of 513.5 m^3/s in the upstream area affords the down stream area to use the same amount of 513.5 m^3/s. The flow to be maintained is 760.5 m^3/s at Vientian. The maintained flow insures the flow of 1313.5 m^3/s in the downstream reach from Vientian together with the inflows from tributaries. In the downstream area, the water of 1,274 m^3/s among the discharge of 1827, comes from upstream reach. The same processing might be necessary to comply with the stipulations in Article 26 of the Mekong Agreement that the Water Utilization Rule shall include the maintaining flow level requirement at each station. The water use provided by this processing procedure might secure the optimum use and maintain the required levels of flow in equitable manner except the historical drought case.

(3) Proportion

The international frameworks for management of an international river, recommend taking the drainage area, population, hydrologic conditions, existing use and etc into consideration to define the proportions of shares. In this respect, multi-disciplinary evaluation procedure may act an important role.

(4) Increment of right by water generation

Those who succeeded in increasing flow by certain water generating measures as a water conservation, may increment the right accordingly. The activity to conserve water resources should be assessed enumerating the possible water generating effect. The increment of the water right should reflect the equity in balance of right and duty.

(5) Assessment of equity

In order to utilize water optimal, a special organization to assess the available water at strategic points is necessary. The Agreement mandates the MRCS to carry out planning and implementation of projects. And it might be convenient if the MRCS could have such organization and function.

(6) The Protocol of the Samur River, an example of reasonable and equitable water use

The protocol agreed by Azerbaijan and Russia in October 1967 may be one of the good examples of agreement of reasonable and equitable water use. The protocol defines the shares of water use to the riparian two countries in its provision at their intake site for the case of the 4-year drought on the basis of the data recorded in a long year period. It defines each average 10-day shares starting from January 1st to December 31st. It provide the monitoring site of river flows about 50 Km upstream from the intake sites. It provide that the proportion of the designated shares shall be applied in the case that the monitored flow is other than that of 4-year drought.

The intake sites of both countries are located at just upstream from the delta of the river towards Caspian Sea. The protocol defines the average shares proportional to the areas of delta belong to the territories as the beneficiaries of water and victims of the flood damages.

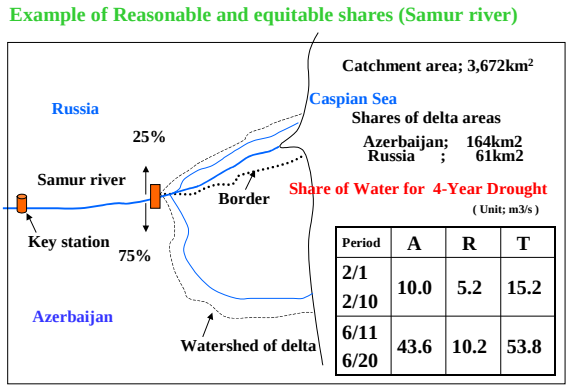


Fig. 9 Example of Reasonable and Equitable Shares (Samur River)

The Protocol defines the shares on the 4-year drought however it prescribes to apply the same proportions to other hydrologic conditions considering the uncertainty. It affords adaptive operation because it provides that the actual shares are defined on the basis of the flow observed at the designated monitoring station.

The shares in the period from February 1 to 10 are 10 m^3/s for Azerbaijan and 5.2 for Russia. The difference in the shares is the smallest in a year. Meanwhile, that of June 11 to 20 are 43.6 - 10.2. The difference of the shares is the largest.

The provisions of the protocol aim equitable use and define the shares proportionally to the draining areas.

2.6.5 Principle of Sustainable Development

(1) The conceptual definition of Sustainable Development

Sustenance means continuation or keeping of a situation without changing. Meanwhile development means some sort of improvement or enhancement of welfare. In the light of this, the sustainable development of the river basin envisions continuous improvement of the economy, society, environment and culture of the river basin. The water utilization rule should contribute to the river basin by enhancing the welfare through economic development, social development, environmental development and cultural development continuously.

(2) Logical definition of Sustainable Development

A decision and subsequent implementation of development scheme affects the situations of various fields. There may be positive effects to a field and negative ones to another field as well. Further the effect may change as the laps of time. There is a case that a positive effect in a time turns to negative in

the next. The river basin development plan is a comprehensive development plan that integrates those schemes. Consequently the total benefit (B) to be accrued by a river basin development plan is given by the following formula;

$$B(t) = \Sigma W(i, j, t)$$

Where;

B (t): comprehensive and integrated net welfare or benefit of a river basin development plan at time t

W (i, j, t): net welfare of i-th scheme in the j-th field as a component of river basin development plan at time t

The Sustainable Development Plan should increase B (t) along the inclement of time t in line with the conceptual definition as discussed in the previous section. Since the benefit in future is to be discounted, the differentiation of the discounted benefit should be positive. Subsequently the following equation is introduced as the logical definition of the Sustainable Development Plan;

$$d\{ B(t)/ (1+r)^t \} / dt \geq 0$$

Where; r : discount rate

In this addition, the reasonable water use shall afford the optimum utilization of water. The optimum use is to maximize the welfare to be accrued from the water use. Subsequently, the optimum sustainable development by water use may be defined as Max.Σ B (t).

2.6.6 Principle of Risk Management

(1) The conceivable hazard

A flood is a typical hazard to be induced by river flow. In this addition, there are several hazards, which are susceptible to the quality and quantity of river flow. The following table summarizes the conceivable risks.

Table 12 Water Related Hazard and Cause (Quantity)

Object	Condition	Hazard	Cause	Note
Quantity	Exceeding	Flooding and inundation	Land use	Both up- and downstream reach areas
		Surface erosion	Land use	Erosion and silting
		Slope collapse and debris flow	Land use	Land use in slope
		High flow velocity	Channel slope	Difficulty in navigation and destruction of channel
	Deficit	Shortage	Land use	Both up-and downstream reach areas
		High saline concentration	Land use	
		Stream impediment	Silting	Flow and navigation

Table 13 Water Related Hazard and Cause (Quality)

Object	Condition	Hazard	Cause	Note
Quality	Exceeding	High sediment	Land use	
		Concentration of chemicals	Land use and treatment	Return flow and drainage water
		Toxic matters	Treatment	Mal operation
	Deficit	Oxygen	Treatment	

A special organization may be necessary to implement risk management along line with water utilization rule under the MRCS.

(2) Risk management and disaster mitigation

The objective of risk management is to abate the damage to be incurred by natural and man made disasters. Damage may be partly recovered by insurance. Imputing of damage to insurance is one of the options of risk management. However the substantial risk management should be an activity to mitigate disaster. The magnitude of a disaster is the result of the magnitude of hazard and the vulnerability of the society against the hazard. A lager hazard incurs a larger disaster. Meanwhile if the region is more vulnerable against hazard, a hazard with same magnitude liable to entail more significant disaster. On the contrary no disaster is to be incurred by a considerable magnitude of landslide if the area is not utilized at all. Likewise, no disaster occurs in a developed area located at the foot of mountain slope, if no landslide nor mud and debris flow occur. Consequently the following formula to define the magnitude of disaster is introduced:

$$D = H \times V$$

Where;

D ***magnitude of disaster***

H ***magnitude of hazard***

V ***vulnerability of the society against hazard***

A risk management is, therefore, to mitigate the disaster through the mitigation of hazard and / or vulnerability.

(3) Component of disaster mitigation

As mentioned above, disaster mitigation comprises the mitigation of hazard and the mitigation of vulnerability. The structure of risk management activities for flood is illustrated below.

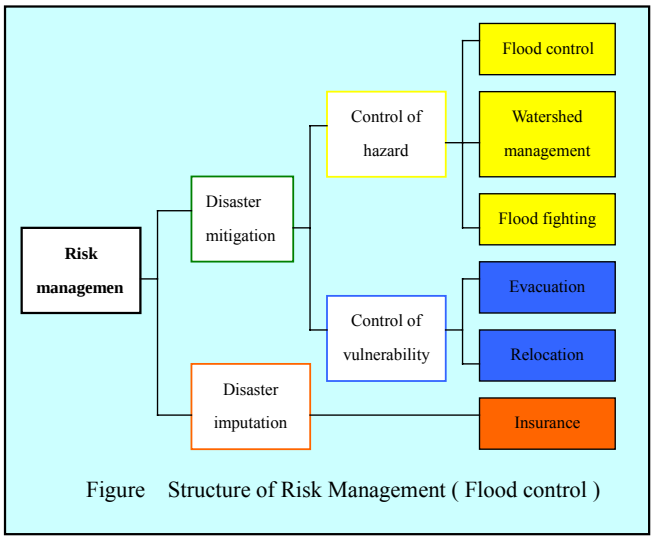


Fig. 10 Structure of Risk Management (Flood Control)

(4) Key issues of disaster mitigation

The formulation of water utilization rule should contemplate hazards and counter measures in line with risk management concept. The conceivable counter measures and the impacts thereof are discussed below;

(a) Flood disaster mitigation

The common measures to control flood are to provide dam, retarding basin, river improvement and floodway. The provisions of those works require lands of a considerable area otherwise be used for production. And restrictions of area for a retarding basin and a river channel are liable to the increase in flood water levels in the up- and down stream reaches. A floodway often causes increase in flood discharge in the down stream reaches if it is a shortcut. The flow regime in the downstream reach may be affected to some extent even in low flow period by the change in land use and the operations of those facilities.

The vulnerability against flooding is mostly due to the human activities in flood prone alluvial plain. The relocation such activities from the flood prone areas are the most complete measure to control the vulnerability if it is affordable. Temporary evacuation from the area is another option although to be saved by this measure is limited to human life and movable assets. Evacuation do not cause any effect to the river flow in other stretch, however relocation may affect the flow regime in the

downstream reach especially in low flow period by the change in land use. The possible impacts of disaster mitigation for flood are summarized in the following table.

Table 14 Possible Impact of Flood Disaster Mitigation

Control	Measure	Impact	Cause
Hazard	Provision of retarding basin and river channel improvement	Increase in flood discharge in the downstream reach or in flood water level in the upstream reach	Restrictions of areas in retarding basin or river channel
	Shortcut	Increase in flood discharge in the downstream reach	Increase in discharge by a shortcut
	Watershed management	Change in flow regime in the downstream reach	Change in land use
Vulnerability	Relocation from flood prone area	Change in flow regime in downstream reach	Change in land use
	Evacuation	None	-

(b) Surface erosion disaster mitigation

Intensive land use is often the cause of exaggerated surface erosion. The eroded surface may decrease the retention capability of water, which will change the flow regime in the downstream reach. Meanwhile the changes in the vegetation affect the flow regime in the downstream reaches through the change in the evapo-transpiration. The eroded materials tend to silt in the river channel.

Watershed management mitigates the surface erosion through the conservation of watershed. The possible impacts of disaster mitigation for surface erosion are summarized in the following table.

Table 15 Possible Impact of Surface Erosion Disaster Mitigation

Control	Measure	Impact	Cause
Hazard	Change in land use	Change in flow regime in the downstream reach	Changes in the water retention in soil and in evapo-transpiration
	Watershed management	Scouring of river channel or alleviate the aggravation of riverbed	Decrease in the sediment supply
Vulnerability	Relocation	Change in flow regime in the downstream reach	Changes in the water retention in soil and in evapo-transpiration

(c) Slope collapse disaster mitigation

The common measures to protect slope are to provide retention wall, anchor, drainage system if a slope is susceptible of land slide and if it is located at a river side, revetment works are common measures to protect the slope. Sand pocket, sabo dam, groundsill and drop are effective to

control the magnitude of mud and debris flow hazard. Those works more or less occupy productive lands and bring change in the flow regime in the downstream reach. The works decrease the sediment load in the downstream reaches as well.

The vulnerability against slope collapse is mostly due to the human activities in disaster prone mountain slope and alluvial fan because the area is fertile next to the delta and alluvial plain. The relocation such activities from the disaster prone areas are the most complete measure to control the vulnerability if it is affordable. Temporary evacuation from the area is another option although to be saved by this measure is limited to human life and movable assets. Evacuation do not cause any effect to the river flow in other stretch, however relocation may affect the flow regime in the downstream reach especially in low flow period by the change in land use in the mountain slope and alluvial fan. The possible impacts of disaster mitigation for slope collapse disaster are summarized in the following table.

Table 16 Possible Impact of Slope Collapse Disaster Mitigation

Control	Measure	Impact	Cause
Hazard	Sabo works and revetment works	Scouring of river bed	Decrease in sediment supply
	Sabo works	Change in flow regime in the downstream reach	Change in land use
Vulnerability	Relocation	Change in flow regime in downstream reach	Change in land use
	Evacuation	None	-

(d) High flow velocity disaster mitigation

Deterioration of river channel due to high flow velocity is discussed in the disaster of slope collapse. Extremely high velocity of river flow impedes navigation. The occurrence of such flow is not so frequent and the construction of ship lock may not be justifiable. The measure to mitigate the disaster may be evacuation by mooring and to wait until the flow velocity become normal.

This control of vulnerability incurs no impact at all in relation to water utilization.

(e) Water shortage disaster mitigation

During the low flow period, water shortage may occur at some reaches along the river. The disaster is the first concern of water resources management. A conceivable and the most common measure to mitigate the disaster is to control of flow volume supplementing water by dam and reservoir as a control of hazard. The releasing water from a designed retarding basin has the same effects. Some sort of change in land use by watershed management is effective to increase the dry period runoff through increasing the water retention capability of soil.

Control of vulnerability with this regard is effective to mitigate the disaster as well. Change of land use in the upstream reach areas from the site in question might solve the problem if the changed land use decrease water demand therein. Likewise, the change of land use in the site to reduce water demand might be another solution. Further, dissolute water use is frequently the main root cause of the vulnerability of the society against the disaster. In this case, rationalizations of yield of the water use in the upstream area and the site in question are effective options to mitigate the disaster. The following table summarizes the possible impact of the water shortage disaster mitigation.

Table 17 Possible Impact of Water Shortage Disaster Mitigation

Control	Measure	Impact	Cause
Hazard	Water release from dam and retarding basin	Scouring of river bed	Sediment trap by reservoir and retarding basin and the control of erosion
	Watershed management	Change in runoff regime	Land use change by watershed management
Vulnerability	Change in land use (decrease water demand)	No adverse impact (decrease in demand)	-
	Rationalize yield	No adverse impact (rational use)	-

(f) Salinity intrusion disaster mitigation

High concentration of salinity is damageable for a certain water use. The causes of salinity are water shortage and high tide. The water shortage problem might be solved by means of releasing water from a reservoir or retarding basin. A estuary barrage may protect saline water intrusion. However the provision of river crossing structure may cause various problems including uncertainty in case of the Mekong River. Consequently the barrage option should be discarded.

Meanwhile, the change in land use durable against the saline water can be an option for the disaster mitigation. The reduction of water consumption in the upstream area is another option to secure water in the downstream reach sufficient to flush the saline water. The possible impacts of saline water disaster mitigation are summarized in the following table.

Table 18 Possible Impact of Saline Water Disaster Mitigation

Control	Measure	Impact	Cause
Hazard	Increase flow by Dam	Scouring of river channel	Sediment trap
	Increase flow by Retarding basin	Scouring of river channel	Sediment trap
Vulnerability	Change in the land use in upstream area	None	-
	Change land use to be durable to salinity	None	-

(g) Stream impediment disaster mitigation

Low velocity of flow due to low water tends to deposit sediment in the river channel especially in the downstream reaches because of low traction force. Such sediment is liable to be impediment for river flow and navigation. To remedy the situation, dredging is the common practice. Dredging work itself does not cause any impact in view of water utilization.

Another counter measure is to abandon the river channel as the controlling measure for vulnerability because the sedimentation is one of river-morphologic phenomena. The following table summarizes the impacts of the mitigation measures.

Table 19 Possible Impact of Channel Impediment Disaster Mitigation

Control	Measure	Impact	Cause
Hazard	Dredging	None	-
Vulnerability	Abandon channel	Flooding in the upper reach	Decrease in drainage capacity

(h) High chemical concentration disaster mitigation

Intensive land use is liable to entail high chemical concentration of drainage water. One of the measures to mitigate the disaster is to control the concentration by providing treatment facility to remove chemicals from disposed water. Concentration may be controlled by dilution. For this purpose, a release of water with a certain amount from upstream reach is necessary.

Change in land use is a measure to control vulnerability in this respect. Different land use may not require such amount of chemicals. The conceivable impacts of mitigation measures are summarized in the following table.

Table 20 Impacts of Chemical Concentration Disaster Mitigation

Control	Measure	Impact	Cause
Hazard	Treatment	None	-
	Dilution	Change in flow regime and water shortage	Reserve water and release of water for dilution
Vulnerability	Change in land use	Change in flow regime	Change in water consumption

(i) Toxic disposal disaster mitigation

The basin habitant avails the Mekong river and its drainage area for multiple purposes. The uses of the people affect the conditions of the river and on the contrary, the conditions of the river affect the life of people sensitively. Some land use in the basin may discharge toxic matters incidentally. In order to mitigate the disaster, the user should

have treatment facility to remove the matter. Dilution is another mitigation measure releasing water reserved for this purpose.

To prohibit such land uses that have the possibility to discharge toxic matters in the catchment area of the River is a measure which controls the vulnerability. A user equipped with duplicated or triplicated emergency facility is allowed to conduct his activities. The conceivable impacts are summarized in the following table for each enumerated measure.

Table 21 Impacts of Toxic Matter Disaster Mitigation

Control	Measure	Impact	Cause
Hazard	Treatment	None	-
	Dilution	Change in flow regime and water shortage	Reserve water and release of water for dilution
Vulnerability	Restriction of land use	None	-

(j) Deficit of oxygen solution disaster mitigation

In the low flow period, the temperature of water becomes high and soluble oxygen decrease. The provision of a facility to expose to air is effective counter measure for water with high COD and BOD. The dilution of high COD and BOD by mixing with newly released water from dam and reservoir is another measure. The conceivable impacts are summarized in the following table for each enumerated measure;

Table 22 Impacts of High COD and BOD Disaster Mitigation

Control	Measure	Impact	Cause
Hazard	Treatment	None	-
	Dilution	Change in flow regime and water shortage	Reserve water and release of water for dilution

(5) Stages of risk management

The time horizon of risk management specifies and classifies the required activities in accordance with the stages shown in the following figure.

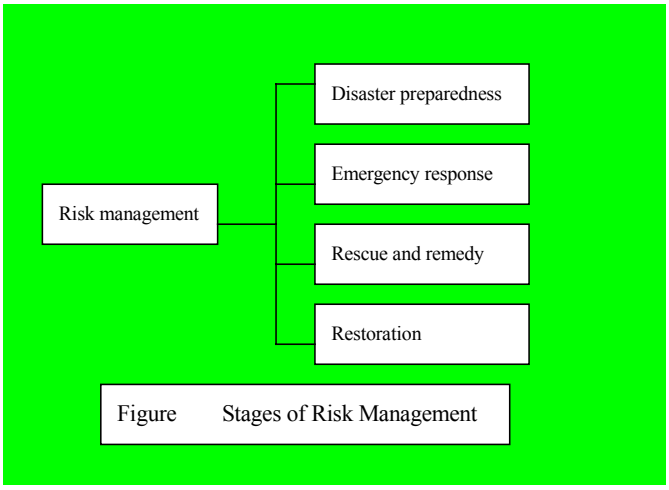


Fig. 11 Stages of Risk Management

Planning, implementation and maintenance of facilities for disaster mitigation are main subjects in the preparation stage. Change in land use is another important subject in this stage as well as the vulnerability control. The operations of facilities such as release from a dam are the main activities in the emergency response stage in relation to water utilization. The activities in other stages have minor relations with water utilization rule.

2.6.7 Principle of Exchange of Data and Information

(1) Draft Procedures for Data and Information Exchange and Sharing

Draft Procedures for Data and Information Exchange and Sharing was prepared and endorsed by the 14th Joint Committee Meeting on 6 July2001 for submission to the 8th Meeting of the MRC Council.

The contents thereof are:

- PREAMBLE
- DEFINITIONSOF KEY TERMS
- OBJECTIVES
- PRINCIPLES
- DATA AND INFORMATION EXCHANGE AND SHARING
- IMPLEMENTATION ARRANGEMENTS
  - * CUSTODIANSHIP OF MRC-IS
  - * REPORTING
- ENTRY INTO FORCE

It follows that the interpretation puts its basis on these Procedures.

(2) Data and information of water resources and their exchange

Water resource is susceptible to hydrology and hydraulics as reiterated. The existence thereof is stochastic and it moves along hydraulics. And yet the use thereof shall be reasonable, equitable and sustainable. Accordingly the exchange and sharing of the data and information of the common property are essential for the water resources management in an international river basin. The main uses of the data and information are summarized in the following table.

Table 23 Use of Data and Information

Objective	Use
Water utilization	- To monitor the reasonable and equitable use - To support the decision making for water utilization - To decide the allowable impounding for reservation in reservoirs - To decide the required release of reserved water
Risk management	- To support flood forecasting and warning - To support mud and debris flow forecasting and warning - To support disaster fighting in an emergency case
Knowledge base	- To support scientific assessment of water resources for better use

(3) Data and information to be exchanged

The Draft Procedures mentioned above specifies the kinds of the data and information to be exchanged and shared by the related countries in its Article 4. The following details of data and information may be high lighted in order to realize the reasonable and equitable use and thereby to achieve sustainable development.

Table 24 Details of Data and Information

Item	Details
Water resources	- Rainfall and other climatic data - Water level, discharge, flow velocity - Water quality, sediment load
Water use	- Agriculture - Municipal water supply - Hydropower generation - Retention and release of dam - Effluent and water quality - Navigation and tourism

(4) Custodianship of MRCS

The Draft Procedures mandate the MRCS the custodian role. The MRCS shall collect and distribute the data and information in orderly manner. The MRCS is further to estimate the naturalized flows at the strategic sites to support the decision making for water utilization by the related countries and for storing in reservoirs working out the Basin Model being developed by the Working Group 1. The MRCS is to support the decision making for the operation of reservoirs to release water therefrom as well. In this connection the Basin

Model is required to have functions and accuracy sufficient to comply with these roles.

2.6.8 Principle of Not Causing Harmful Effect to Others

(1) Provisions in the Agreement

The Agreement stipulate the principle of not to cause harmful effect to others in line with the concept of friendship and cooperation as follows:

Table 25 Principle of Not to Cause Harmful Effect in the Agreement

Article	Provisions
1	The water is managed in a manner to minimize THE HARMFUL EFFECTS that might result from natural occurrence and man made activities.
3	To protect HARMFULEFFECTS resulting from any development plans and uses of water and related resources in the Basin.
7	To make every effort to avoid, minimize and mitigate HARMFUL EFFECTS that might occur to the environment

(2) Conceivable harmful effect

There may be quantitative and qualitative conceivable harmful effects incidental to water utilization as discussed in the principle of risk management. The water utilization rule should provide articles to avoid the conceivable harmful effects. The conceivable quantitative harmful effects are summarized in the following table.

Table 26 Quantitative Harmful Effects

Harmful effect	Cause
Water shortage	Water consumption or diversion exceeding the reasonable and equitable amount without consents of others
	Water retention or storage exceeding the reasonable and equitable amount without consents of others
Flood	Land use enhancement in watershed
	Land use enhancement of natural retarding basin
	River channel improvement
	Excess spill out from dam
Sediment discharge	Land use enhancement in watershed
	Poor management of slopes
	Poor management of river channel
Damage to riverine structures	Scouring of river channel due to sediment trap in reservoir
	Aggravation of river channel due to sediment silting

The conceivable qualitative harmful effects are summarized and presented in the following table.

Table 27 Qualitative Harmful Effects

Harmful effects	Cause
Chemical concentration	Poor effluent treatment
Toxic matters	Poor effluent treatment
High BOD, COD	Poor effluent treatment
High salinity	Water shortage for dilution

(3) Conceivable measures to alleviate harmful effects

An activity in a river basin area may incur harmful effects in other portions of the river basin. A protection works in an area may alleviate the harmful effects in other area. Subsequently, the key issue to alleviate the harmful effects may be cooperation among the related countries in the various facets of the effects. The following table enumerates the measures to alleviate the harmful effects;

Table 28 Measures to Alleviate Harmful Effects

Stage of action	Measure
Protection	Coordination in the conservation and development of river basin. The role of BDP is significant.
	Coordination in comprehensive flood control
	Establishment of rule for dam operation
	Implementation and monitoring of water utilization rule
	Strengthening of organization
Emergency response	Establishment of emergency response organization
	Establishment of information networks
	Establishment of rule and manual for response activities
Rescue and remedy	Agreement and rule on the joint operation
	Establishment of coordinating organization
Preparedness	Establishment of risk managing organization
	Establishment of monitoring networks
	Establishment of rule for the cost sharing for various activities for alleviation

The water utilization rule shall prescribe the definitions of harmful effects, necessary counter measures and reaction to be taken when a water user caused a harmful effect incidentally.

2.6.9 Principle of Cooperation

(1) Cooperation principle stipulated in the Agreement

The Agreement provides the principle of cooperation in its various Articles. Especially, the PREAMBLE of the Agreement highlights the principle as the unique spirit of cooperation in the region. The principles stipulated in the Agreement are presented below.

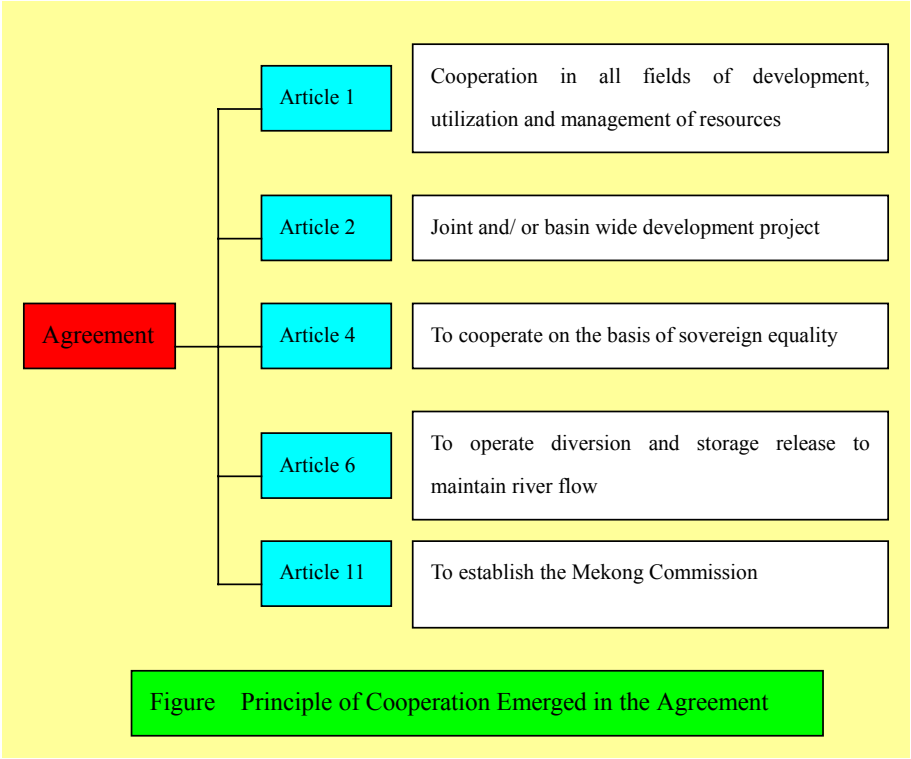


Fig. 12 Principle of Cooperation Stipulated in the Agreement

(2) Effective cooperation

As provided in the Agreement, cooperation may govern the management of the Mekong River Basin. The planning and implementation for development and conservation, the operation and maintenance of the development projects, the risk management including avoidance of harmful effects require the cooperation among the related countries.

A developing project to enhance land use should be planned and implemented not to cause harmful effect to others. The water uses of the project may not cause difficulty and be accepted by others if the implementation and management thereof are jointly carried out and are beneficial to all the participants. The projects to conserve the environment of the river basin are compulsory activities of the whole countries and shall be implemented with the cooperation of all. The main fields and activities requiring cooperation are illustrated as follows:

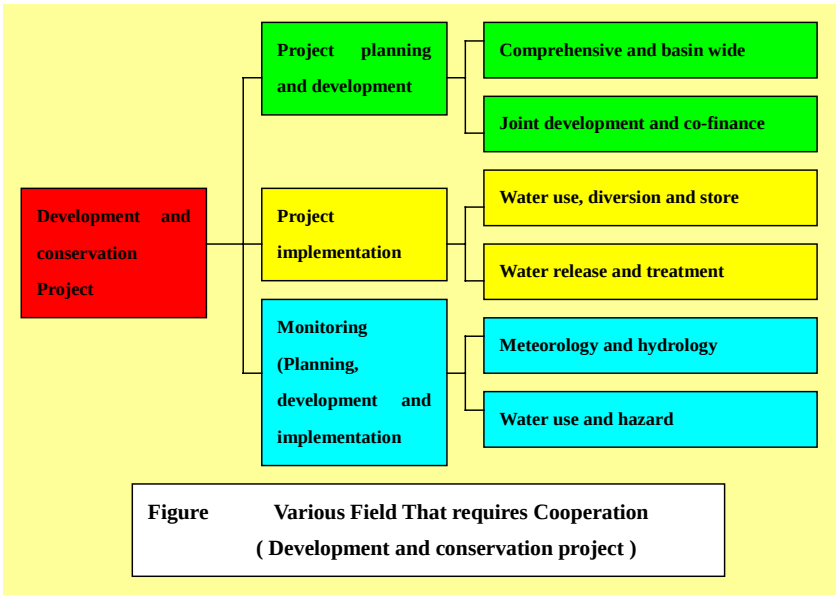


Fig. 13 Various Fields that Require Cooperation (Development and Conservation Project)

Cooperation among countries as well avoidance of harmful effects is imperative in risk management. Hazard and harmful effects are frequently transgressing. The main fields that require good cooperation are illustrated as follows.

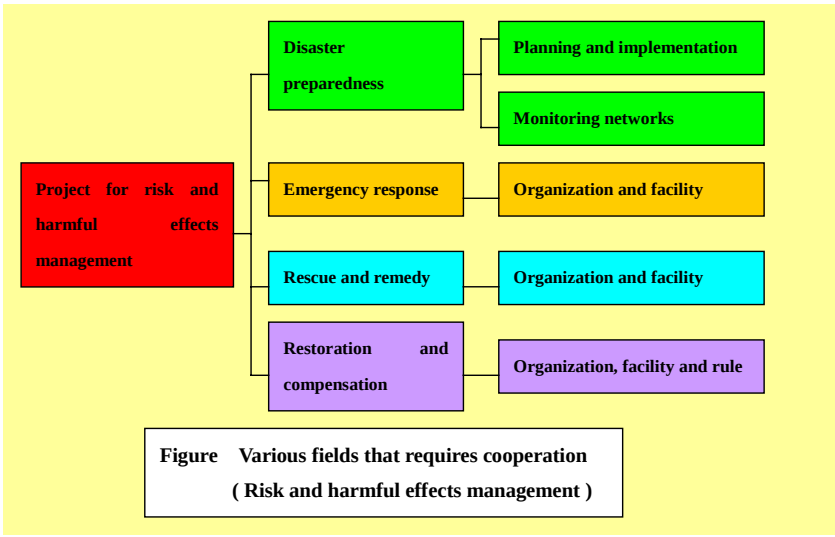


Fig. 14 Various Fields that Require Cooperation (Risk and Harmful Effects Management)

(3) On-going cooperation and Water Utilization Rule for further cooperation

The Agreement mandated The Joint Committee to be the core of the cooperation among the related four countries. The Agreement specifies the

Secretariat thereof, MRCS, as the implementing body to prepare the draft plans and programs for approval of the joint committee. The MRCS responded to comply with the assignment establishing WUP, BDP and ECP. The main subject of WUP is to prepare a water utilization rule for the implementation or operation of projects for cooperating development. It is studying further the monitoring networks with the cooperation extended by the JICA. BDP is studying the project plans for the cooperating development. Meanwhile EP is responsible to study the environmental conservation plan. Recently a program for the planning of flood protection has started as an activity of the MRCS.

The Water Utilization Rule, presently being prepared should pay special attention to promote the cooperation since water utilization have historically incurred conflicts among the riparian countries of international river courses. Said cooperation is necessary with regard to both development and conservation project and the project for risk and harmful effect management. In this discussion, it is assumed that the rules with regard to reasonable and equitable use, the water required to conserve the ecological lives and the significant harmful effects are all defined in advance.

With regard to the development and conservation project, the main issue is the allocation of water and monitoring. Mean while compensation and monitoring are significant subjects with regard to the project for risk and harmful effect management.

The significant issues with regard to the project for development and conservation are presented below;

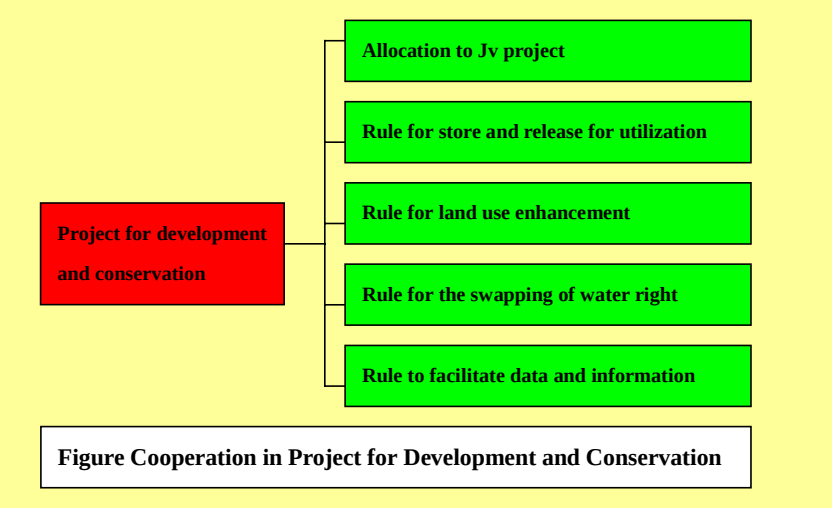


Fig. 15 Cooperation in Projects for Development and Conservation

The key issues in the preparation of water utilization rules are as follows:

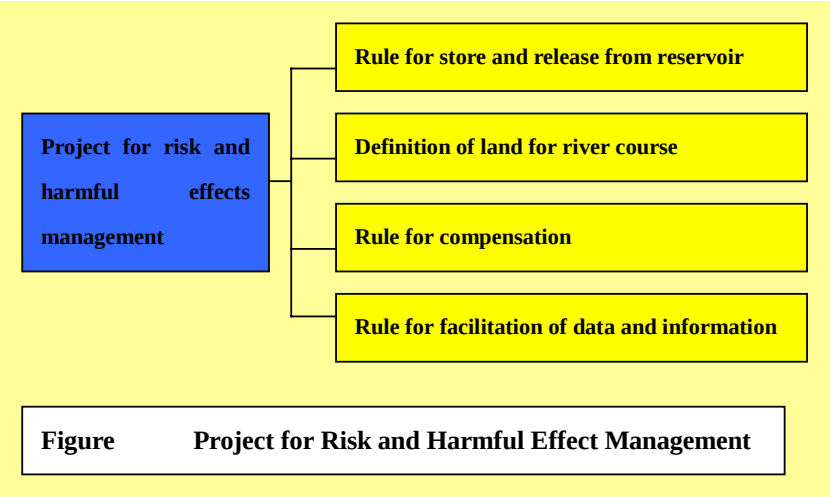


Fig. 16 Project for Risk and Harmful Effect Management

2.6.10 Principle of Compensation

(1) The Agreement and compensation

A country caused harmful effect to other countries shall compensate the damage. The Agreement stipulates the compensation in Article 8. The water utilization rule should provide compensation not to cause arbitration or conflict. The compensation related to water utilization comprises as follows.

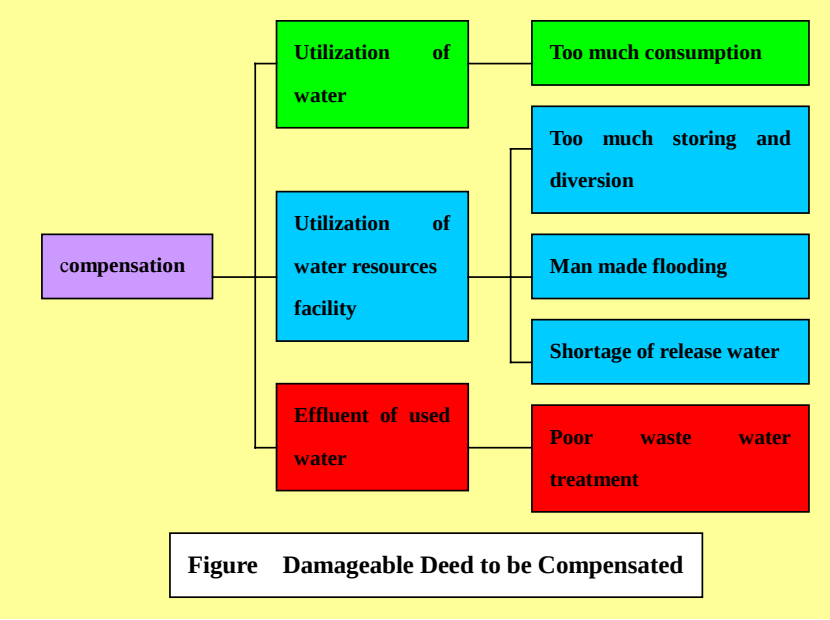


Fig. 17 Damageable Deed to be Compensated

(2) Object of compensation

The water utilization rule should specify the objects of compensation. The substantial objects are as follows;

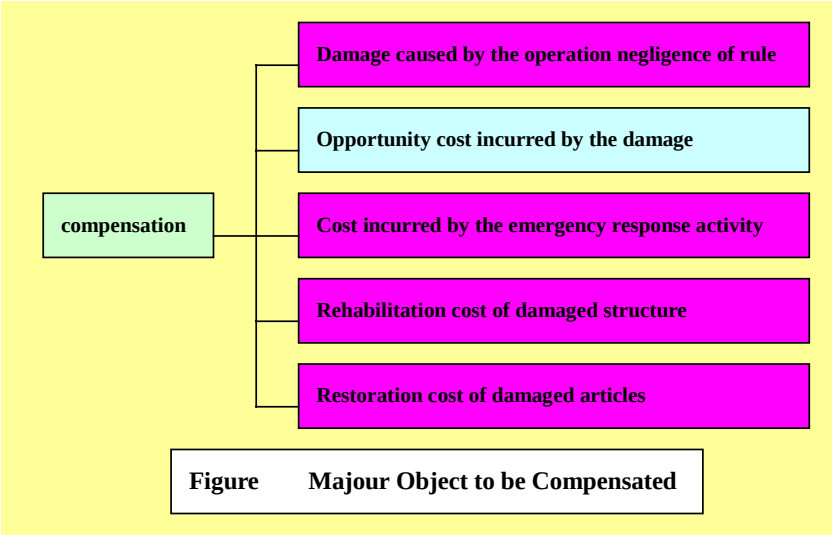


Fig. 18 Major Objects to be Compensated

2.7 Examination on the Consistency of Domestic Laws to the Concepts and Principles

2.7.1 Targets of Assessment

The concepts, principles and conditions discussed above should overrule the formulation of the Water Utilization Rule. Meanwhile all of the provisions of the Rules should be consistent with both the Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin and the laws enforced in the countries concerned to secure smooth formulation and implementation thereof. In this connection, the consistency of the enforcing domestic laws to the concepts, principles and conditions were preliminarily assessed to confirm the amicability of the Rule to each domestic law. Further the responses of the domestic laws against international agreements are crucial to implement the the Rules amicably in each country. The assessed and studied laws are as follows:

Cambodia DRAFT LAW ON WATER RESOURCES MANAGEMENT OF THE KINGDOM OF CAMBODIA (Submitted to the Council of Ministers on 05 March 2001)

Laos THE WATER AND WATER RESOURCES LAW (Resolved at the National Assembly on 10November 1996)

Thailand WATER RESOURCES ACT (Unofficial translation; Note on principle and reasons)

Vietnam THE LAW ON WATER RESOURCE (Resolved at the National Assembly on 20 May 1998)

There might be some more enforced laws and acts that govern the water and water resources management in some countries. And the study of such laws may afford much appropriate results of assessment on the conformity of the laws with regard to a certain principle. However, it is assumed that the laws selected herein as above might integrate and represent the concept and principle of the respective countries in the legal approach to the water resources. And it should be noted that the examination itself is preliminary and needs further elaboration.

2.7.2 Examination of Consistency and Interpretation of Each Law

The conformity of each law with the concepts and principles requisite for the management of the international river basin was examined referring the prescriptions of the provisions thereof. An interpretation is given to bridge the prescription to the concepts, principles and necessary conditions if it is considered appropriate.

(1) Concept of river basin

(a) Cambodia

The law of Cambodia prescribes the Water Law Implementation Area as river basin in its Article 5. Further Article 7 thereof stipulates that water resources projects shall be prepared in accordance with the national water resources plan, the economic development plan and environmental plans. This implies that water utilization and land use which affect hydrology and water demand are under the control of national government. In this addition the MOWRAM is responsible for watershed management according to the prescription in Article 26. Thus the river basin is managed by the central government.

(b) Laos

The law defines that water source is the place where water exist (catchment area) in Article 3 and Article implicitly express the concept that the management of water include the management of catchment area(river basin). This concept is observed in Articles 10 and 11. Article 22 prescribes that the water resources development project should be planned in conformity to the socio-economic and environmental development plans. Article 35 provides the right of way for the waste water drainage granted to a water user. These indicate that water could not be managed without river basin concept.

(c) Thailand

The section 5 of the Act defines the place where public water exists. The definition is synonym of river basin although it does not use words river basin. The section 11 provides that the water resources plan shall be in compliance with the national socio-economic development plan. The water resources management shall have good coordination with the land use in the river basin according to the provision. The section 20 and 22 stipulates that the unit of management of water utilization is river basin. The river basin concept is well understood to be imperative to manage water resources in Thailand as well.

(d) Vietnam)

Article 3 provides the definition of river basin. Article 5(1) and (4) indicate that the management of water could be achieved through integrating with the management of river basin and with the national and regional socio-economic development plans. Article 20(1) prescribes that the regulation and distribution of water resources must be based on the planning of the river basin. The development of water resources such as diversion of water must be in line with the socio- economic development plan according to Article 21. Article 64 provides the river development plan. Vietnam acknowledges well that water utilization rule can be practical when it has sufficient conformity to river basin concept.

(2) Principle of common property

(a) Cambodia

Article 3 provides that State is the owner of water, river, channel even reservoirs. And everyone has the right to use water and water resources according to Article 8. These provisions manifest that the basic Cambodian stance for the management of water stands to the principle of common property.

(b) Laos

The ownership of water and water resources is specified as the national community represented by State. This is a declaration of Laos that water and water resources are common property. Along this line, Article 18 request the medium and large scale water users to obtain the approval of the government so that water could be commonly used. Further article 21 assures that anybody and any organization can obtain the approval for water use. Article 34 prohibits the owner of upstream land to block water in his land at his discretion not to impair the right of downstream use. Article, on the other hand, secures the owner of an upstream land the right to use the downstream lands owned by others to discharge water. Article reflects the principle of common property.

(c) Thailand

The section 3 defines the state water resources which Thailand may utilize. Meanwhile the section 5 prescribes that the state allows common public usage although the state holds the power to reserve for public utility. The section manifests that state water resources are public domain. The section 6 defines the public water resources shared for public use from the state water resources.

(d) Vietnam

The first clause of the law provides the ownership of water resources as the entire people under the unified management of the State. Further articles 57, 58 prescribe that the responsibility to manage the water resources is vested to the State. The law conforms to the principle of common asset.

(3) Principle of reasonable and equitable share

(a) Cambodia

Article 42 highlights the right to use and manage the international river basins within its reasonable and equitable share. Articles 9 through 17 provide the license to use, divert and abstraction of water and related resources like sand and gravel. Before granting license MOWRAM is entitled to consult with other institutions according to Article 11. Article 16 prescribes the cancellation and modification of license for public purpose. Article 21 throgh24 prescribe the license regarding groundwater and drainage of used water. A licensing system that is managed well may secure the reasonability and equitability.

(b) Laos

Article 4 stipulates that water and water resources are to be allocated to various parties for uses. Article 6 stipulates that their use must be conducted according to centralized and integrated comprehensive management principles. The government shall determine the distribution of water and water resources in order to realize the principle (article 12) and water and water resources management shall be centrally controlled pursuant to the provision of Article 19. The medium and large scaled uses need the approval of the government according to the provision of Article 18. The government that manages water and water resources with the reasonable and equitable use principle allocates water reasonably and equitably.

(c) Thailand

The section 8 stipulates the water to be used privately should be reasonable quantity and should not prejudice with the right of the other people. The section 9 prescribes the duty of a person who possesses water shall share water for public utilization in case of draught. The river basin committee has power and duty to consider the water distribution as stipulated in the section 22. In this connection, the distributions in normal and dry cases are outlined in the sections 34, 35 and 36. All the prescriptions concern the reasonable and equitable allocation principle. Especially, there is a description that the distribution shall maximize the common benefit as a whole and shall minimize the damage to water users. The section 39 provides the granting of water use license. The sections 40, 41 and 42 provide the water use fee to be paid by the licensed user. Equitable water use principle might be implemented partially by this water charge.

(d) Vietnam

Article 4 stipulates the government to exercise unified State management of the water resources, which is supposed to guide the development reasonable and equitable. Meanwhile Article 5 provides the equitable prevention of water induced disaster all over the country in its third paragraph. Article 8 envisions even the territorial integrity and mutual benefit in international relationship with regard water resources management. Article 20 stipulates that the regulation and distribution of water resources must ensure the principle of fairness and reasonability. It

further provides that a rational use of water in case of draught shall be made according to the principle of ensuring fairness and reasonability as well. One of the measures to implement the principle is the issuing of the permission to exploit water as stipulated in Article 24. The same are provided in Article 34 for ground water. Principle of sustainable development

(e) Cambodia

Article 7 stipulates that water resources project shall be so planned as to maintain the balance between water availability and present and foreseeable future demands. Article prescribes further that the water resources project shall be planned in accordance with national economic development plan and national and regional environmental plan. Along this line, the government will pay full attention to the sustainable development. Articles 21 and 22 prescribe the orderly development of ground water. The maintenance of water related facilities are assured by the stipulations of Article 39. Article 18 prescribes water use fee which is to secure the budget to sustain operations of water works. Meanwhile articles 37,38 and 39 provide the penalty against various offences. The stipulations might be effective to secure the sustainable development through the compelling force and the collected penalty in accordance with this prescription might incidentally contribute to sustainability.

(f) Laos

In the first article, Laos manifests the necessity in its provision to manage water and water resources based on the sustainable development principles. And Article 7 stipulates that all the water use strictly comply to the water and water management regulation in order to secure sustainability. In this connection, the substantial water uses need to apply for the approval by the government as prescribed in Article 21. While Article 24 stipulates the obligation of water user to contribute funds for the maintenance of water origin, Article 25 provides that a dam project for power generation should include the purposes to maintain the water origin and flood control so that sustainable development is assured.

(g) Thailand

The socio-economic development plan should be sustainable in its nature and incidentally the water use is sustainable along the prescription in the section 11. Further, the government issues water use license (section 39) with a good considerations (section 41) that will contribute to secure sustainable development. The sustainability of water resource itself is prescribed in sections 54 and 55 as the conservation of watershed areas. The regulation of land use in the section 56 might contribute to maintain water resources sustainable through controlling water demand. Penalty prescribed in the sections 58 and 67 may function as the legal force of the government and the collected penalty might be the revenue for sustain management if it is allocated to the management budget.

(h) Vietnam

Article 3 defines that development of the water resources is the measure aimed at raising the capacity of exploitation and sustainable use of water

resources. Article 4 provides that the water resources management shall serve the sustainable development of the country. The law of the country warrants the sustainable development.

(4) Risk management concept

(a) Cambodia

Flooding is one of the most significant issues in the country. Article 27 provides the flood protection works, meanwhile the subsequent article prescribes the emergency works. In this connection, Article 20 empowers the MOWRAM to instruct the owner or manager of any water works endangered to take necessary actions to remedy the situation. Articles 37, 38, 39, and 40 stipulate the compulsory force of the government in emergency case and the charging of penalty for the organization or person who are attributable to the emergency. The law of the country defines a risk management as one of the component of water resources management.

(b) Laos

Water and Water resources development activities include ones to protect against ill effects from flooding, drought and erosion as provided in both articles 20 and 22-3. Article 39 specifies the natural and man made disaster. Meanwhile Article 31 specifies and prohibits the activities which liable to entail ill effects. Articles 40, 41 and 42 provide risk of flood, erosion and water pollution due to a wastewater disposal. In this manner, Laos has much concern on risk management as a component of water resources management.

(c) Thailand

The river basin committee is responsible for flood protection and flood relief operation according to the section 22(5). It is responsible to take counter measure for the drought as well according to the section 35. The works required for a river basin committee to protect flood and to relief from flood are specified in the provisions of section 47 and 48. The section 53 provides the risk management for the flood protection facilities. The rights to enter and to occupy a land by the emergency fighting team are secured by the prescriptions in the section 58. The prohibition of water pollution is provided in the section 59. The Act shares a certain volume to the risk management.

(d) Vietnam

As discussed above, the equitable benefit through flood protection is stipulated in Article 5. Article 9 forbids any person to undertake acts that would deteriorate hydrologic cycle or to obstruct the circulation of water. While the law shares 5 articles from Article 36 through 40 for the flood prevention works, Article 41 is the provision of public involvement to flood fighting activities. Articles 42 and 43 prescribe the response against the occurred flood. And Articles 44 and 45 provide the preventive matters against other risk. The budgetary preparations against water related disasters are provided in Article 46.

(5) Exchange of data and information

(a) Cambodia

Water related data are to be collected by various agencies and institutions. Article 6 stipulated that such collected data and information shall be submitted to the MOWRAM. The same article assigned MOWRAM to keep a centralized data inventory of water resources. Article 35 grants those authorized by the MOWRAM to enter any land to control technical matters relating to water. In this respect, investigation, measuring, monitoring and data collection are included in the technical matter. Article 6 prescribes the publicity of the data and information.

(b) Laos

The Ministry of Agriculture and Forestry is responsible to survey and to keep the data on water and water resources all over the country through coordination with other agencies concerned as provided in Article 8. The data are availed in allocating water and water sources according to Article 11. The monitoring and inspection of water use is assigned to relevant division and local authorities (article 19 and 22). The main subjects of the monitoring are specified in Article 43. A water user is obligated to participate in providing data to the relevant authority (article 23). According to Article 37, the agency to manage water and water resources has the right to install necessary facilities to inspect and monitor the water use.

(c) Thailand

National water resources committee shall submit all the undertakings to the Cabinet as well as Minister controller according to section 12. The national water resources committee shall collect data and information as stipulated in the sections 19 and 29. The section 43 obligated licensee to install water meters and collect data for the competent officials to inspect and control water usage. The section 47 indicates the necessity of data and information for proper flood protection and flood relief works. The sections 63 and 64 stipulate that competent officials are entitled to enter the land for inspection, investigation and data collection.

(d) Vietnam

Article 6 obligates the State to invest the necessary amount for surveying of water resources, establishment of monitoring system and raising the capacity of flood forecasting. Meanwhile ones utilize water are obligated to supply data and information with regard to potentials and evaluating water resources. The responsibility of the agency of meteorological service is provided in Articles 37, 43 and 45 to observe, to forecast and to issue the information regarding rainfall, flood and high tide. Article 55 prescribes that the Vietnamese State encourage the exchange of information related to international water resources. Article 60 prescribe that the survey and preparation of an inventory thereof are carried out by the organization comprising the relevant Peoples Community and related agencies under the cooperation by the central government.

(6) Principle not to cause harmful effect to others

(a) Cambodia

Article 9 and 10 stipulate that the Government by means of licensing controls the substantial water use. The MOWRAM, the governmental agency to issue water use license, may consult with other agencies before it decide to issue license not to cause harmful effect to others according to the provision in Article 11. Consequently a well-managed administration will not cause harmful effect to others due to water use. Further, the government may correct the situation because it has the power to cancel the water use license once granted according to Article 14. Land use may be managed by the provision of Article 25 not to raise the flood discharge. Articles 29 and 30 may effective to avoid conflict between upstream reach and downstream reach with regard to drainage. The stipulations not to cause qualitative harmful effects are provided in Article 37 and 38.

(b) Laos

Article 18 provides the necessity to assess the social and environmental impacts of a large scale of water use project not cause harmful effect to others. Article 22 obligates a water use must prevent ill effect arising from water including shortage of water. The harmful effects of water use in the upstream reach area to the downstream and harmful effects of the modification of river channel in the downstream reach to the upstream reach are prohibited in Article 34. The damage in the downstream land due to the discharge of wastewater in the upstream reach is prohibited by article 35 as a harmful effect of water use.

(c) Thailand

The section 8 prohibits water user to cause any harmful effect to others as the results of water utilization. The competent officer carrying out flood protection works have power to demolish facilities and structures that affect the works according to the section 49. Ministerial regulation shall control activities affecting the deterioration of water resources and deteriorating the water utilization as prescribed in the section 58. Meanwhile, the section 60 provides to prohibit the environmental deterioration and the compensation for injury. The penalty against the deed, which damages the water resources, is provided in the sections 61 and 62.

(d) Vietnam

Article 23 prohibits the water user not to cause obstruction or damage to the legitimate exploitation and use of water resources by other organization or individual. While Article 26 provides the pollution to be entailed by the water use for agriculture, Article 30 prescribes the harms to be caused by navigation.

Article 31 forbids water users to cause deterioration and depletion of water resources or to impede the current or to cause salty water intrusion.

(7) Principle of prior information on development project

(a) Cambodia

A project shall apply for the water use license according to Article 9 or 21. The application is processed and stored in the inventory of the MOWRAM as stipulated in Article 6. Meanwhile a flood control project which determines the flood discharge is to be carried out by the MOWRAM in cooperation with other agencies as stipulated in Article 27. Further the MOWRAM is responsible for the management of waste water(article23), watershed management(article26). Incidentally, the government is in a position to be informed about all the development projects, which are anticipated to affect the hydrology in terms of quantity and quality. The law of Cambodia does not impede the principle of the prior information on development project.

(b) Laos

Article 6 stipulates that water and water resources management and use must be conducted according to centralized and integrated comprehensive management principle. Article does not specify the responsible central agency.

Article 18 provides that a middle or large scaled water use requires the approval of the government. Thus the government is informed the project which use a certain volume of water in advance. According to Article 29 water resources preservation is the obligation of individual or organization that use water. Mean while Article 40 and 41 provide that all levels of administrative authorities are responsible to prevent flood and erosion. Thus government may obtain information as a whole regarding projects in advance.

(c) Thailand

The river basin committee shall submit the policy of water resources development and utilization to the National Water Resources Committee according to the section 22. The competent official is responsible to issues water utilization license (section 40) and may obtain the information on water using project in advance. The officials obliged to inform the ministry and river basin committee for centralization of information (section38). The section 47 specifies the River Basin Committee as the responsible institution for flood control. According to section 54 the National Water Resources Committee is responsible for water resources conservation. Along this line, there is no impediment for the National Water Resources Committee to obtain the information on substantial water related project in advance.

(d) Vietnam

The stipulation that regulation and distribution of water to use must conform to the river basin development plan in Article 20 assures the administrating government to obtain the information regarding the development plan. Article 21 assures the principle providing that the water resources development project must be implemented in line with the national and regional socio-economic development plan. Further, the

water resources development activity requires the permission of the government prior to its implementation. In this addition, major project requires the ratification of the government according to Article 59. Article 60 assigns the MARD to manage the river basin planning. Article 36 stipulates that the Govern ment is responsible to prevent the harmful effect of water. Meanwhile Article 47 specifies the State agency as the responsible agency to conduct water conservation works. In this manner the government is in a position to be informed about the project prior to its implementation.

(8) Principle of cooperation with other country

(a) Cambodia

The law does not provide any special provision for cooperation with other country. The provision 42, however, assures that the international agreements bind the activities of Cambodia.

(b) Laos

Article 44 provides the conformity to international treaty and conventions in the exploitation, use, control, protection and development of water and water resources. The resolutions of dispute among other countries with regard to water use and protection are to be attained through diplomatic channel based upon friendship and equality according to Article 45.

(c) Thailand

No special prescription is found on this matter.

(d) Vietnam

Article 8 prescribe that the State encourages the broadening of international relations and cooperation in the basic survey, protection, exploitation and use of water resources. Article 46 manifests that foreign funding is envisaged to implement flood control projects. The water resources development is so planned as not to harm the rights and interests of other countries according to Article 53. Article 55 provides international cooperation in the water resources management as introduced before. The State government is to handle international relation according to Article 57.

(9) Principle to onserve and protect water resources

(a) Cambodia

Article 5 prescribes the determination of water law implementation area to conserve water resources. The licensing system provided in Articles 9 and 21 contributes to water conservation. The water discharge license provided in Article 23 is another measure to conserve water from the water quality facet. Watershed management prescribed in Article 26 bind the government to pay attention to water resources conservation.

(b) Laos

The conservation of water and water resources are clearly stipulated in Article 7. Meanwhile, Article 25 prescribes the promotion of watershed management to preserve the origin of water and water resources for use in producing electric power. Articles 29, 30, 31 provide the conservation and protection of water and water resources in view of environmental protection.

(c) Thailand

The office of the National Water Resources Committee shall have to compile the suggestions on water conservation and to appraise and prepare the achievement report pursuant to the prescription in section 29. Same section provides that the office of the National Water Resources Committee shall enhance the public sector to take part in water conservation. Section 38 prescribes the publicity of water conservation by the River Basin Committee. Section 54 obligates the National Water Resources Committee to advise to conserve appropriate areas. Further, Section 58 grants power to the committee to issue Ministerial Regulation defining the measure to preserve water quality.

(d) Vietnam

Article 5 provides that the conservation of water resources should be linked with protection and development of forest. Article 9 strictly prohibits the activities that deteriorate river basin and deplete water resources. Articles 10 through 16 provide the conservation of surface water and ground water in terms of quantity and quality. Meanwhile Article 17 stress the necessity of the conservation of river channel to conserve water resources. Articles 47, 48, 49 and 50 provide the works to conserve water. Article 52 stipulates the forbidden acts in the management, construction and protection of conservation facilities.

(10) Principle to protect environment and polluter pay

(a) Cambodia

Article 23 provides the protection of environment from discharge, disposal and deposit of polluting substances. Article provides the wastewater discharge license as well together with the treatment requirement. The license emerges from the policy of polluter pay.

(b) Laos

As discussed before, Article 18 prescribes the necessity to carry out feasibility study to assess environmental impact of a large-scale development. Water and water resources use must propose and implement measures to diminish undesirable effects upon the environment and natural beauty according to Article 29. The prohibitions of activities specified in Article 31 indicate the views of Laos with regard to environmental protection. Article 42 focuses on the pollution control due to wastewater.

(c) Thailand

As described above subject, section 58 prescribes the proposals of principle and procedure to protect water quality. Section 59 forbids anybody to dump and dispose wasted matters or to drain polluted water in order to protect environment and to preserve water quality. The penalty for the violation against the provisions for environmental protection is specified in Section 60. The punishments for the violation against Section 59 are provided in Section 75.

(d) Vietnam

Article 18 provides the granting of permission to dispose wastewater. Article 19 stipulates the obligation of permitted organization or people to discharge wastewater. Articles 26, 27, 28 and 29 stipulate the obligations and restrictions to lessen the pollution incurred by the various types of water uses. Article 42 prescribes the responsibility of government to drain the inundation water to protect environment. Article 44 provides the governments responsibility to protect water and lands from salty water intrusion. The responsibility to protect environment from hail and acid rain is prescribed in Article 45.

(11) Principle of appropriate compensation and indemnity

(a) Cambodia

Article 14 provides the compensation paid by the water user against the damage caused by the defaults. Meanwhile the government should pay compensation for the damage incurred by the cancellation or modification for public purpose of water use license pursuant to the provision in Article 16.

Article 32 provides the rights of neighbour to receive compensation for the use of land belong to him or her for water drainage.

(b) Laos

The water and water resources law grants the government with the right to expropriation in the provision of Article 28 to implement necessary project. The owner of the project shall compensate the damages of those people to be removed. A project should be so designed as not to cause harmful effect to others. If a project fails to avoid any harmful effect, the project shall compensate the affected peoples according to Article 34. The damages due to the discharge of effluent are to be compensated as well pursuant to the stipulation in Article 35.

(c) Thailand

The section 9 prescribes that the Minister is empowered to deprive the water of licensee to use it for public in case of draught. In that case the licensee is entitled to claim compensation. Inequitable water allocation in terms of water quantity may be rectified by means of monetary compensation according to the section 36.

Further a landowner who subordinates his land for the activities of emergency preparedness or response is entitled to receive indemnity thereof according to the section50. A historical water user who was forced to correct the use in accordance with the Act is entitled to receive indemnity for the damage due to the correction.

(d) Vietnam

Compensation is due if a permitted person or organization to discharge wastewater fails to conform to the conditions attached to the permission according to Article 19. The organization or person who is granted right to use water is entitled to receive compensation if the right is withdrawn for the national defence and security according to the provision of Article 22. Meanwhile they are to compensate the damage liable to the conduct thereof pursuant to Article 23. Article 41 provides the compensation to be given to the individuals to be moved from their resident site to facilitate the flood protection works.

(12) Institution and organization

(a) Cambodia

Article 4 provides that the responsibility to implement the law is vested to the MOWRAM. The subsequent articles specify the implementation of law;

- Watershed management
- Water environment management
- Flood control
- Issuance and management of water use license
- Issuance and management of wastewater discharge license
- Data and information collection and management and investigation
- Preparation of technical standard
- Collection of water fee, compensation and penalty

However, Article 18 prescribes that irrigation water fee may be collected by the Farmer Water User Community if the organization is established and registered.

(b) Laos

Article 5 prescribes as follow; the government promotes the development, exploitation, use preservation and protection of water and water resources including the prevention of ill effects arising from water and all acts which cause depletion. The organization that designates the distribution of water to use is the government according to Article 12. The approval is

issued by different organizations according to the scale as stipulated in Article 19.

- Large scale use: Government
- Medium scale use: Relevant agency
- Small scale use: Not necessary to be approved

The same article prescribes that all the management shall be centrally controlled but monitoring and inspection are assigned to relevant agencies and local authorities. Article 27 specifies the approval organizations for the modification of water flow;

- Large-scale modification: National assembly
- Medium scale: Government
- Small scale: Provincial or prefecture administrative authority

Government is responsible to delineate the water protecting area according to Article 29 and 30. Article 43 provides that the organizations that administrate water are responsible to monitor and inspect the water use.

(c) Thailand

Prime Minister enforces the Act as Minister. Minister authorizes Provincial Governor to appoint Official on his behalf according to section 3 and 4. One of the main responsibilities of the competent official is to issue water use license as prescribed in section 40. The State shall have a power to develop the public water resources. The National Water Resources Committee is set up with the Office of the National Water Resources Committee according to section 10 and 11. The member and the functions are specified in the sections. The National Water Resources Committee may appoint Sub-committee (Section 18). The Committee shall appoint River Basin Committee to perform the function in each specific river basin according to section 20. The government agency shall present the flood control view to the National Water Resources Committee (Section 47). The Committee prescribes plan for flood protection and deliver it (Section 47). The government agency shall prepare equipment and materials required according to Section 47.

(d) Vietnam

As mentioned before, Article 1 provides that the State (government) is the organization to manage the water resources. Article 4 specifies as follows:

"The Government exercises unified State management of water resources."

"The Peoples Councils and Peoples Committees at all level shall within their scope of tasks and powers take measure to manage, protect, exploit and use the water resources."

Article 10 specifies the responsible organizations to protect water resources:

"The State agencies, organizations of economy, politics and social Peoples armed force unit and all individuals…"

Article 24 assigns competent State agencies to issue permissions to water use.

While the State managing agency for water resources designate the various standards for disaster prevention, the local branch of the ministry implement disaster prevention works together with local government according to the stipulation of Article 37. The MARD is duly assigned as the State managing agency in Article 58. The State agency assigns the water conservation works to the organization or individuals that use water according to Article 47. The Government shall make concrete provisions on the protected area for water conservation. Article 59, 63 and 66 specify the organizations responsible for water resources managing plan as follows;

Ratification of policy	The National Assembly
Ratification of general plan	The Government
Ratification of river basin plan	The MARD
Ratification of project	The Ministry, Peoples Committee, local Government
Consultant for the government	National Water Resources Council
Inspection on water resources	The Specialized Inspector on water Resources

2.7.3 Response to International Agreement

The preliminarily studied laws herein are the domestic ones on the management of water resources. The response of each law against an international agreement is significant for the preparation and the implementation of the Rule now being formulated. Each response was studied as follows:

(1) Cambodia

Article 42 provides as follows:

"The Kingdom of Cambodia has the right to use, develop and manage international river basins on its territory within its reasonable and equitable share, consistent with the obligations stemming from the international agreements to which Cambodia is a Party."

In accordance with this provision, Cambodia will utilize water of the Mekong river basin within its reasonable and equitable share. Further it stipulates that Cambodia will act in compliance with the obligations stemming from the Water Utilization Rule to be established. The domestic law of Cambodia appears not being to have inconsistency with the Water Utilization Rule.

(2) Laos

Article 44 prescribes as follows:

"The exploitation, use, control, protection and development of water and water resources between countries must be conducted in compliance with the signed treaties and conventions."

Further Article 45 provides that:

"Disputes regarding the management of water resources must be solved based upon friendship and equality via diplomatic channel and as provided for by treaty."

Laos will manage the water resources of the Mekong river basin in compliance with the Rule to be established. The domestic law of Laos appears not being to have inconsistency with the Water Utilization Rule.

(3) Thailand

No special provision is found with regard to the response to international agreement. In this respect, the National Water Resources Committee Chaired by the Prime Minister is responsible for all the river basin management as stipulated in Articles 10 and 11. The guidance provided by the Committee governs the plans and activities of the River Basin Committee and governmental agencies as prescribed in sections 22 and 23. Accordingly, the Water Utilization Rule to be agreed by Thailand should be consistent to the domestic water and water resources management.

(4) Vietnam

Article 8 stipulates:

"The State encourages the broadening of international relations and international cooperation in conformity with the international conventions which the Socialist Republic of Vietnam has signed or acceded to."

Article 53 provides the principle in international relations in water resource to respect the interests of the countries sharing the same source of water, to ensure justice, reasonability, mutual benefit and sustainable development, not to harm the right and interests of other countries and to observe the domestic laws and international conventions. Article 55, among others, provides the encouragement of the exchange of information related to international water resources and of the coordination in research and river basin management planning. No difficulty is foreseeable to formulate and to implement the Water Utilization Rule as the new international agreement.

3. WATER UTILIZATION RULES

3.1 Rationale

Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin, so called the Mekong Agreement, provides the preparation of Rules for Water Utilization and Inter- basin Diversion in its Article 26. Article stipulates as follows:

> "The Joint Committee shall prepare and propose for approval of the council, inter area, Rules for Water Utilization and Inter-Basin Diversions pursuant to Article 5 and 6, including but not limited to: 1) establishing the time frame for the wet and dry season; 2) establishing the location of hydrological stations, and determining and maintaining the flow level requirements at each station; 3) setting out criteria for determining surplus quantities of water during the dry season on the main stream; 4) improving upon the mechanism to monitor intra-basin use; and 5) setting up a mechanism to monitor inter-basin diversions from the main stream."

Article 5, prescribed in Article 26 as above, enunciates that the four countries agree to adopt the Principles of the Reasonable and Equitable use in the utilization of the waters of the Mekong River System. Article stipulates as follows:

> "To utilize the waters of the Mekong River system in a reasonable and equitable manner in their respective territories, pursuant to all relevant factors and circumstances, the Rules for Water Utilization and Inter-basin Diversion provided for under Article 26."

Meanwhile, Article 6, referred to in Article 26, stipulates that the Rules for Water Utilization and Inter-basin Diversion shall serve to maintain the flows on the main stream to secure the reasonable and equitable use of waters of the Mekong River System as follows:

> "To cooperate in the maintenance of the flows on the mainstream from diversions, storage releases, or other actions of a permanent nature; except in the cases of historically severe drought and/or floods:..."

Article further provides:

> "The Joint Committee shall adopt guidelines for the locations and levels of the flows, and monitor and take action necessary for their maintenance as provided in Article 26."

At its 6th meeting in October 1999, the MRC Council fully endorsed the Water Utilization Program (WUP) and committed the governments to undertake in good faith efforts to negotiate and complete specific sets of rules for water use. These are:

(1) Procedures for data and information exchange by the end of 2001,

(2) Preliminary procedures for notification, consultation and agreement by the end of 2003,

(3) Procedures for monitoring existing water uses by the end of 2003,

(4) Procedures for notification, consultation and agreement by the end of 2003,

(5) Rules for the maintenance of flows by the end of 2004

(6) Rules for water quality by the end of 2005

The Procedures specified in the second row (2.) as above is to be superseded by the fourth Procedures. Eventually the contemplated are 5 Rules enumerated as 1, 3, 4, 5,and 6 as above.

3.2 Preparation of the Rules

3.2.1 Organization for the Preparation

The Mekong River Commission is implementing 3 core programs through its Mekong River Committee Secretariat (MRCS); Basin Development Program (BDP), Water Utilization Program (WUP) and Environment Program (EP). BDP is the program for the socio-economic development of the Mekong River basin. EP is the program for the conservation of the environment in the river basin. Meanwhile the substantial mandates of WUP are to prepare the Water Utilization Rules and the implementation thereof.

In 2001, the MRCS organized 3 strategic working groups under the team leader of WUP in order to formulate the Water Utilization Rules in addition to administration sector such as financial and secretarial sectors. Working Group 1 is responsible to develop a comprehensive hydrologic model to simulate the quantitative and qualitative hydrology of the whole Mekong river basin. The WG1 is responsible to assess the impacts of water use through conducting simulation applying the model to be developed. The impact assessment may directly contribute to deliberation of Procedures of notification, consultation and agreement, Procedure of monitoring of water use, Rules for maintenance of flow and Rules for water quality. The WG2 is responsible to define the environmental requirement of the river water levels which is closely related with the Rules of maintenance of flows. The works contribute to formulate the Rules of Water Quality.

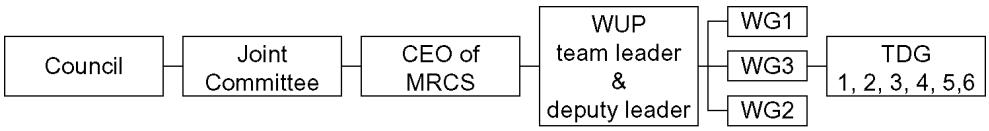


Fig. 19 Organizational Structure for Rule Preparation

Drafting of the Rules has been mandated to Working Group 3 (WG3). WG3 has drafted the terms of reference (TOR) of a Technical Drafting Group (TDG) for each Rule for the approval of the Joint Committee (JC). WG3 has duly organized TDGs comprising selected members from each country and from MRCS in accordance with the TOR approved by the JC in advance. TDG is drafting relevant Rule through discussions to materialize to the JC meetings. A draft becomes a Rule after being agreed by the Council of the Mekong River Commission.

The organization to prepare the Rules adopted by the Mekong River Commission is illustrated in a diagram as shown above.

3.2.2 Present Status of Rule Preparation

The Technical Drafting Group 1 (TDG1) compiled the Draft Procedure for Data and Information Exchange and Sharing after a series of discussions and submitted to 14th Joint Committee Meeting in Phnom Penh, Cambodia on 6 July 2001. It was endorsed for submission to the 8th meeting of the MRC Council. The Council adopted the Procedure at its

eighth meeting in Bangkok, Thailand on 01 November 2001. Thus Rules for Data and Information Exchange and Sharing has established.

The Technical Drafting Group 2 (TDG2) drafted the Preliminary Procedures for Notification, Prior Consultation and Agreement after several drafting meetings. The Council approved the Preliminary Procedures for Notification, Prior Consultation and Agreement at its 9th meeting in Ho Chi Minh City, Viet Nam on 12 November 2002. The approved Preliminary Procedures contain some pending issues. The approved preliminary Procedures provide that the remained pending issues are considered in preparation of the final Procedures. The Technical Group 4 (TDG4) has held several meetings to discuss the remained pending issues in the Preliminary Procedures. The MRC council approved the proposed Procedure at its Tenth meeting held in Phnom Penh, Cambodia on thirtieth November 2003.

The Technical Drafting Group 3 (TDG3) has held repetitive meetings for the Procedures of Water Utilization Monitoring. Its forth meeting was held in Phnom Penh on 21 and 22 August 2003. Several wordings in the Procedures called for discussion to define the meaning and reach unanimous agreement. Finally, the MRC Council approved the proposed Procedures at its tenth meeting held in Phnom Penh, Cambodia on thirties November 2003.

MRC Joint Committee agreed to establish the Technical Drafting Group 5 (TDG5). The Committee agreed the Draft Terms of Reference (TOR) on 16 October 2003. TDG5 will work out to provide a comprehensive and adaptive framework for maintenance of flow on the main stream as stipulated under Article 6 of the Mekong Agreement.

No particular progress has been achieved with regard to the preparation of the Rules for Water Quality yet as of November 2003.

3.3 Outline of the Rules and Preliminary Assessment

3.3.1 Procedure for Data and Information Exchange and Sharing

The Technical Drafting Group 1 of WUP3 has held a series of meetings to discuss the Procedures for Data and Information Exchange and Sharing. The Group drafted the Procedures and submitted them for approval of the Council through the Joint Committee.

The Council approved the Rules (Procedures) at its eighth meeting held in Bangkok, Thailand on 01 November 2001. The Procedures comprises 6 Articles with aPreamble as follows:

Preamble

Article 1 DEFINITION OF KEY TERMS

Article 2 OBJECTIVES

Article 3 PRINCIPLES

Article 4 DATA AND INFORMATION EXCHANGE AND SHARING

Article 5 IMPLEMENTATION ARRANGEMENTS

- 5.1 CUSTODIANSHIP OF MRC-IS
- 5.2 REPORTING

Article 6 ENTRY INTO FORCE

Article 2 provides the objectives of the Procedures as follows:

- Operationalize the data and information exchange among the four MRC member countries;
- Make available, upon request, basic data and information for public access as determined by the NMCs concerned; and
- Promote understanding and cooperation among the MRC member countries in a constructive and mutually beneficial manner to ensure the sustainable development of the Mekong River Basin.

The third objective envisages the contribution of the exchange of data and information to secure the reasonable and equitable water use principle for sustainable development through monitoring activities in the various fields as specified in the Procedures.

The Procedures specify four principles for the data and information exchange and sharing in its Article 3. The third principle prescribes as follows:

- The data and information contained in the MRC-Information System that is maintained by MRCS, should be relevant, timely and accurate …

The principle implies that the MRC-Information System should be able to provide relevant, timely and accurate information to MRC and member countries to ensure a reasonable and equitable water use superimposing the objective discussed as above.

Article 4 enumerates the categories of data and information to be provided to MRCS in order to implement the Mekong Agreement. The specified data and information extends vast fields as follows:

- Natural resources including water resources
- Flood management and mitigation
- Water demand including agriculture, industrial, municipal water and tourism
- Environment and ecology
- Socio-economy

The Procedures mandated custodianship of the data and information on the MRCS in its fifth article. Article provides the responsibility of MRCS to report the data to Joint Committee and Council annually. The MRCS responded to this mandate and organized the Mekong River Commission Information System Design and Implementation Team (ISDIT). The functions of the ISDIT were duly transferred to Technical Assistance and Coordination Team (TACT) with broader functions to implement Procedures for Data Exchange, Prior Notification and Water Use Monitoring.

The data and information exchange is to be so designed as to contribute to ensure Reasonable and Equitable water utilization for sustainable development of the Mekong River basin mutually beneficial manner. The Procedures are appropriate for the purpose of forming the frameworks of the Rules. However some reinforcements thereof are necessary in order to secure effective operation as follows:

The standards for collections of data and information are required together with the standards for data access or retrieval.

- The intervals of transfer of data and information to the MRCS should be such that afford the management of water uses as is implemented for the flood management.

- Forecasting method should be established and be agreed by the related countries to afford optimum use of water observing the Rules for Maintenance of Flows.

- The standard for data transmission to the Management Agency of water use is required to facilitate smooth and effective operation.

- Establishment of a special Rule is necessary to compensate the extra expenditures incurred to line agencies by observation and transmission of data to comply to the Procedures.

3.3.2 Procedures for Notification, Prior Consultation and Agreement

The Technical Drafting Group 2 (TDG2) of WUP3 has held a series of meeting to discuss about the Preliminary Procedures for Notification, Prior Consultation and Agreement. The Group drafted and submitted the Procedures for the approval by the Council through the Joint Committee. The Commission approved the Preliminary Procedures at its ninth meeting held in Ho Chi Minh City, Viet Nam on 12 November 2002. The TDG4 took over the deliberation thereof discussing further especially on the Pending Issues.

The Council duly approved the Rules (Procedures) at its tenth meeting held in Phnom Penh, Cambodia on 30 November 2003. The Procedures comprises 7 Articles with Preamble as follows;

Preamble

Article 1 DEFINITION OF KEY TERMS

Article 2 OBJECTIVES

Article 3 PRINCIPLES

Article 4 NOTIFICATION

Article 5 PRIOR CONSULTATION

Article 6 SPECIFIC AGREEMENT

Article 7 FINAL PROVISIONS

The Procedures contains the Forms and Formats for Notification, for Prior Consultation and for Reply to Prior Consultation in its ANNEX.

The definition of “Wet and Dry Season” is a significant issue to define the necessity of prior consultation for a water utilization project. The approved Procedures defined the season with ranges of around one month for both start and end of a season taking account of the probabilistic uncertainty of hydrology along the river stretches. The Procedures stipulate further the Joint Committee to decide on the actual dates of the start and end of a season to ensure the reasonable water utilization principle.

With this regards, the TDG4 discussed in its fourth meeting held on 20-21 August 2003. The minutes of the meeting describes the discussions as follows:

(1) Onset of the wet season shall be the date at which the upcrossing of the mean annual hydrograph intersects the median discharge.

(2) The end of the wet season shall be the date at which the downcrossing of the mean annual hydrograph intersects the mean discharge.

The logic adopted herewith is in line with the suggestion by the JICA Study in its INTERIM REPORT (Vol.2) section 2.6.3, Principle of reasonable water use, page V-47 prepared in February 2003. The MRCS might study on this matter prudently along this line although the adoption of median and mean discharges are controversial as pointed out in the INTERIM REPORT and this Paper VIII in Subsection 2.6.3.

The Procedure categorises a natural bifurcation channel as a tributary. Accordingly the branches in the delta are classified as tributary including the Bassac River. The development of an offtake or inter-basin diversion from a branch is a matter to be notified although the water in question is a part of the mainstream water.

The third article defines the principles of equitable and reasonable utilization adopted in the Procedure. The policy of socio-economic development may vary from country to country. And nobody can infringe the policy pursuant to another adopted principle of sovereign equality. A country aims rapid socio - economic development may have a larger water demand today than one aiming slow and steady development. However the water demand of the latter will increase surely towards distant future. The principle should encompass the equitable utilization in future to come.

The scope of Notification, form, institutional mechanism, process, timing and absence of Notification are the subjects provided in the forth article. Water use at ones discrete is important basic concept of the Notification. However registration of comments raised by other riparian countries should be provided in the rules whether or not the country to use water takes account the comments, because the water use affects more or less the flow of the mainstream, which should be maintained by another Rules. The principle of not causing harmful effect supersedes the Procedure because the principle is adopted in the Mekong Agreement.

The fifth article provides scope of Prior Consultation, form, institutional mechanism, process, timing and absence of Prior Consultation.

3.3.3 Procedures for Water Utilization Monitoring

The Technical Drafting Group 3 (TDG3) of WUP3 has held a series of meeting to discuss about the Procedures for Water Utilization Monitoring. The Group drafted and submitted the Procedures for the approval by the Council through the Joint Committee.

The Council approved the Rules (Procedures) at its tenth meeting held in Phnom Penh, Cambodia on 30 November 2003. The Procedures comprises 5 Articles with Preamble as follows;

Preamble

Article 1 DEFINITIONS

Article 2 OBJECTIVES

Article 3 PRINCIPLES

Article 4 WATER USE MONITORING

Article 5 FINAL PROVISIONS

Article 1 provides the definition of Water Use as follows:

- It means any use of water which may have a significant impact to the water quality or flows regime of the mainstream of the Mekong River System by any member state.

The definition envisages the mobility of the water resources and enunciate acknowledgement of the MRC and member countries that a consumption of water in a tributary may affect the flow regime of the mainstream. The definition implies that the Procedure is established on the basis of river basin concept and in line with the principle of reasonable and equitable use of water.

The second article specifies the objective of the Procedure as to provide a comprehensive and adaptive frameworks and process to support effective implementation of water use monitoring. The provision enunciates that the Procedures is frameworks and detailed method to implement the Procedures is yet to be established.

The fourth article specifies three components of the Monitoring System and mandates a technical support team to determine the details thereof.

Institutional arrangement is another subject of Article. It specifies that the establishment of the Monitoring System is the roles of the MRC joint committee and National Mekong Committee. They will decide the target of monitoring, sites and methods of monitoring. Meanwhile the institutional arrangement mandates the MRCS to assist the National Mekong Committee for financial and technical strengthening regarding this monitoring.

Since the technical support team is to determine the details of the system component, the establishment of the team is urgent matter to be settled. The MRC joint committee and the national Mekong Committee shall establish the monitoring system as soon as possible. The MRCS shall find financial sources and establish the procedure for financial assistance of the National Mekong Committee.

3.3.4 Rules for Maintenance of Flows

The Mekong River Commission (MRC) Joint Committee agreed to establish the Technical Drafting Group 5 (TDG5) to draft Rules for Maintenance of Flows on the Mainstream. And it agreed the draft Terms of Reference (TOR) for TDG5 on 16 October 2003.

The agreed draft TOR specifies the mandates of TDG5 as to draft the Rules that provide a comprehensive and adaptive framework for maintenance of flows on the main stream. The TOR mandates TDG5 to coordinate and to utilize the information to be provided by the Technical Review Group (TRG) as well. The TRG to be established by the JC discuss following technical issues:

- Baseline hydrological and meteorological data series and analysis
- Condition deemed to be natural
- Representative hydrologic stations on the mainstream of the Mekong River
- Determining and maintaining the acceptable flows at each station

- Social, environmental and economic indicators that impact the setting of the flows at each station

- The trade-off between insuring the protection of existing uses of water and further development of the basin, and maintenance of desired and mutually agreed upon river condition

The TDG5 will continue study and discussion towards the end of 2004 to draft the Rules coordinating and using the information to be provided by the TRG. In this connection, TRG may be requested to deliberate following issues;

- Naturalization of manipulated hydrologic data due to water uses although available records of water use may be limited.

  - Probabilistic evaluation of the water resources for each site

  - Analysis in line with kinetic and continuity theories

- Appropriate evaluations of return flow and the incremental consumption

- Indicative hydrologic stations that represent the available water to meet the social , environmental and economic demands of each country

- Equitable flow reflecting the occurrence probability at each site

- Priorities among different water demands

- Optimization of land use

3.3.5 Rules for Water Quality

The MRC has a plan to establish the Rules by the end of 2005 and has conducted no special activity for the Rules yet.

4. WATER UTILIZATION RULES AND HYDRO-METE0R0LOGICAL MONITORING SYSTEM

4.1 Water Utilization Management and The Water Utilization Rules

The management of water utilization is one of the substantial components of water resources management. The main activities of water utilization management are management of water demands and management of potential water resources. Administration to support these activities is the other main task of water utilization management.

Control of demand might be the most time effective option to manage water demand although it is liable to incur socio-economic opportunity costs through impairing production which utilizes water. The demand management through rationalizing of water use is a preferable mean in view of reasonable water use without affecting the scheduled production. However it may require a higher technology and often may require additional investment, for instance, for the installation of a controlling system with certain instrumentation. Management of land use may be another fundamental and ultimate measure to manage water demand although it may induce social and economic issues together with large-scale investment because it is susceptible to the change in the livelihood of a large numbers of people who live in the land in question.

Precipitation, the source of water resources in the Mekong River Basin, is no doubt a natural phenomenon and is out of control of human beings in a practical meaning so far. Its substance is probabilistic and uncertain. Incidentally management of water resources potential focuses on the management of runoff and discharge, which are the next stage of the actually received precipitation in the hydrologic cycle. The typical and substantial measures to manage runoff or discharge are watershed management to increase low flow and decrease peak flow, provisions of dam and reservoir or development of retention pond to smoothing the fluctuating flows in time frames between years and within a year. Meanwhile, a diversion of water is another smoothing of water resources. It smoothes the spatial fluctuation of water resources transferring water from the area where water is abundant to the area where water shortage is foreseeable.

The estimation of demand and supply balance may indicate the necessary actions to take as the water resources management. If the estimated balance does not meet the required quantity or quality, any of the remedial measures or combination of several measures is to be implemented to meet the required water quantity and quality.

The water utilization Rules contemplated by the MRC are strategically allocated in the water utilization management cycle and well correspond to the components of the diagram which expresses the management cycle. The figure shown below illustrates the diagram of water utilization cycle and the allocation of each Rules to the component of the cycle.

The Procedures of Data and Information Exchange and Share (PDIES) correspond to the block of the evaluation of water resources potential. The implementation of the Procedures enables to evaluate the potential of the water resources in the Lower Mekong River Basin through its provisions on the data and information exchange of the basin hydrology and meteorology.

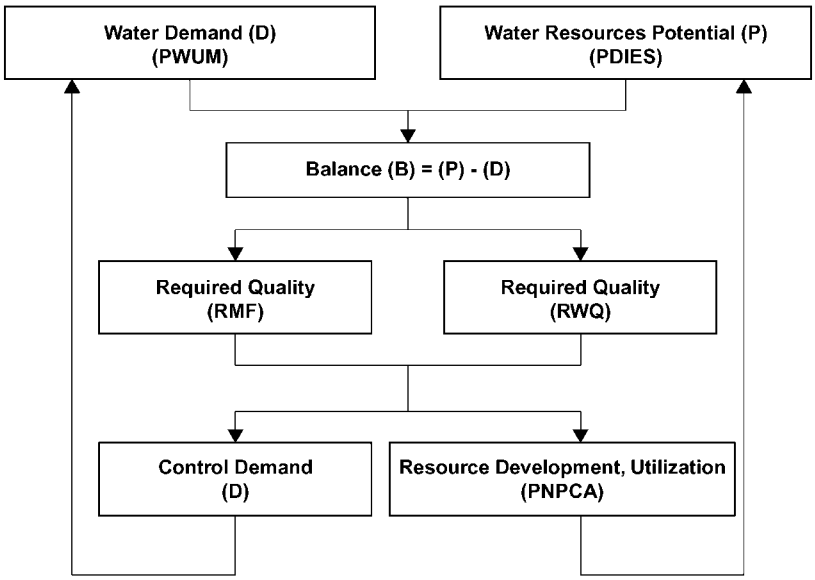


Fig. 20 Water Utilization Management Cycle and Roles of Rules

Meanwhile the Procedures of Water Utilization Monitoring (PWUM) facilitate the MRC and its member countries to assess the water utilization because the Procedure provides transparent monitoring of present water utilization. Thus the implementations of two procedures mentioned above afford the MRC to estimate the water balance in the Lower Mekong River basin.

Further Rules for Maintenance of Flows (RMF) and Rules for Water Quality (RWQ) specifies the required quantity and quality respectively. Consequently the results of comparative studies on water balance (B = P – D) and the required quantity, and the required quality may reveal the necessity of the control of water demand (D) or the management of water resources potential (P). The Procedures of Notification, Prior Consultation and Agreement (PNPCA) provide the procedures for the development of water resources as a measure of the water resources potential (P) management.

Since the subject is water utilization rules, the rules to control or to rationalize demand are out of scope of the Rule preparation and of this Study. However it should be noted that Article 6 and 10 of the Mekong Agreement provides the actions to be taken to remedy the situation. Article 6, Maintenance of Flows on the Main Stream, prescribes as follows:

> "The Joint Committee shall adopt the guidelines for the locations and levels of the flows, and monitor and take action necessary for their maintenance."

Meanwhile Article 10 Emergency Situations provides as follows;

> "Whenever party becomes aware of any special water quantity or quality problems constituting an emergency that requires immediate response, it shall notify and consult directly with the parties concerned and the Joint Committee without delay in order to take appropriate remedial action."

One of the actions to be taken should be the control of water demand (D) and water utilization if a shortage in water balance is detected. The Joint Committee is mandated to adopt the guidelines for monitoring and taking action for the maintenance of flows.

The provision specifies the monitoring of the flows at the selected stations along the mainstream of the Mekong river. Said flows represent the demand and supply balances in the relevant river basin. The monitoring should include the assessment of the observed flow or demand and supply balance because action can be taken after the comparison of the balance and the required quantity and quality. One of the most significant " special water quantity or quality problems" in Article 10 above may be the case that the monitored balance (B) does not satisfy the required quality or quantity. In this addition, the action designated on the basis of observed information on the flow or the balance liable to be behind the time and fail to maintain the flow due to the probabilistic uncertainty and spatial mobility with a certain lag time of flow. Consequently the action should be taken on the basis of forecasted information with appropriate lead-time. Along this line, the " monitoring" is understood to include the forecasting works on the bases of the observed hydro-meteorological time series, monitored water use time series and observed present balance for the two cases; Case of natural runoff without manipulation by water use and the case with water use.

Observation of flows or balance might be conducted by line agencies of each member country and transmitted to MRCS through the National Mekong Committee for filing as provided in the PDIES. Neither the Mekong Agreement nor the established Rules specify the organization that should forecast and assess the balance or flow at a station. The reliable and responsible forecast and assessment thereof should be informed to the relevant countries so that each country could take effective and cooperative actions in time.

4.2 The Implementation of Rules to Utilize the Waters in a Reasonable and Equitable Manner

As discussed in Chapter 2, the reasonable use of water aims the maximum or optimum utilization of the water resources taking account of the mobility and probabilistic uncertainty of water. The former section defines that the maximum utilization is to minimize the ineffective release of water to the sea under the conditions that the maintaining the required flows or balances of demands and supplies at the selected stations by means of taking appropriate actions on the basis of the monitored information.

As reiterated, the supply capacity or the potential of water resources varies from time to time and place to place. The water demand fluctuates from time to time as well due to various causes. The effective rainfall for agricultural cultivation, which has a decisive to define the diversion requirement, depends on the variable precipitation. In case the water availability in the upstream reach area is just enough and the downstream reach area is suffering shortage, appropriate controls of demands in the both areas may insure an equivalent use. In case of the contrary, the upstream reach may use the water to the maximum extent consuming even the water that otherwise be released to the downstream reach in normal situation. Agriculture with by far the largest demand has elasticity against water demand to some extent within a certain period. Accordingly a water supply corresponding to the controlled demand may not affect seriously only if the shortage due to the control is made up within a several days.

In this consequence, daily monitoring and daily balance forecasting are required to realize a reasonable water use by means of adaptable actions to cope with the hydro-meteorological fluctuation. Eventually, the implementation of Rules PDIES and PWUM are daily base. Along this line, daily implementation of maintenance of flows and water quality, or taking action are technically feasible although actual operation may be 10-day interval taking account of the costs to be incurred by operation.

The Rules are mostly frameworks and further guidelines, standards and detailed procedures are necessary to implement them effectively in the actual fields. However, a scenario of the implementations thereof is conceivable as an assumption applied in the study on the

enhancement of the hydro-meteorological monitoring system for the smooth implementation of the Rules.

The simplified scenario is assumed preliminarily and shown in the following flow diagram:

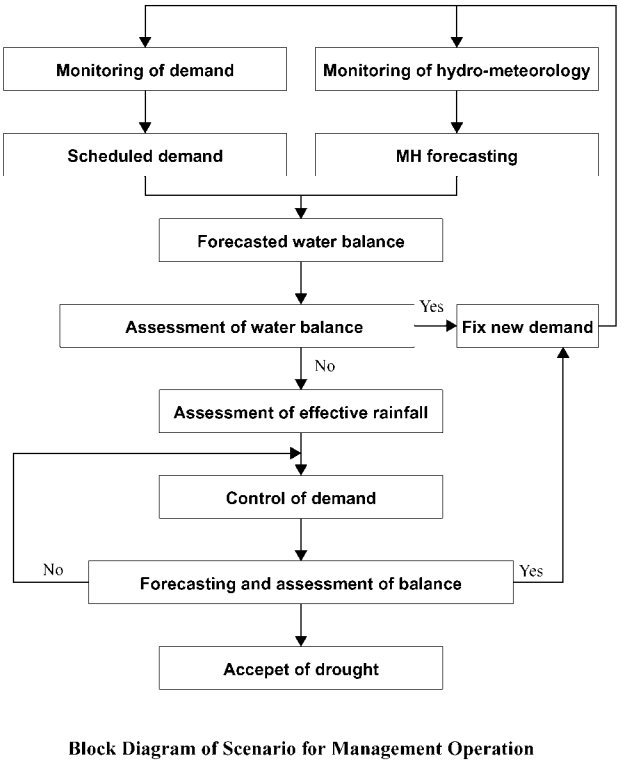


Fig. 21 Block Diagram of Scenario for Management Operation

Monitoring of hydro- meteorological conditions and water utilization is conducted daily or on real time. The schedule of demand and forecasting of hydrometeorology are to be made available. The estimation and the forecasting of flows at each selected station is daily works as well availing the monitored data and scheduled demands. The assessment thereof is carried out at the same time. All the works up to this assessment may be included in the works of monitoring.

If all the simulated flows exceed the required flows, no special action is necessary to be taken. If not, effective rainfall is accounted and the diversion requirement is decreased accordingly and the flows are reassessed. If all the flows exceed the requirement, no further action is taken. If any, further decrease of demand is considered. The actions to be taken shall comply with the reasonable and equitable water use principle.

A proposed water resource development project may affect water demand or the supply potential. The PNPCA are procedures to assess the response of the proposed development to the demand and supply balance along the diagram.

4.3 The Required Functions of the Hydro-Meteorological Monitoring System to Secure Effective Implementation of the Rules

4.3.1 Human Resources and Organization

Line agencies are responsible for hydro-meteorological observation. Each meteorological observatory and hydrological gauging station shall be able to send accurate data at least once a day to the regional office of the agency. A periodical skill-up of the observer should be applicable. The system that enhances the incentives of observer is necessary. A system should be able to solve electric and mechanical troubles within 24 hours after the trouble is detected. The regional office of a line agency should have function to assess the potential of water resources, effective rainfall and water demand. The regional office should have a function to maintain the monitoring equipments in the region. The central office should have function to assess the potential of water resources, effective rainfall and water demand. It should have function to develop the capacity of regional offices and observatories as well.

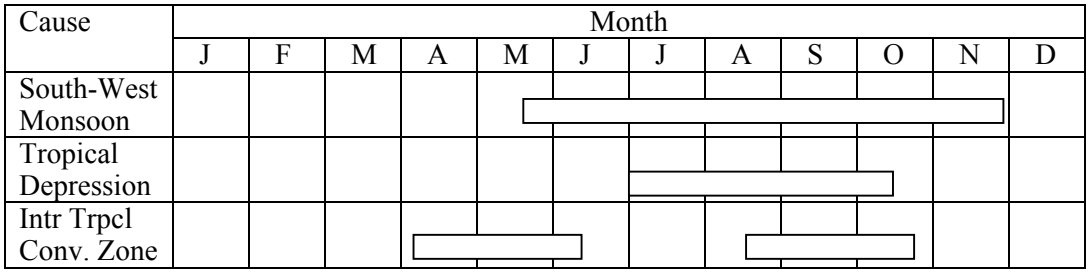
Each NMC shall have the function to review the assessment done by line agencies. It should have functions to review the demand control proposed by MRC and to advice the water resources managing authority to make decision.

The TSD of the MRC is in charge of the custodianship of monitored data. The TSD should have sufficient staffs to maintain the database. MRC should have a Joint Mechanism to carry out the simulation to forecast and asses the water demand and supply balances taking account of the effective rainfall. It should have function to submit the analyzed results to MRC to make decision on the modification of the scheduled demands under the principle of equitable water utilization.

4.3.2 Facility

Observations in all the observatories are to be carried out under any weather at least once a day. The observation should have accuracy of error within 10%. With regards to precipitation, the accuracy of the spatial precipitation estimation is important in addition to the accuracy of the spot rainfall. Since the products of the rainfall depth and the area gives the volume of water resources, the accuracy of the spatial rainfall depth or average rainfall depth is important.

The substantial causative phenomena of the precipitation in the Mekong River basin are the South-West Monsoon, tropical depression, which traverse from Mekong delta to Tonkin Bay, and Inter Tropical Convergence Zone (ITCZ). The contemporary occurrences of these causes bring wet season to the river basin. The following chart shows the timetable of the average occurrence.



Source; World Climate (Baifukan, Japan)

Fig. 22 Season of Precipitation in the Mekong River Basin

Usually the southwest monsoon or Tropical depression covers a large part of the basin by rainy cloud within a few days lags. Accordingly the depth of received rainfall is rather homogeneous within a certain area. Subsequently the mean of the point data obtained from several gauging stations may provide a spatial rainfall depth with certain accuracy.

Meanwhile the ITCZ, a kind of a line of front, which extends from East to west, lands at the Mekong Delta in the middle of April in normal year. It travels to the North and reach the northern end of the river basin in the middle of June. It goes north further until it reaches the Latitude of about 27 degree. Then it turns its travel to the south and reaches the northern end of the basin in the middle of August. It goes down to the South and it traverses the Mekong delta again in the middle of October on an average. The rainfall caused by the ITCZ is so called convective rainfall with a small rain cell and a high intensity but short duration just like the rainfall caused by a cold front.

Since a rain cell is small and covering area is only 5 km2 to 30 km2 in general, a point rainfall gauge tends to miss its detection. However it is not negligible in view of water resources. Moreover, with its high intensity it often causes flood if several such convective rainfalls occur in a group in a river basin at the same time. No record on the contribution of the ITCZ to the water resources in the Mekong River Basin could be found, and the available weather records are not such that allow to evaluate its effects on the total recorded rainfall. However the table presented below implies the considerable effect of the ITCZ on the average monthly rainfall depth recorded at several stations in the period from 1961 to1998.

The table shows the average monthly rainfall depth recorded at 6 stations located at different Latitude from South to North in the Lower Mekong River Basin. The assumed approximate days when the ITCZ might have passed the Latitude of each station site is marked with an asterisk (*) . The actual days of passing are not known but they are assumed based on the average movement of the ITCZ.

It should be noted that the monthly rainfall records have multiple peaks, which almost correspond to the assumed influencing period of the ITCZ except for Luang Prabang. In this addition, the first peaks appear at Korat, Kratie and Kep Monaster in May when the contributions of the southwest monsoon and the tropical depression might not be prominent as indicated in the chart shown in the previous page. Meanwhile the stations are located in the southern part of the Basin and the ITCZ passes those areas in the end of April to middle of May coinciding with the occurrence of the first peaks of the year. Eventually it may be natural to consider that the contributions of the ITCZ to the monthly precipitations are significant in this period.

After July, each station records the maximum peak in a year. All or some of 3 causes may affect the precipitation. It might be suggestive that the occurrences of the peaks after July distribute from July to October coinciding with the occurrence of the ITCZ again.

The occurrence of precipitation induced by the ITCZ is significant from the water use management viewpoint in the southern part of the LMRB. It brings precipitation in the end of April to May when the discharge of the Mekong River mainstream become low or sometime even the lowest. The effective rainfall that may decrease the diversion requirement is valuable for the implementation of the Rules for Maintenance of Flows because it may afford control of agricultural water demand without causing serious damages for the production.

Along this line, the monitoring system should have the function to measure and to evaluate the sporadic precipitation caused by the ITCZ with a certain accuracy and reliability.

Table 29 Average Monthly Distribution of Precipitation

(Unit : mm)

Name of Gauging Station	Latitude	Month												
		J	F	M	A	M	J	J	A	S	O	N	D	Ann
Luang Prabang	19 °53'	11.5	20.7	31.2	105.4	149.6	*178.7	230.2	*263.8	159.4	101.0	29.9	16.1	1297.5
Vientiane	17 °57'	6.3	12.8	37.4	82.4	232.7	*283.6	272.2	*317.3	285.6	90.0	8.6	4.7	1633.6
Savannaket	16 °33'	3.3	16.9	31.6	78.8	*160.2	261.4	217.3	*333.3	222.8	73.4	6.5	2.3	1407.8
Korat	14 °58'	5.3	19.9	40.2	63.9	*150.0	103.7	117.6	137.7	*235.2	135.5	27.2	3.5	1039.7
Kratie	12 °29'	9.0	9.3	28.8	87.8	*234.7	229.1	250.0	293.9	*292.0	155.8	41.2	17.6	1649.2
Kep Monaster	10 °28'	32.5	14.0	97.3	*197.6	260.9	236.1	384.3	308.8	276.8	*332.4	89.6	81.4	2311.7

Source: Hydrologic Yearbook from 1961 to 1998
Note): shaded figures show the local maximum; figures with asterisk (*) indicate the approximate period when the ITCZ is assumed to pass the gauging station site

No record of the study on the covering area of a rain cell caused by the ITCZ could be located in the Lower Mekong River basin. And a preliminary study was carried out to estimate the covering area of a precipitation to decide the outline of the specification for the function for the precipitation monitoring system.

According to the Hydrological Yearbook, the existing precipitation gauging stations that record the daily precipitation mostly populate the surrounding area of Vientiane and Nong Khai. The daily rainfalls recorded at 7 gauging stations are available in the area of about 4800km2 in the year of 1998. The gauging stations are Vientiane, Ban Maknao, Phon Phi Sai, Phen, Nong Khai, Tha Bo and Ban Phu.

Because of the location or the Latitude thereof, the ITCZ might have affected the rainfalls recorded in 2 periods of between May 25 and June 5 and between August 25 and September 5. On the other hand, only the SW monsoon and the tropical depression could be the causes of the precipitation recorded in the period between July 25 and August 5. The ITCZ might have not affected the precipitation in this period. Among these period, 14 rainy days were adopted for the analysis.

The spatial variability of the daily precipitation is examined estimating the mean area precipitation and standard deviation of the daily precipitation. The mean of the precipitation recorded at the seven stations is the estimation of the mean area precipitation (M) of the precipitation event in the day. The standard deviation (б) of the event is obtained on the basis of the estimated mean as mentioned above and the deviations of the precipitation recorded at each station. A coefficient of variability (C) given by б /M represents the spatial variability of the event and is commonly adopted as the index to show variability. The chart shown above illustrates the distributions of the estimated Coefficient of Variability. The precipitation affected by ITCZ results in higher C as compared with the precipitation that is not affected by the ITCZ. The C of 1.95 is the highest for the precipitation on September 1. There was some being affected by the ITCZ but show the smaller C of around 1.0. The influence of monsoon or tropical depression might have been so strong and the influence of the ITCZ might have been buried in. The maximum C among those not affected by ITCZ is 1.1 occurred on July 5.

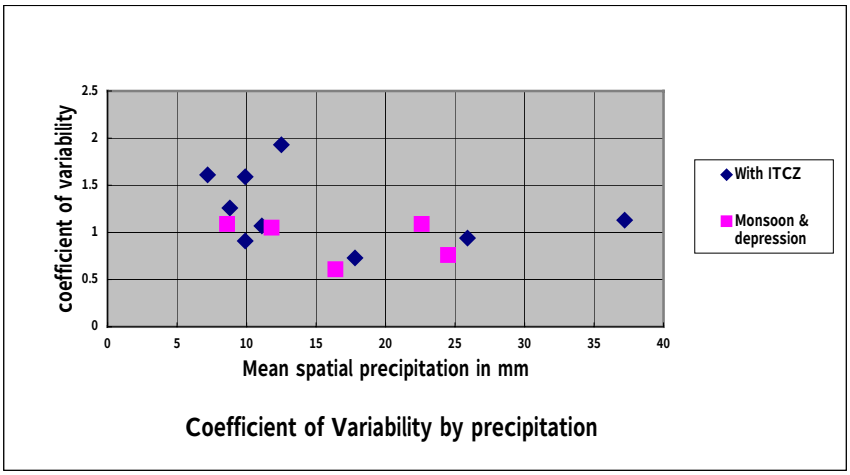


Fig.23 Coefficient Variability of Precipitation

Assuming that the intensity of the precipitation distributes according to the Normal Distribution N (μ, б2) in the area, the distribution of the estimated mean (M) accord to the Normal Distribution N (μ , б^2/ n). μ is the mean of the population and n shows the numbers of the sample, in this case 7 recorded at 7 gauging stations. Accordingly, normalization of the estimated M or E ・√n ・1/C is in accord with the standard normal distribution of N (0, 1). E is the error of the estimation. Consequently the occurrence probability of the normalized variable M or E ・√n ・1/C is defined. The table of the Standard Normal Distribution gives 0.6745 for the occurrence probability of 25%. Accordingly if the value of the variable, E ・√n ・1/C, is larger than 0.6745, the occurrence probability is less than 25%. In other words, the occurrence of the case that the variable exceeds 0.6745 is less than 25 times out of 100 times. The logics are given by the following formula;

$$E \cdot \sqrt{n} \cdot 1/C \geqq Zd$$

Zd is to be read from the table of the Standard Normal Distribution. If error of 10% in the estimation of area precipitation is acceptable and the estimation of 25 times out of 100 times is allowed to have larger error, since Zd is 0.6745, the formula presented above result in:

$$n \geqq 182 \text{ for C of } 2.0$$

$$n \geqq 55 \text{ for C of } 1.1$$

The figures for n shown above enunciate that the required numbers of the gauging stations in the area are more than 182 stations for the estimation of average spatial rainfall depth if the precipitation is affected by the ITCZ. Meanwhile data observed at 55 gauging stations may give the estimation of mean spatial precipitation within the error of 10% for 75 times out of 100 times.

Since the studied area is approximately 4800 km2 the mean areas covered by a station are 26.4km2 for the case of the ITCZ and 87.3km2 for the case without the influence of ITCZ. In other words, a rainfall gauge may monitor the area delineated by a circle with diameter of 2.9km in case of the ITCZ. The diameter may be extended to 5.3 km for the monitoring of the precipitation affected by only the monsoon or tropical depression.

A covering area of a gauge suggested as above is the preliminary and further study is necessary. There may be several controversial issues such as the assumption of normal distribution for the spatial variability of the intensity of the precipitation and the evaluation of the occurrence of the coefficient of variability.

In order to implement the Rules of maintenance of flows, the locations of stream gauging station sites are to be designated along the main stream of the Mekong river. In addition to the stations, gauging stations at the middle reach of each main tributary and large scale reservoir and pond are necessary for the calibration purpose of the Basin Model and simulation purpose to take action. The gauge should monitor water level on the real time bases subsequently automatic gauging is indispensable. The sensor and type of the gauge should adapt to the social, geomorphologic and hydrologic conditions of the site.

Discharge measurement is necessary at the monitoring site from time to time because the river channel is variable. The facility that measures both channel cross sectional profile and flow velocity at once is preferable.

Sediment samplers for suspended sediment and bed load are necessary. The hauling facility of sampler and sample are another facility to be secured. The facility to analyze the sample say laboratory is to be established.

The same are necessary for the water quality monitoring. With regard to the analyses of turbidity, BOD, COD, PH, temperature and density, automatic sampling and analyses are to be made available at several site along the river to detect emergency.

In the normal case, the transmission of data in an interval of one hour is sufficient. The data of electronic form is desirable for transmission, processing and filing.

The organization of the suggested Joint Mechanism (MRCS for the time being) shall hold a various soft wares like database, GIS, Basin model, Runoff analyses, Hydraulics, Sediment transport, Diffusion analyses and optimization to manage the water utilization. The hardware shall be corresponding to the role of the organization. Database server, GIS server, Processing unit and personal computing system are the minimum requirement in addition to the LAN system

4.3.3 Budget

In order to enhance the hydro-meteorological monitoring system for the implementation of the Water Utilization Rules, a special budget should be generated. The allocation of the special budget should envisage the compensations to each member country and the MRC for their additional expenditures due to the enhancement of the monitoring system.

The following are conceivable as the target items for compensation:

- Member country
  - Employment cost of new observer, laboratory analyst & NMC staff
  - Installation cost for new gauging station and laboratory
  - Renovation cost for the existing gauging and laboratory equipment
  - Cost for capacity building
  - Incremental maintenance cost

- Incremental operation cost (energy, materials)

- MRC
  - Employment cost of new analyst, specialist and supporting staff
  - Installation cost for new processing unit with software
  - Installation cost for new communication system
  - Cost for capacity building
  - Incremental maintenance cost
  - Incremental operation cost (energy, materials)

The MRC council should seek the measures to generate this new budget. There may be the opinion that the expenditure of each member country should be born by each government just as other budget for the governmental affair. However in order to assure the enhancement of the monitoring exclusive for the Rules implementation, it might be better for the MRC to extend cooperation to the governments to generate and allocate the budget.

5. EXISTING HYDRO-METEOROLOGICAL MONITORING SYSTEM AND THE IMPLEMENTATION OF THE RULES

5.1 Surveys

The WUP-JICA conducted a survey on the existing hydro-meteorological monitoring system to examine its adaptability to the functions required under the Rules. Each National Mekong Committee cooperated to the WUP-JICA in this survey as well and coordinated line agencies that are mandated to monitor hydro-meteorological conditions in each territory. WUP-JICA surveyed the MRCS as a recipient and the custodian of the data and information as well. So far the role of the MRCS in this respect is the custodianship, which is presently the terminal stage of the monitoring. However the monitoring works may be expanded up to forecasting and simulation works to assess the influences of the proposed action to be taken to maintain flows adapting to the hydrological situation when the Rules are implemented as discussed in the former Chapter in 4.2. The MRC may entrust the MRCS to conduct such data processing for the implementation of the Rules.

The survey focused on the data being monitored, capability of monitoring from human resources facet, facilities availed and budget allocated to the monitoring. WUP-JICA distributed questionnaire to the line agencies through the relevant National Mekong Committee in advance. Each National Mekong Committee held a meeting with WUP-JICA with the participation of the representing staff from agencies concerned on the occasion of the WUP-JICA's visit to collect the answer to the questionnaire. The answers to the questionnaire and the discussions in the meeting have furnished the WUP-JICA with effective information on the existing monitoring system.

The WUP-JICA surveyed the MRCS through interviews to the related staffs to assess the necessary enhancement of the monitoring system thereof to implement the Rules.

The agencies that gave answers the questionnaire are the following:

Cambodia: Cambodia Mekong Committee

- Ministry of Water Resources & Meteorology
  - Department of Meteorology
  - Department of Water Resources and River works

Laos: Laos Mekong Committee

- Ministry of Agriculture and Forestry
  - Department of Meteorology and Hydrology
- Ministry of Communication, Transport, Post and Construction
  - Waterway Administration Division

Thailand: Thailand Mekong Committee

- Ministry of Natural Resources & Environment
  - Department of Water Resources

- * Department of Groundwater
- * Office of Environment and Natural Resources Policy and Planning
- * Pollution Control Department

- Ministry of Agriculture & Cooperatives
  - * Royal Irrigation Department
- Ministry of Transport
- Marine Department
- Ministry of Interior
  - * Land Development Department
- Ministry of Information Technology & Communications
  - * Meteorological Department
- (Ministry of Energy)
  - * Electricity Generating Authority of Thailand

Viet Nam: Viet Nam Mekong Committee

- Ministry Agriculture and Rural Development
  - * Institute of Water Resources Research
  - * Institute of Water Resources Planning
- Ministry of Natural Resources and Environment
  - * National Center for Hydro- Meteorology

5.2 Human Resources for Hydro-Meteorological Monitoring

The line agencies of the member countries have contracts with local residents for the observation at the substantial gauging stations located in the isolated remote areas. The locations of the gauging station are usually remote even from the residences of such observor. The accesses are poor especially in the wet season. Staffs of branch offices of the agencies are mandated to measure most of the synoptic gauging stations. The incentives of these people are allowances for the observation. However almost all the observers feel that the allowances they receive are too small to pay efforts to observe and send the data to the regional offices. Accordingly they will quit observations rather easily if they have difficulties in access.

Special seminars for the observer have not contemplated. The chances to participate to orientation or seminar on hydro-meteorological monitoring are almost nil for these observers. Subsequently they have little concern about the importance of the monitoring in most cases.

Mechanical and electrical engineers or technicians for the maintenance works of the monitoring equipment are limited. Once they obtained such technology, they are easily to

transfer to enterprises that pay better salary to them. Accordingly the technologies are not accumulated and the transfer of knowledge is difficult. The closed system of personal affair which often impede their promotion is another reason for them to mobilize to private sector.

For the manager class of the regional offices or central government, scientific interest and betterment of water resources management become an incentive of monitoring. However the mobility of the experienced specialist is an impediment of the enhancement of monitoring. The reasons of the mobility are salary and the environment of works. Some experienced engineer in charge of monitoring iterated that he would like to actually experience the important roles of monitoring. He pointed out that monitoring itself is not always the objective and it might be sometime a measure or information to take action so that monitoring could carry out its mission.

Human resources development programs to reconfirm the mission of the hydro-meteorological monitoring and to foster the mind of cooperation are necessary to all levels of the staffs in the line agencies of the member countries.

As mentioned in Chapter 3, the Procedures for Data and Information Exchange and Sharing provided Mekong River Commission Guidelines on Custodianship and Management of the Mekong River Commission Information System in its attachment. While the Guidelines entrusted the Custodianship to the MRCS, it prescribe to establish the MRC-IS to support the activities of the MRC through serving information. The Guidelines provides further to establish the Information System Design and Implementation Team (ISDIT) to manage the MRC-IS inviting participants from the member countries and the MRCS.

Recently all the functions of ISDIT were succeeded by the newly established comprehensive organization of the Technical Assistance and Coordinating Team (TACT) with the participation of representatives from each member country. The TSD is mandated to play the role of the TACT secretariat. The TSD is managing all the information system of MRCS with its 6 staffs. It may require a special database administrator and additional system engineers to comply with the enlarged tasks.

5.3 Facilities for Hydro-Meteorological Monitoring

5.3.1 Facilities for Precipitation Gauging

The meteorologists and hydrologists from all the member countries indicate the main causes of the precipitation are the SW monsoon, tropical depression and the Inter Tropical Convergence Zone. Amongst, they admit the SW monsoon is the most significant cause of the precipitation in their territories. While ones from Thailand and Vietnam place the tropical depression in the second significance and The ITCZ third, ones from Cambodia and Laos place the ITCZ second and the tropical depression third.

The substantial precipitation gauges have tipping bucket type sensors. Roll Paper logging are dominant but recording on a magnetic card is becoming popular recently. Manual measuring by measuring cylinder is common in a comprehensive meteorological station to collate the records of automatic gauges. Tele-metering systems are installed where real time data are necessary for operation of facility such as a hydroelectric power station.

Most of the countries adopt the equipment and location of gauging station in accordance with own standard or standard proposed by the WMO. The actual experience in usage is one of the most important conditions to select the type of the equipment considering the maintenance and repair. Meanwhile the condition of access is an important factor to select the location of the gauging station. This is quite natural taking account of the manual data collection and the maintenance works of the equipment.

The MRCS registered about 700 gauges in total. The numbers of the gauges are distributed to the territory of each member country rather evenly. The MRCS received the data observed at 231 stations in case of 1997 or almost 30% of these stations and compiled in the Lower Mekong Hydrologic Yearbook. The numbers of the data is too small to estimate spatial mean precipitation.

5.3.2 Facilities for Water Level Gauging and Discharge Measurement

The substantial water level gauges have pressure sensors or float sensor. Roll Paper logging are dominant but recording on a magnetic card is becoming popular recently. Manual observation by measuring staff gauge is adopted for backup at important gauging stations. Tele-metering systems are installed where real time data are necessary for operation of facility such as a hydroelectric power station.

Most of the countries adopt the equipment and location of gauging station in accordance with own standard. The actual experience in usage is one of the most important conditions to select the type of the equipment considering the maintenance and repair. The sedimentation and scouring at the gauge site are matters to be deliberated in the selection of the location in case of the Mekong river basin. Further the condition of access is an important factor to select the location of the gauging station as well. This is quite natural taking account of the manual data collection and the maintenance works of the equipment.

The MRCS registered more than 200 gauges in total. The numbers of the gauges are distributed to the territory of each member country rather evenly. The MRCS received the data observed at 125 stations or almost 60% of these stations in 1997 and compiled in the Lower Mekong Hydrologic Yearbook. The numbers of the data are supposed to be sufficient to make the estimations and the forecasts adaptive to the actual figures. Monitoring at borders might be necessary for water utilization management.

Discharge measurements are carried out at the selected stations therefrom. Measurements are carried out at least twice a year, once in dry season and once in flooding season. Most of the case current meters are used to measure the flow velocity at the sites. Meanwhile, GPS system, leveling surveys and theodolite with echo sounder are common equipment to measure the river cross section. Trucks howl this equipment to the site and boats are used for the underwater works. There are sites where wires are provided to fix the boat. There is a difficulty to settle the current meter at the intended depth even such wired sites.

The line agencies in charge of discharge measurement have developed the discharge rating curves on the basis of the data on water stage and the measured discharge. WUP- JICA has cooperated the government of Cambodia in the establishment of discharge rating curves in the territory.

5.3.3 Facilities for Sediment Discharge Measurement and Water Quality Analysis

The line agencies of the member countries have carried out sediment analysis with frequencies of once a month to 4 times a month. The used equipment are mostly those internationally accepted sampler for the suspended sediment sampling. Samples are to be sent to laboratory and the concentrations thereof are estimated. Most of the agencies do not conduct sampling of bed load.

The line agencies of the member countries have carried out water quality analysis mostly with frequencies of once a month. The used equipment are mostly those internationally accepted sampler for the water sampling. Samples are to be sent to laboratory and the concentrations thereof are estimated using mainly Ph-meter, conductivity meter, DO-meter and spectrometer.

5.3.4 Facility for Communication and Data Transmission

Precipitation Data

The answer to the questionnaire reveals that more than 60% of the daily precipitation data are sent to the monitoring center within 24 hours. The remaining data are sent in paces of once 2days, monthly and once a year.

The measures availed to send the data are post or by hand (50%), telephone or fax (30%), E-mail (10 %) and SSB exclusive radio (10%). The daily transmission of 60%, described as above, exceeds the total of telephone or fax, E-mail and SSB of 59%. This enunciates that at least 10% of the records are brought to the center by hand within 24 hours.

The monitoring center transmits 10% of observed data to NMC daily including the data for flood forecasting. The NMC receive about 50% at once in a year to prepare the yearbook. E-mail is the substantial measure transmitting about 45% of data to NMC. Accordingly there might be the possibility that the NMC receive 60 % of data daily without significant additional input availing E-mail some more.

Stream Flow Data

The answer to the questionnaire reveals that more than 50% of the daily water level data are sent to the monitoring center within 24 hours. The remaining data are sent in paces of once 2days, monthly and once a year.

The measures availed to send the data are post or by hand (45%), telephone or fax (35%), E-mail (10 %) and SSB exclusive radio (10%). The daily transmission of 50%, described as above, is slightly lower than the total of telephone or fax, E-mail and SSB of 55%.

The monitoring center transmits 30% of observed data to NMC daily including the data for flood forecasting. The NMC receive remaining about 70% at once in a year to prepare the yearbook. E-mail is the substantial measure transmitting about 50% of data to NMC. Accordingly there might be the possibility that the NMC receive 50 % of data daily without additional significant input availing E-mail some more.

Water Quality Data

The answer to the questionnaire reveals that more than 20% of the water quality data are sent to the monitoring center within 24 hours. The remaining data are sent in paces of once 2days and monthly.

The measures availed to send the data are post or by hand (70%), telephone or fax (10%), E-mail (10%) and SSB exclusive radio (10%).

The monitoring center transmits 10% of observed data to NMC within a day. The NMC receive remaining about 90% at once in a year to prepare the yearbook. E-mail is the substantial measure transmitting about 55% of data to NMC.

Data Processing by the MRCS

The TSD of the MRCS has installed 3 units of IBM X-series for the server including 1 temporary unit. The installed servers have managed LAN, GIS, various databases like the Hymos and DSF. So far the installed software like Arc Info, Oracle, Microsoft Access has functioned well. The performances of such tools are satisfactory and only specific software to implement the Rules might be necessary in the future

5.4 Budgetary Constraints and Other Issues

The data on the exact annual budgets to be allocated to hydro-meteorological monitoring have not been available for each country because an accountable and reasonable segregation of the gross amount to the specific works requires a complicated study. However the amounts are assumed to be in a range between 50,000USD and 200,000USD. The assumed amounts are not sufficient even only for the maintenance. And enhancement or extension of the existing system is not affordable. Actually the surveyed results enunciate that the budgetary constraints are the most significant impediments for both observation and data transmission. The water use management on the basis of the monitoring optimizes the use of water resources decreasing the ineffective discharge and increasing available water. And certain benefit may accrue through a good water management. The alternative cost concept should be introduced in the budget allocation.

6. SUGGESTIONS AND RECOMMENDATIONS

6.1 Findings and Conclusions

The Lower Mekong Basin (LMB) lies in an extensive area from latitude 10 degrees to 21 degrees in the Indochina Peninsula. The main causes of precipitation therein are the Southwest Monsoon, tropical depressions and the Inter-Tropical Convergence Zone (ITCZ). The occurrence of these causes is simultaneous in certain periods of the year in the basin. Consequently the area receives the substantial precipitation in that period of a year. In this addition, the rainy season of the Upper Mekong Basin timely falls on almost same period in a year and entails to discharge high flows to the LMB.

Eventually the fluctuation of the stream flows is significant within a year. The average monthly flow in September is almost 15 times of one in April in the middle reach along the river. The LMRB is susceptible of the recursive alteration of flood and drought.

The river channel is mostly kept natural. There are some stretches with riverbanks that are eroded by the attack of flood flows. Meanwhile it is rather frequent to find that a silting of sediment materials forms a huge sand bank. The river channel is variable as well.

The residents of more than 70 million in the LMRB have relied their livelihoods on the bounty of the Mekong River. The main industries therein are agriculture and inland fishery. The sustainable developments of these industries are vital to the socio- economic development of the LMRB.

In the light of this, the important roles of Water Utilization Rules are conspicuous to secure sustainable development of the area because the Rules are the procedures agreed by the member countries of MRC to afford reasonable and equitable use of the water resources of the LMRB.

The Council decided to formulate 5 Rules in its 6th meeting in 1995 as mentioned in the former chapter. The MRC under its Water Utilization Program (WUP) has been preparing the Rules together with Technical Drafting Group participated by the delegations from each member country. They have successfully formulated 3 Rules out of 5 by the end of November 2003.

Institution comprises legal aspects and organizational aspects as its main components. Hence the Institutional Strengthening by the JICA Study comprises legal strengthening and organizational strengthening. The strengthening was duly specified as to provide suggestions to the MRCS in legal and organizational aspects with regard to the Rules as follows;

- Legal strengthening
  - Strengthening for rule preparation
  - Strengthening for rule implementation
- Organizational strengthening
  - Strengthening for the organization of hydro-meteorological monitoring

6.2 Conclusions Related to Rule Preparation

The Rules are international agreements and should consist with the stipulations of the internationally accepted frameworks for universal application in general. The frameworks are Helsinki rules established in 1966, UN Geneva Resolution agreed in 1980 and UN New York Resolution agreed in 1997 in its general assembly. In this addition, the Rules should be consistent to the domestic related laws as well to be implemented smoothly in each country.

As a strengthening for rule preparation, the Study abstracted important concepts and principles from ones adopted in the internationally accepted frameworks as a guideline for the Rule preparation. And the Study provided the interpretations thereof to furnish MRCS with rather technical meanings for their reference in Rule formulation. The prominent interpretations with regard to the rule formulation are shown as follows:

- Reasonable use of water
  - Optimum water uses which take account of the mobility and probabilistic uncertainty of water resources.
- Equitable use of water
  - Water uses which provide equity of balance of right and duty in the management of water resources. Equity is defined taking account of various factors such as population, drainage area, hydrological contribution, existing use and others.
- Harmful effects to others
  - To cause undesirable effects to water resources in terms of quantity and quality including to jeopardize the designated flows to be maintained.

The confirmation study on the conformity of domestic laws to the international frameworks is another substantial legal strengthening because if a domestic law is inconsistent to the Frameworks, the rules to be formulated consistent to the Frameworks may conflict with the domestic law in its implementation stage. The study confirmed that all the proposed laws are consistent to the Frameworks although there are some that are not ratified yet. The results of the Study enunciate that the Rules being prepared are consistent to the domestic laws if the Rules are formulated along the international Frameworks. There are some domestic laws that mandate water using agencies to manage water resources. There are some laws that do not manifest the priority of international treaties in managing water resources in its provisions.

Most of laws do not mandate the water user to monitor and report the hydrologic conditions of the water resources. Most of laws prescribe the right of water use but very little mandate the user to monitor water use and to report it to water administrator.

6.3 Conclusions Related to Rule Implementation

Water resources management is an activity to maintain the balance of water demand and supply or potential in a appropriate level or more as shown in the following block diagram of work flow;

The balance is compared with the required quantity and quality, which are priorly designated under various conditions. If the balance could not satisfy the requirement, an action is necessary to be taken either to increase supply (P; potential) or to decrease demand (D)

because balance (B) is expressed by the simple logical form of B = P - D. The Rules are well allocated strategically to the blocks in the diagram as frameworks.

While the Procedures for Data and Information Exchange and Share (PDEIS) is to contribute to the assessment of water resources potential (P), the Procedures for Water Use Monitoring (PWUM) is to provides the information on the water demand. The Rules for Maintenance of Flows (RMF) and Rules for Water Quality (RWQ) define the required water quantity and quality of balance respectively. The Procedures for Notification, Prior Consultation and Agreement (PNPCA) is the rules to develop water resources to increase the water potential (P) to improve the balance. An additional rules for the control or rationalize demand (D) are necessary in the stage of the implementation.

The water management takes action on the basis of the forecasted water balance so that the action is in time. Subsequently the rules for the compensation for the damages incurred by the error of forecasting are necessary in the implementation stage.

Further the rules to compensate the damages brought by the exceeding water use that impeded the maintenance of flow are necessary to avoid serious conflict among the countries in the implementation stage.

6.4 Conclusions Related to Organization

Understanding on the Procedures and Rules of line agencies are not sufficient. Their understandings on the mission to monitor hydrology and water use are still insufficient in view of the implementation of the Rules.

The study on the organization for the hydro-meteorological monitoring and water use monitoring system regarding human resources established the necessity of human resources empowerment for line agencies, National Mekong Committee and Mekong River Committee Secretariat.

The roles of the MRCS become more important when the Rules are implemented. The numbers of TSD staff should be increased to provide services with the same level against the inflated tasks.

The study regarding facility revealed that the influence of the ITCZ to the precipitation in the LMRB is significant. The existing numbers of the precipitation gauging station are far satisfactory to estimate the spatial precipitation depth due to the sporadic nature of the precipitation being affected by the ITCZ. The data transmission measure between a gauging station to the central office of the line agency are mostly manual and should be improved to afford reliable daily transmission. Additional hydrological observation stations are required to monitor the flows to be maintained. The facilities to measure the discharge should be provided taking account of the variable channel section.

TSD of the MRCS have been processing all the necessary works with the server of 3 units. The existing servers are sufficient for the time being. However some additional capacity up may be necessary to carry out the increased jobs when the Rules are implemented.

The MRCS and Technical Review Group (TRG) is mandated to implement the RMF and RWQ using Decision Support Frameworks (DSF). Since the DSF is simulator to estimate the balance of water, additional software to support the selection of the optimum scenario for maintaining flows and water quality is necessary as the next step of taking adaptive actions.

Budget is not sufficient especially for observation and for maintenance and repair of the equipment for observation. The implementation of Rules may incur additional expenditures to

line agencies to collect data on hydrology and water use. The maintenance costs of computer software are not negligible even now. The increase in the maintenance cost of database is foreseeable in the custodianship of the MRC.

6.5 Suggestions and Recommendations for Preparation and Implementation of the Rules

6.5.1 Procedures for Exchange of Data and Information and Shares

The data presently provided to MRCS through each National Mekong Committee are weather data including precipitation and hydrologic data with regard to quantity and quality. The agencies conducting the monitoring adopt their own standards for selection of monitoring equipment, monitoring methods and method of data transmission. The data to be exchanged under these Rules include other various kinds of data such as topography, land use, soil and so on. Standardization of monitoring, measurement and classification are necessary including the specification of data transmission. The MRCS through TACT should take the initiative on this matter.

Procedures and method for forecasting water resources potential on the basis of the monitored data should be developed to generate input data for the simulation using the DSF in order to assess the water resources.

The establishment of procedures and methods to disseminate the decisions availing the facilities of the data exchange are necessary to notice the decision to the relevant NMC to take actions smoothly.

Procedures to make up the incremental expenditures of the line agencies incurred by the implementation of these Procedures should be established because the monitoring sections of line agencies are suffering of budgetary shortage even now.

6.5.2 Procedures for Notification, Prior Consultation and Agreement

Prompt definitions of the starting and terminating dates of the wet and dry seasons are necessary to implement the Procedures as provided in the stipulations therein. The section 2.6.3 in chapter 2 of this paper presents an approach to define in reasonable manner.

The adopted principle in the Procedures as prescribed in Article 3 should be carefully defined to guide the implementation thereof to be accepted by all the member countries. Amongst the definition of the principle of reasonable and equitable use might be important because all the four countries may enumerate the impact to their water resources to assess the equitability when a water use plan is proposed. Only a detailed definition of equitable use might be able to avoid the confusion.

Procedures for dealing with a proposed water use plan which is judged and claimed not to accord to a principle by a country or countries might be necessary to avoid conflicts and to foster friendship and cooperation among the countries.

6.5.3 Procedures for Water Use Monitoring

The establishments of procedures and method for forecasting future water use on the basis of the monitored data and planned water uses are necessary to generate input data for the simulation using by the DSF. In this connection, effective rainfall and return flow in the agricultural land might be imperative to assess the consumptive use.

The MRC has decided to entrust TACT to implement the Procedures. TACT is necessary to prepare a detailed procedure for implementation such as the standards for the monitoring.

The detailed approach and procedures to link the water use data with the DSF are necessary as well to assess the influence of the water use over the water balance.

The monitoring of water use incurs additional expenditure to the line agencies. The procedures to compensate the expense might be necessary.

6.5.4 Rules for Maintenance of Flows and Water Quality

Concrete definition of equitable use is necessary in order to define the flows to be maintained. In this connection, the descriptions in 2.6.4 of Chapter 2 of this paper suggest an interpretation of the principle. Among the main issues of the study on the definition may be the factors to be taken into consideration. The priorities or weights thereof should be evaluated in the definition of equitability such as population, hydrology, basin area, existing use and so on.

The data and information obtained through the implementation of PEDIS and PWUM afford operational or adaptive implementation of the Rules for maintenance of flows and maintenance of water quality. The data of demand and potential generate an eventual flow or balance and the water quality through most probably working out the DSF. The MRCS should develop the software to link the data obtained by the implementations of PDEIS and PWUM with the DSF so that timely balances are to be obtained.

The MRC has decided to entrust TRG to implement the Rules for Maintenance of Flows on the Main Stream. The prompt establishment of the TRG is necessary to prepare the detailed technical criteria, procedures and algorithm to define the flows to maintain adaptively.

As mentioned before, one of the option to maintain flows and water quality may be the resource potential enhancement through water resources development implementing the Procedures of PNPCA. The other option to maintain flows and water quality is control or rationalizing of demand. Operational or real time maintenance is affordable by means of the demand control adaptive to the variable potential. So far neither rule nor procedure is prepared to control demand. Prompt formulation of new rules to control demand is necessary. The Rules in question should comply with the principle of reasonable and equitable use taking account of effective rainfall and reserving in or releasing water from reservoirs. MRC might be responsible to prepare these new Rules but additional input from out side might be effective as well to reflect knowledge and experiences to the works of the MRC since the formulation of new Rules might require a comprehensive approach.

The input from out side may need about 2 years of study period including the time for steering and deliberations by the MRC. From time to time workshops are to be held to present the intermediate results of the study. The results of the study will be referred to by MRC as preliminary study for draft Rules for taking action by means of the control of demand.

In this respect, studies on various disciplines are necessary as given below:

Social Study:	Assessment of social impacts of demand control
Economic Study:	Assessment of economic impacts of demand control
Hydrologic Study:	Hydrologic forecasting and assessment of physical impacts of demand control

Agronomic Study:	Study on effective rainfall, return flow and incremental consumptive use
Institutional Study:	Study on demand control that afford equitable water use
Water Resources Management:	Demand forecast, assessment of reservoir operation, motion-time study of control and multi-disciplinary optimization
Environmental Study:	Assessment of environmental impacts of demand control
Legal Study:	Examination of the consistency to the domestic water related laws

MRC will thus make decision to take action to maintain the flows in view of reasonable and equitable water use. The Rules or manual to disseminate the decision to each NMC is necessary to secure a reliable implementation of the decision.

The implementation of the Rules might be the monitoring of water levels at the stations to be defined and the confirmation of the water levels to clear the required levels. In this respect, it should be noted that a variation of the river channel entails that the water levels to be monitored may not reflect the flows to be maintained. Further a variation of a river channel and eventual change in flow surely affects the relations of water levels and flows at the up- and downstream reaches.

6.5.5 Some Issues to Note with Regard to Domestic Water Related Laws

There are some domestic laws that mandate water, using agencies to manage water resources. Such agencies should make effort to secure transparent water management.

There are some laws that do not manifest the priority of international treaties in managing water resources in its provisions.

Most of laws do not mandate the water user to monitor and report the hydrologic conditions of the water resources. Most of laws prescribe the right of water use but very little mandate the user to monitor water use and to report it to water administrator. Prompt establishment of a rule to mandate water use monitoring might be necessary.

6.6 Suggestions and Recommendations for the Strengthening of the Organization for Hydro-Meteorological Monitoring

Human resources, facility and budget are the main components that constitute an organization. Hence the strengthening of each component contributes to the organizational strengthening.

6.6.1 Strengthening of Human Resources

The urgent requirement with regards to the strengthening of human resources might be the empowerment of the existing human resources. Empowerments are necessary to various level of the manpower such as observer, technician, hydro-meteorologist, manager of line agency, staff of NMC and MRC-IS including TACT to improve not only technology but also to foster the mind of cooperation. Capacity might be enhanced through seminar, workshops and field works. Since such enhancement requires special tools and other input, it might be effective to

organize an exclusive team to carry out the human resources empowerment program with cooperation from TSD of MRCS.

Seminar, workshops and field works are to be conducted in each country as national base. However exchange of experiences among the member countries tends to encourage the acknowledgement of the mission to monitoring. Along this line, the schedule of workshops should envision to include ones of regional basis as well. The main subjects of seminar and workshop for each category of human resources are as follows:

Observer & Technician:	Standards of technology, mission of monitoring
Hydro-Meteorologist:	Design of monitoring network, Rules, DSF and the river basin hydrology
Manager of Line Agency:	Concept and principles of Rules, DSF, the river basin hydrology and water resources management
Staff of NMC & MRXS:	Concept and principles of Rules, DSF, the river basin hydrology and water resources management

About 18 months of period is necessary. The planning and preparation of the materials may need the first 8 moths period. The seminars, workshops and field works consume the next 8 months. The last 2months are the period for the assessment of the program and planning of the future capacity building program. The report to be prepared compiles all the data and the results of the assessment. The necessary inputs to carry out the program are estimated as follows:

(1) Manpower

Water Resources Engineer:	Preparation of material, resource presentation
Hydrologist:	Preparation of material, resource presentation, field works
Legal Specialist:	Preparation of material, resource presentation
Electronics Engineer:	Preparation of material, resource presentation, field works
Facilitator:	workshop

(2) Equipment and Facility

PC:	Preparation of materials, presentation
Projector:	Presentation
Measurement Equipment:	Field works
Land Vehicle and Boat:	Transportation and field works

The monitoring works are mandated to TACT by the MRC. The TSD of the MRCS plays the role of the secretariat of TACT. The data to handle and database and processing software to maintain may increase to some extent from the existing ones. Consequently the TSD should additionally employ a database administrator and 5 systems engineer. Further the TSD should

employ an economist and a sociologist because it will be the secretariat of TRG, which will implement Rules for maintenance of flows and water quality. In order to make a decision, economic and social assessments of each conceivable option are indispensable.

6.6.2 Strengthening of Facility

A preliminary study on the precipitation revealed that the influence of the ITCZ to precipitation is significant in the LMRB. Further the results of the Study indicate that a rainfall gauging station may represent the area of about 26 km2 that surrounds the gauging station site. This implies that the existing gauging system by means of point rainfall observation is not realistic to estimate the spatial precipitation received in the basin area of 606,000 km2. Along this line, a special gauging system to install RADAR rainfall gauge should be studied. Examinations and studies from various viewpoints are necessary prior to apply the system for the quantitative monitoring of operational purpose. And it is advisable to entrust the study to outside experts with experiences under the close cooperation from the TSD. The scope of main works for the study is aggregated as follows:

- Hydro-meteorological study to confirm the necessity of RADAR gauge
- Performance study on the existing RADAR system
- Preliminary design on the integrated RADAR networks in the LMRB
- Selection of sub-area for pilot system
- Basic design of pilot system
- Study on real time calibration method
- Study on operation, maintenance and repair
- Field prove test and analysis using a small scale equipment

The study should provide seminar and workshop at appropriate stage of the study. About 26 months is necessary to complete the Study. The field prove test should be carried out from 13th month to 24th month to experience all kinds of precipitation. The analysis and assessment may require the last 2months. The necessary input for the study from outside is assumed as follows:

(1) Manpower

Hydro-Meteorologist:	Study on precipitation, real time calibration methods
Radar Experts (2):	Design of integrated system, design of pilot system and field test
Water Resource Engineer:	Study on existing performance, design of integrated system, design of pilot system and field test and analysis of tested results
Equipment Specialist:	Study on OMR

(2) Facility & Equipment

Small-Scale Radar:	Field prove test

Vehicle: Transportation and hauling

Foundation: Field test

Monitoring of flows at the designated sites along the mainstream is necessary to implement the Rules for the Maintenance of Flows. The MRC should decide the locations of the monitoring sites as soon as possible. The MRC should select the most suitable gauge equipment taking account of the variability of the river channel. There are riverbanks susceptible to scouring. Meanwhile there are riverbanks buried by silting of sediment. In site selection the followings shall be considered;

- Representation of the site of the water use and environmental requirements of the area
- Stableness of the river channel
- Backwater effects

A change in the river channel affects the flows and water levels of the up- and downstream reaches where relevant flows to maintain are to be designated. Accordingly the monitoring of channel stabilities is prerequisite. In this respect, an equipment to be installed in the site should afford easy measurement of the flows coupling with the survey of the river channel like ADCP.

6.6.3 Strengthening of Budgetary Arrangement and Related Recommendations

The allocations of budget to the monitoring works are limited in most of the countries. While the gauge observers manifest that their incentives for observation are allowances, the actually paid are tiny. There is anxiety that monitoring of water use may exacerbate the shortage in budget. The MRC should support the system to compensate the additional expenditures of line agencies incurred by the implementation of the Rules. In this respect, the MRC should study the system to collect tariffs from the use of water and river.

The implementations of the Rules for maintenance of flows and water quality call for adaptive demand controls on the basis of forecasted hydrology and water demand. The MRC should establish the system to compensate the opportunity damage induced by the error of forecast.

The Rules are to be implemented to function effectively. However, there may be the case that a use of water entails harmful effect to others or jeopardize the flows to be maintained. The MRC should formulate the rules to compensate the harmful effects to be incurred.

A development of a project on the basis of joint financing, joint development and joint operation may be effective to foster a practical cooperation among the member countries and to realize equitable use of water. The MRC should establish the system to develop projects jointly. The MRCS may play an important role in the establishment and operation of the consortium.