No.

JAPAN INTERNATIONAL COOPERATION AGENCY

COMMITTEE OF EMERGENCY SITUATIONS
AND CIVIL DEFENSE
THE REPUBLIC OF TAJIKISTAN

THE STUDY ON
NATURAL DISASTER PREVENTION
IN PYANJ RIVER

FINAL REPORT

VOLUME 1 MAIN REPORT

DECEMBER 2007

CTI ENGINEERING INTERNATIONAL CO., LTD.

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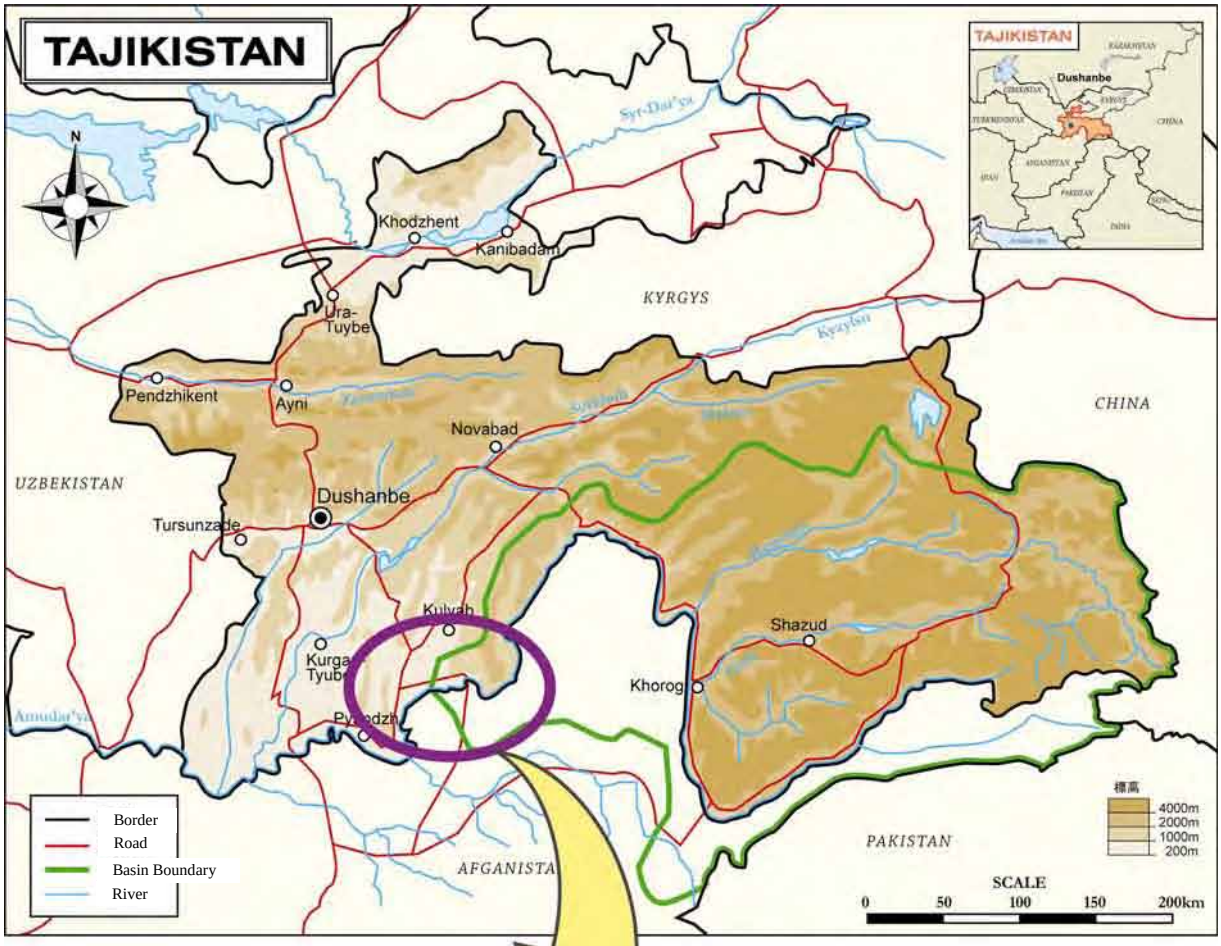
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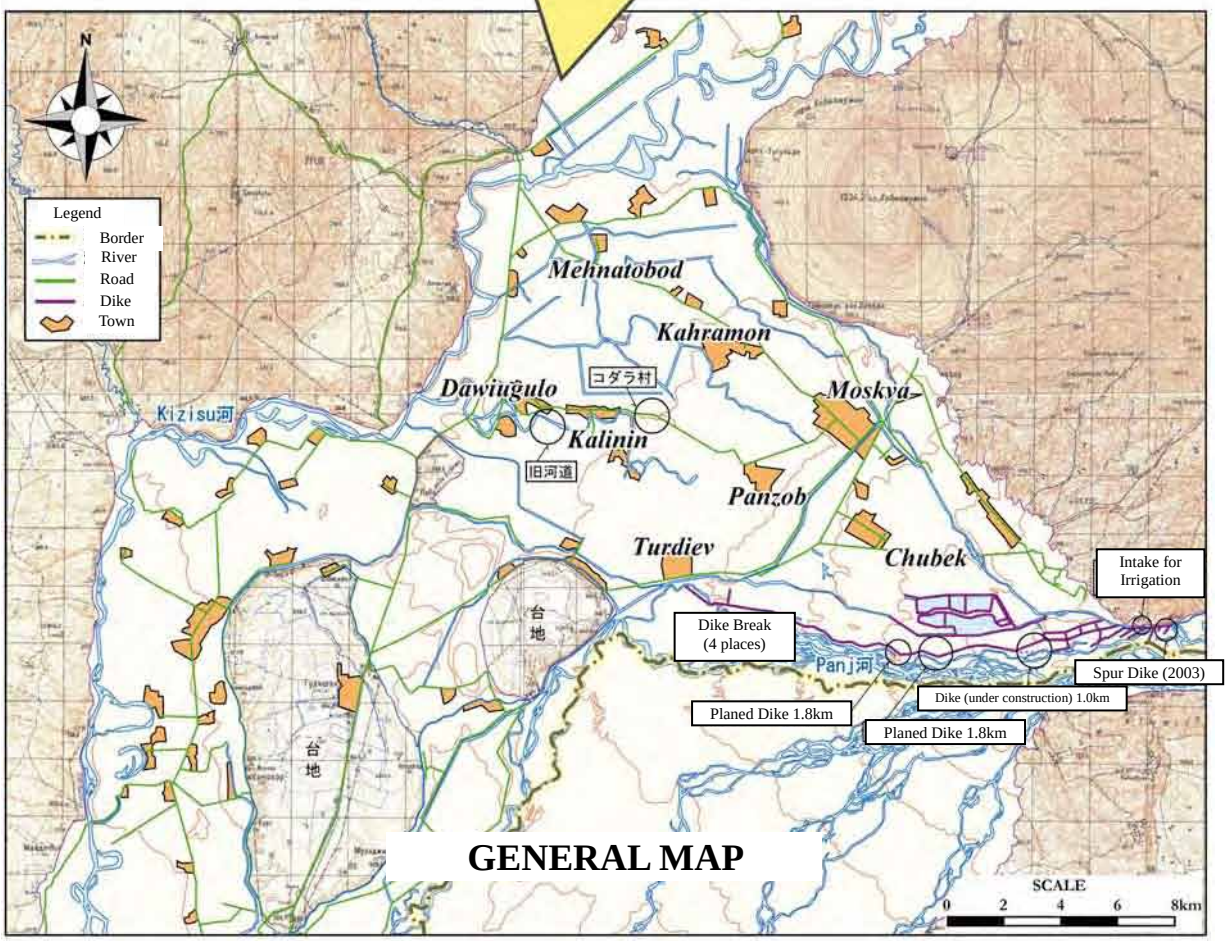
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台地
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GENERAL MAP

PREFACE

In response to a request from the Republic of Tajikistan, the Government of Japan decided to conduct a Study on Natural Disaster Prevention in Pyanj River in the Republic of Tajikistan and entrusted to the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Toshiki Kawakami of CTI Engineering International Co., LTD. between March, 2006 and November, 2007.

The team held discussions with the officials concerned of the Government of the Republic of Tajikistan and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Tajikistan for their close cooperation extended to the study.

December 2007

Ariyuki Matsumoto,
Vice President
Japan International Cooperation Agency

SUMMARY

CHAPTER 1 INTRODUCTION

The Republic of Tajikistan, bordering with Kyrgyzstan on the North, China on the East, Afghanistan on the South and Uzbekistan on the West, has an area of 143.1 thousand square kilometers, more or less, 93% of which is characterized with a mountainous topography. The Pyanj River, the objective of the Study, originates in the Pamir Highlands, runs from east to west along the border with Afghanistan, and drains into the Aral Sea in Uzbekistan. The Pyanj River has brought benefits with water resources for the Hamadoni District while the excess water has brought harm with floods. Therefore, in the Soviet Union Era, an irrigation system was installed and a dike was constructed to protect the district from floods. However, after the country became independent from the Soviet Union in 1991, the dike suffered from bank erosion and partial destruction due to the repeated attack of floods and lack of proper maintenance. As a consequence, the district has suffered from flood damage, repeatedly.

Specially reported was the flood in Hamadoni District in July 2005, which devastated 48 ha of cotton fields, 190 ha of wheat fields, 5 km of trunk roads, 3.5 km of river dikes and 3 water supply districts, accounting for 50 million US dollars in total damage. The flood damaged area in Hamadoni District reached a total of 4000 ha.

Under the above circumstances, the Government of the Republic of Tajikistan (hereinafter referred to as “the Government of Tajikistan”) had officially requested the Government of Japan to provide technical cooperation and assistance in conducting a developmental study to find a solution to the issues of perennial flooding. In response to the request, the Government of Japan had decided to conduct the Study on Natural Disaster Prevention in Pyanj River in the Republic of Tajikistan (hereinafter referred to as “the Study”) through Japan International Cooperation Agency (JICA).

As the result of a competitive public bidding, JICA commissioned CTI Engineering International Co., Ltd., which organized the JICA Study Team to conduct the Study starting from March 21, 2006. The CoES, which has acted as the counterpart agency to the JICA Study Team, is responsible for non-structural measure against flood disaster while the Ministry of Melioration and Water Resources (MMWR) is for structural measure. The disaster management in the site is jurisdiction of Hamadoni District Office organizing the emergency commission under guidance and supervision of CoES.

CHAPTER 2 FEATURES OF THE STUDY AREA

Floods of Pyanj River in Hamadoni District happen during June to August every year due to the melting snow and glaciers in the Pamir Highlands. The intensity of floods and flooding damages are increasing because of the following causes:

(1) The flow course of the Pyanj River has been moving closer to the Tajikistan side in the recent years while it was located on the Afghanistan side from 1970 to 1990.

(2) The dike in Hamadoni District is vulnerable to erosion because it has had engineering defects, and it is being exposed to slope erosion due to the torrential flow of the Pyanj River.

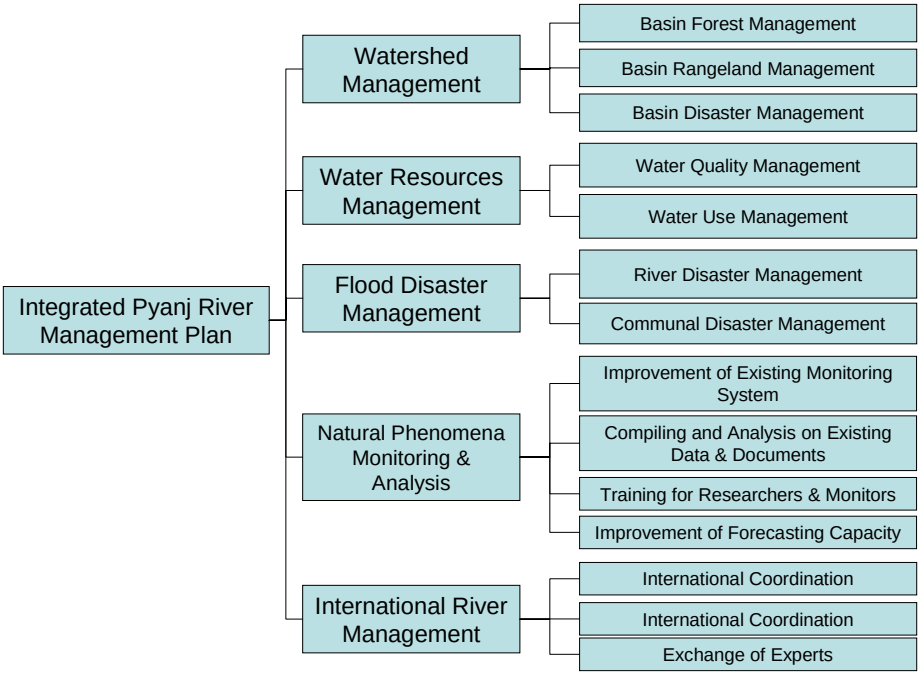
(3) The preparedness for flooding in Hamadoni District as arranged under the disaster management systems of the local level and the central level is not enough.

(4) The flood prevention works have not been adequately implemented because of the unsolved issue on the arrangements for the dike construction work in the border area between Tajikistan and Afghanistan.

The framework of the Study has been proposed as summarized in the following chapter after studying the problems mentioned above.

CHAPTER 3 FRAMEWORK OF THE PLAN

The causes of flooding and flooding damages are related to issues over the entire drainage area of the Pyanj River Basin. Therefore, the framework plan has been prepared based on the concept of integrated flood management as the Integrated Pyanj River Management Plan (IPRM), the composition of which is shown as follows:



Composition of Integrated Pyanj River Management Plan (IPRM)

In addition, River Disaster Management, which is one of the components of the IPRBMP and directly related to the floods in Hamadoni District, has been divided into segments according to the causes and problems. The directions of planning the River Disaster Management for Hamadoni District have been provided, as shown in the table below.

Required Countermeasures for the Framework Plan

Causes or Problems	Framework of Countermeasures	Outline of Countermeasures
Snow-Melt	Enhancement of the Observation, Analysis & Forecasting System	• Restoration and improvement of existing observation system • Improvement of forecasting accuracy
River Course Transition	Improvement of the Restoration and Management of River Structures	• Improvement and reinforcement of river dike structure • Coordination with Afghanistan on river engineering • Consistency of communal disaster management
	Enhancement of Watershed Management	Enhancement of forest management, rangeland and disaster management
Engineering Problems	Enhancement of the Capacity for River Restoration and Management	Enhancement of river engineering capacity
Little Preparedness on Disaster Management	Enhancement of the Capacity of River Disaster Management	Enhancement of disaster engineering capacity
	Revision of institution/organization for disaster management (NSM) in the national and local levels	Enhancement of capacity to prepare the communal disaster management plan
	Establishment of the communal disaster management system in Hamadoni District in cooperation with CoES (NSM)	Promotion of activities on communal disaster management

CHAPTER 4 THE MASTER PLAN

The Master Plan of Flood Prevention for the Hamadoni District (Master Plan) along with the Supporting Plan of Natural Disaster Prevention (Supporting Plan) have been provided based on the directions of planning for Flood Disaster Management for Hamadoni District mentioned in the previous chapter, as shown in the following table.

Contents of the Master Plan and the Supporting Plan

Plan	Measures	Implementation Plan	Contents
Master Plan of Flood Prevention in Hamadoni District	Structural Measures	10-Year Program Plan	Dike restoration works in Hamadoni District (100-year return-period design scale)
		5-Year Program Plan	Urgent dike restoration works in Hamadoni District (30-year-return period design scale)
	Non-Structural Measures	10-year Program Plan	Enhancement of Capacity for Flood Fighting in Hamadoni District
		5-year Program Plan	Enhancement of Capacity for Communal Disaster Management in Hamadoni District
Supporting Plan of Natural Disaster Prevention	Rescue Activities		Enhancement of Capacity for Rescue Center of CoES
	Observation, Analysis and Forecasting of Natural Phenomena		Enhancement of Hydro-meteorological observation and communication systems
	Disaster Management		Enhancement of Capacity for Disaster Management of CoES with the following components; - Enhancement of organizational capacity of disaster management of CoES -Enhancement of capacity for disaster engineering and management of CoES -Establishment of Advisory Commission on Natural Disaster Management
	Coordination mechanism between Tajikistan and Afghanistan		Establishment of Pyanj River Management Committee

CoES: Committee of Emergency Situations and Civil Defense

Economic Evaluation

As a result of the economic evaluation for the Hamadoni District Flood Management Master Plan, the economic internal rates of return (EIRR) are 11.59% and 18.41% for the 10-year-program, which includes a 5-year-program portion, and the 5-year-program, respectively.

Environmental Influence Evaluation

It is estimated that the Master Plan has minimal or little negative impact on environment and society because there are few houses and infrastructures in the proposed project site and the surrounding areas. The proposed project is composed of only the improvement of the existing dikes that may create little negative impact; besides, strategic plans like the Master Plan and the proposed project are exempted from the obligation of undertaking on environment impact assessment of the existing laws in Tajikistan.

CHAPTER 5 PRIORITIZED PROJECTS AND RECOMMENDATIONS

The projects selected as prioritized projects among the Master Plans and the Supporting Plans are as follows:

Master Plan of Flood Prevention in Hamadoni District

(1) Structural Measures for Flood Prevention

- Urgent Dike Restoration Works in Hamadoni District

(2) Non-Structural Measures for Flood Prevention

- Enhancement of the Capacity for Flood Fighting in Hamadoni District

- Enhancement of Communal Disaster Management in Hamadoni District

Supporting Plan of Natural Disaster Prevention

(1) Rescue Activities

- Enhancement of Capacity for Rescue Center of CoES
- Disaster Management Capacity Improvement for CoES

(2) Disaster Management

- Enhancement of Capacity for Disaster Management of CoES with the following components;
  - ✧ Enhancement of implementation core of disaster management in CoES
  - ✧ Enhancement of capacity for disaster engineering and management of CoES
  - ✧ Establishment of Advisory Commission on Disaster Management

In addition, the following actions are recommended to be taken:

(1) Implementation of the Urgent Dike Restoration Works in Hamadoni District including a detailed topographic survey, and detailed design based on the design principles given in the Master Plan;

(2) Monitoring and maintenance of the flood prevention dikes;

(3) Implementation of the proposed communal disaster management and flood fighting proposed in the Master Plan;

(4) Promotion of the Pyanj River Basin Management Plan;

(5) Promotion of the establishment of the Advisory Commission on Natural Disasters; and

(6) Promotion of the enhancement of capacity for monitoring, analysis and forecasting of natural phenomena.

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ABBREVIATIONS

Organizations

JICA	:	Japan International Cooperation Agency
ADB	:	Asian Development Bank
MoES	:	Ministry of Emergency Situations and Civil Defense (presently, CoES or Committee)
CoES	:	Committee of Emergency Situation and Civil Defense (formerly, MoES or Ministry)
MMWR	:	Ministry of Melioration and Water Resources
SDC	:	Swiss Agency for Development and Cooperation
DHI	:	Danish Hydraulic Institute
REACT	:	Rapid Emergency Assessment and Coordination Team
UNT	:	United Nations in Tajikistan
UNDP	:	United Nations Development Programme
UNICEF	:	United Nations International Children's Emergency Fund
USAID	:	United States Agency for International Development
WB	:	The World Bank
WHO	:	World Health Organization
FHA	:	Focus Humanitarian Assistance
Tajikmeteorology	:	Hydrometeorology Agency
IMAC	:	Information Management and Analytical Center

Units of Measurement

℃	:	Degree Centigrade
dia.	:	Diameter
g	:	Gram
Ghz	:	Gigahertz
Mhz	:	Megahertz
ha	:	Hectare
Kg, kg	:	Kilogram
Km, km	:	Kilometer
K	:	kilometer point (e.g. 2.0K)
L. l. lit.	:	Liter
m	:	Meter
m^3	:	Cubic meters
m^3/s	:	Cubic meters per second
mil.	:	Million
MLD	:	Million Liters per Day
MGD	:	Million Gallons per Day (1 MGD = 4.546 MLD)
Tjs	:	Tajikistan Somoni
sec	:	second
t, ton	:	Tonnage
US$, USD	:	American Dollar
W	:	Watt

Others

CD	:	Civil Defense
CIS	:	Commonwealth of Independent States
EIA	:	Environmental Impact Assessment
ICRC	:	Internal Committee of the Red Cross
NGO	:	Non-Governmental Organization
M/P	:	Master Plan
F/S	:	Feasibility Study
P/P	:	Pilot Project
TA	:	Technical Assistance
TOR	:	Terms of Reference

CHAPTER 1. INTRODUCTION

1.1 OUTLINE OF THE STUDY

1.1.1 Background of the Study

The Republic of Tajikistan, bordering with Kyrgyzstan to the North, China to the East, Afghanistan to the South and Uzbekistan to the West, has an area of 143.1 thousand square kilometers, more or less, 93% of which has mountainous topography. The Pyanj River, the objective river of the Study, originates in the Pamir Highlands, runs from east to west along the border with Afghanistan, and drains into the Aral Sea in Uzbekistan. A large alluvial fan of 470 square kilometers has formed around the outlet of the river, lying on both the Tajikistan and the Afghanistan side.

The Pyanj River has brought water resource benefits to Hamadoni District with the melting of snow and glaciers in the Pamir Highlands, but the excess water has brought harm due to the floods. Therefore, in the Soviet Union Era, installed were an irrigation system and a dike to protect the district from flood damage.

However, after Tajikistan became independent from the Soviet Union in 1991, the dike suffered from bank erosion and partial but critical damage due to the repeated attack of floods and the lack of proper maintenance. Since then, the district has been suffering repeatedly from flood damage.

Specially reported was the flood in July 2005, which devastated 48 ha of cotton fields, 190 ha of wheat fields, 5 km of trunk roads, 3.5 km of river dikes and 3 water supply districts accounting for 50 million US dollars in total damage in Hamadoni. The flood damaged area in Hamadoni District reached 4,000 ha in total.

Under the above circumstances, the Government of the Republic of Tajikistan (hereinafter referred to as "the Government of Tajikistan") had officially requested the Government of Japan for technical cooperation and assistance in conducting a development study to find a lasting solution to the issue of perennial flooding. In response, the Government of Japan had decided to conduct the **Study on Natural Disaster Prevention in Pyanj River in the Republic of Tajikistan** (hereinafter referred to as "the Study") through Japan International Cooperation Agency (hereinafter referred to as "JICA").

The Scope of Work for the Study was agreed upon on November 18, 2005 by and between JICA and the Ministry of Emergency Situations and Civil Defense (renamed as Committee of Emergency Situations and Civil Defense and hereinafter referred to as the "CoES"). Accordingly, JICA conducted the Study in close cooperation with the CoES and other authorities concerned in the Government of Tajikistan.

As the result of competitive public bidding, JICA had commissioned CTI Engineering International Co., Ltd., a Japanese engineering consulting firm based in Tokyo, Japan, to conduct the Study. The Study started on March 21, 2006, and completed on December 28, 2007. The CoES acted as the counterpart agency to the JICA Study Team, in cooperation with the other organizations concerned in Tajikistan such as the Ministry of Melioration and Water Resources (MMWR), the Designing Institute for Water Resources Facilities (DIWRE), and the Hydrometeorology Agency (Tajikmeteorology). The Study was completed on December 28, 2007 in accordance with the schedule.

1.1.2 Objectives of the Study

The objectives of the Study are as follows:

- To formulate the Master Plan of Hamadoni District Flood Management as the comprehensive flood disaster management plan in the Study Area.

- To carry out technical transfer to CoES and other relevant agencies through seminars and on-the-job-training during the Study.

The ultimate goal of the Study is to improve security and preparedness against floods and to mitigate flood damage with Hamadoni District of the Khatlon Region as the main target area.

1.1.3 Study Area

The Republic of Tajikistan is located between 36°40" and 41°05" North latitude, and 67°31" and 75°14" East longitude. Its territory covers 143.1 thousand square kilometers, bounded by China to the East, Afghanistan to the South, and Uzbekistan and Kyrgyzstan to the West and North. The country is divided into four political regions or oblasts; namely, the Khatlon Region, the Region of Republic Subordination (RRS), the Sughd Region, and the Gorno-Badakhshan Autonomous Region (GBAO). [Note: O or oblast in Russian means region.]

The Study Area includes the Tajikistan side of the alluvial fan of Pyanj River in Hamadoni District of the Khatlon Region, as shown in Fig. R.1.1.1. For deeper understanding of the basin characteristics, the study shall also include the upstream basin.

Fig. R.1.1.1 Location of the Study Area

1.2 GENERAL FEATURES OF TAJIKISTAN

1.2.1 Socio-Economic Condition

1) Governmental Organizational Structure

There are four administrative levels in Tajikistan; namely, the central, regional, district and community levels. Tajikistan consists of the Capital City of Dushanbe and four political regions or oblasts; namely, the Khatlon Region, the Region of Republic Subordination (RRS, or Tobei Chumuhry in Tajik), the Sughd Region, and the Gorno-Badakhshan Autonomous Region (GBAO), as previously stated in Subsection 1.1.3, Study Area. Each region administers the districts under its jurisdiction except the RRS where the Central Government of Tajikistan directly administers its 13 districts. On the other hand, the

Khatlon Region consists of two sub-regions: the Khorgan-Chube Sub-Region and the Kulyab Sub-Region.

Fig. R.1.2.1 shows the governmental structure of Tajikistan.

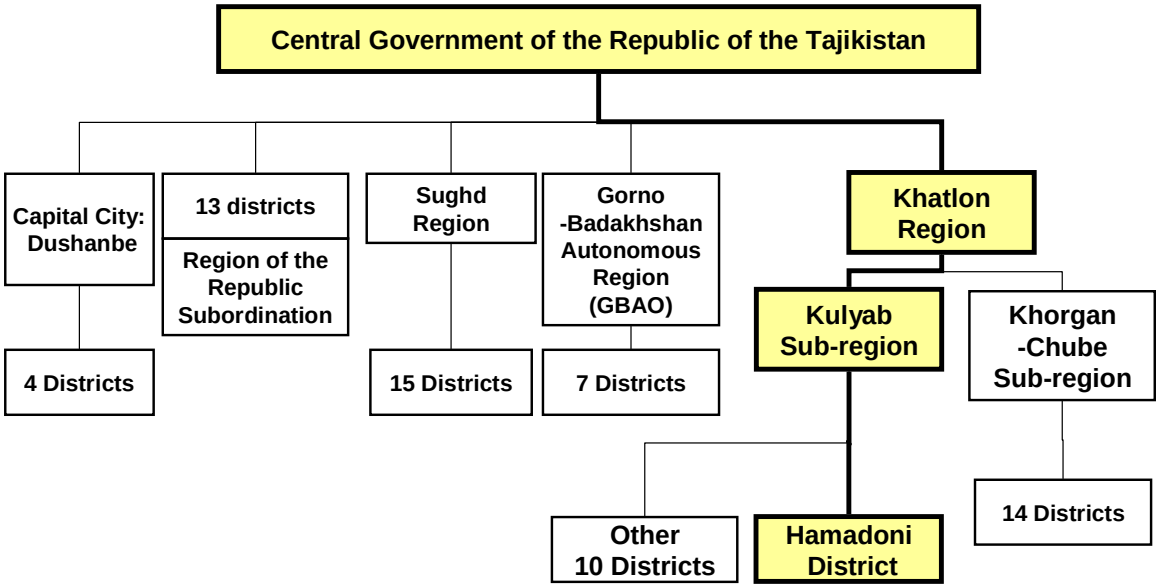


Fig. R.1.2.1 Governmental Structure of Tajikistan

Districts consist of jamoats, kishlaks and mahallas. Fig. R.1.2.2 shows the organizational chart of Hamadoni District.

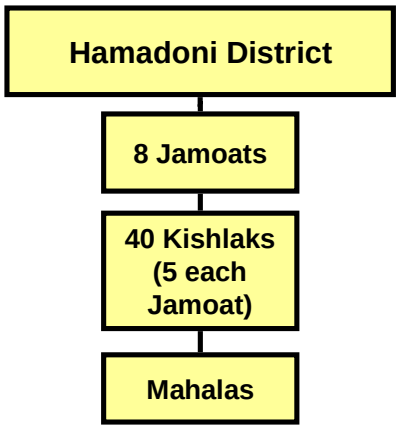


Fig. R.1.2.2 Governmental Structure of Hamadoni District

Hamadoni District belongs to the Kulyab Sub-Region and consists of eight jamoats. Each jamoat consists of five kishlaks. The number of mahallas under each kishlak is not fixed. There are no available data on the number of mahallas in Hamadoni District.

2) Population

According to the Committee of Statistics[1], the national population had increased from 6,001,000 people in 1998 to 6,780,000 people in 2004, with annual population growth of 2.06%. Table R1.2.1 gives the summary of population growth in the Republic of Tajikistan.

Table R.1.2.1 National Population of Tajikistan

(Source: Committee of Statistics of the Republic of Tajikistan)

In Figures (Unit: 1,000)

Year	Total	Urban	Rural	Share Rate of Urban Population to the Total Population
1998	6,001	1,596	4,405	26.60%
1999	6,127	1,624	4,503	26.50%
2000	6,250	1,663	4,588	26.60%
2001	6,376	1,690	4,686	26.50%
2002	6,507	1,718	4,789	26.40%
2003	6,640	1,760	4,880	26.50%
2004	6,780	1,790	4,990	26.40%
Annual Average Growth Rate	2.06%	1.93%	2.10%	

The flood prone area as the target area of the Study is located in Hamadoni District. The population of Hamadoni increased from 103,000 people in 1998 to 117,000 people in 2004, as shown in Table R.1.2.2.

Table R.1.2.2 Population in Hamadoni District

(Unit: 1,000)

Year	Total	Urban	Rural	Share Rate of Urban Population to the Total Population
1998	103	18	85	17.10%
1999	106	18	88	17.10%
2000	108	19	90	17.10%
2001	110	19	92	17.00%
2002	112	19	93	16.90%
2003	115	20	95	17.00%
2004	117	20	97	17.00%
Annual Average Growth Rate	2.16%	2.06%	2.18%	

3) Economic Conditions

a) Gross Domestic Product (GDP)

Gross Domestic Product (GDP) at the current price level in Tajikistan seems to have steadily increased since 2000 until 2005. As shown in Table R.1.2.3, per capita GDP is US$400 as of 2006.

[1] Committee of Statistics of the Republic of Tajikistan: "*Regions of the Republic of Tajikistan*", 2003, 2004 and 2005

Table R.1.2.3 Gross Domestic Product (GDP) and Per Capita GDP

(Source: The National Bank of Tajikistan)

Description	2000	2001	2002	2003	2004	2005	2006	
Current Price								Average
GDP at current Price (million TJS)	1,807	2,512	3,345	4,758	6,158	7,201	9,272	Annual
GDP at current Price (million US$)	972	1,081	1,202	1,555	2,071	2,306	2,812	Increasing
Per Capita GDP (TJS/capita)	289	396	527	732	927	1,041	1,319	Ratio
Per Capita GDP (US$/capita)	155	171	190	239	312	333	400	

b) Main Product

Tajikistan does not have many resources for industrial production. Among the available resources, water is utilized to produce electricity for the processing of Alumina into Aluminum and for the irrigation of cotton farms since the Soviet Union Era. As for the indices to the productivity of Tajikistan, Table R.1.2.4 shows the GDP from 2000 to 2006 and the international balance of trade. Cotton exports contribute to the GDP with around 9% of the total GDP on the average from 2000 to 2006.

Table R.1.2.4 GDP by Economic Activity

(million TJS)

Description	2000	2001	2002	2003	2004	2005	2006	Remarks
GDP in Total	1,807	2,512	3,345	4,758	6,158	7,201	9,272	
Industrial Production	1,335	1,882	2,372	3,143	3,957	4,025	n.a.	
Ginned Cotton Export	171	166	356	590	480	449	n.a.	
Aluminum Export	1,007	925	1,109	1,314	1,675	1,758	n.a.	
Transport (Cargo Carriage)	6	21	19	33	42	40	n.a.	
Electricity Production	14	14	15	16	16	17	n.a.	
Construction Materials	10	14	25	28	55	183	n.a.	
Capital Investment	104	155	158	278	990	617	n.a.	
Wheat Import	68	70	65	38	45	96	n.a.	
Others incl.Governmental Activities	270	356	690	1,222	1,052	2,223	n.a.	
Share Rate by Economic Activities	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	Average Share Rate
Industrial Production	73.90%	74.93%	70.92%	66.07%	64.27%	55.89%	n.a.	67.66%
Ginned Cotton Export	9.45%	6.60%	10.65%	12.40%	7.80%	6.24%	n.a.	8.86%
Aluminum Export	55.73%	36.82%	33.16%	27.62%	27.20%	24.41%	n.a.	34.16%
Transport (Cargo Carriage)	0.36%	0.83%	0.58%	0.69%	0.68%	0.56%	n.a.	0.62%
Electricity Production	0.79%	0.57%	0.46%	0.35%	0.27%	0.24%	n.a.	0.45%
Construction Materials	0.54%	0.54%	0.74%	0.58%	0.90%	2.54%	n.a.	0.97%
Capital Investment	5.73%	6.18%	4.72%	5.85%	16.08%	8.57%	n.a.	7.85%
Wheat Import	3.74%	2.79%	1.95%	0.80%	0.73%	1.33%	n.a.	1.89%
Others incl.Governmental Activities	14.94%	14.16%	20.63%	25.68%	17.08%	30.87%	n.a.	20.56%

Source: The National Bank of Tajikistan (NBT).

Table R.1.2.5 shows the regional production status of cotton. Khatlon Region, where the Study Area is located, has the largest amount of raw cotton production compared to the other regions, but the amount of raw cotton produced in the region in 2005 had significantly decreased compared to the previous three years. The reduced production of raw cotton as well as cotton exported from the Khatlon Region in 2005 compared to the previous years may be due to flood damage.

Table R.1.2.5 Production Status of Cotton in Tajikistan

Description	2000	2001	2002	2003	2004	2005
Cultivated Area (ha)						
GBAO	0	0	32	50	85	0
Sughd Oblast	69,098	75,267	80,834	85,508	88,176	86,392
Khatlon Oblast	150,287	160,505	165,335	173,527	178,851	177,036
DRS	19,233	21,599	22,996	25,282	26,489	25,227
Total in the Nation	238,618	257,371	269,197	284,367	293,601	288,655
Production of Raw Cotton in Total (ton)						
GBAO	0	0	29	32	106	0
Sughd Oblast	120,958	145,347	154,872	148,466	159,424	155,526
Khatlon Oblast	177,950	255,092	305,725	334,031	334,079	240,884
DRS	36,519	52,296	54,852	54,829	63,157	51,508
Total in the Nation	335,427	452,735	515,478	537,358	556,766	447,918
Unit Productivity (tons/ha)						
GBAO	n.a.	n.a.	0.91	0.64	1.25	n.a.
Sughd Oblast	1.75	1.93	1.92	1.74	1.81	1.80
Khatlon Oblast	1.18	1.59	1.85	1.92	1.87	1.36
DRS	1.90	2.42	2.39	2.17	2.38	2.04
Total in the Nation	1.41	1.76	1.91	1.89	1.90	1.55

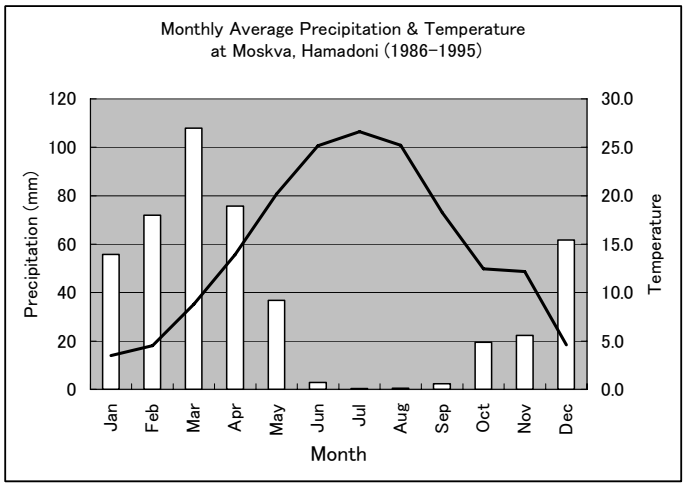
Source: Agricultural Statistics 2006, State Statistic Committee (SSC), Tajikistan.

1.2.2 Natural Conditions

1) Climate

In general, Tajikistan's climate is continental, subtropical, and semiarid, with some desert areas. However, the climate changes drastically according to elevation. Tajikistan's subtropical southwestern corner experiences some of the highest temperatures in the country, ranging from 35°C to 42°C in summer. At Tajikistan's lower elevations, the average temperature range is 25°C to 30°C in July and minus 1°C to 3°C in January. Although rainfall can be sporadic as the drought of 1999-2001 has shown, most precipitations occur in winter and spring.

In Hamadoni District, the dry season is from June to September and the wet season is October to May, as shown in Fig. R.1.2.3. As described later in another chapter, the flood season in Hamadoni District happens in June to August, because high temperatures during this period cause the melting of snow and glaciers in the high mountain areas and produce much water.



Source: Hydrometeorology Agency of Tajikistan, complied by the Study Team

Fig. R.1.2.3 Monthly Average Precipitation and Temperature in Tajikistan

2) Topography

About 93 percent of Tajikistan is mountainous, dominated by the Alay Range in the north and the Pamir Mountains with the highest elevations in the country in the southeast. More than half of the country is higher than 3,000 meters in elevation. The lowest elevations are located in the northwest, southwest, and Fergana Valley, which dominates Tajikistan's far northern section. The mountain chains are interspersed with deep valleys formed by a complex network of rivers. The eastern mountains contain many glaciers and lakes. The Fedchenko Glacier, which covers 700 square kilometers, is the largest non-polar glacier in the world.

In Tajikistan's dense river network, the largest rivers are the Syr Darya, the Amu Darya (called the Pyanj in its upper reaches in Tajikistan), the Vakhsh (called the Surkhob in its upper reaches in Tajikistan), and the Kofarnihon. The Amu Darya carries more water than any other river in Central Asia. The Vakhsh is an important resource for hydropower.

1.3 GENERAL FEATURES OF DISASTER MANAGEMENT

1.3.1 Institutional Arrangements for Disaster Management

1) Legal Arrangements related to Disaster Management

There are several national laws and decrees related to disaster management in Tajikistan, as enumerated below. The most important law among them is the Law of the Republic of Tajikistan on the Protection of Population and Territories against Natural and Man-Made Disasters (hereinafter referred to as the "Disaster Management Law"). This law stipulates the responsibilities and duties of the central and local governments on disaster management, as well as mandates the Committee of Emergency Situations and Civil Defense (CoES; formerly, Ministry of Emergency Situation and Civil Defense or MoES) as the core of disaster management in Tajikistan.

- Constitution of the Republic of Tajikistan
- Normative governmental orders of the Committee of Emergency Situation and other central government agencies
- The Law of Civil Defense
- The Law of the Republic of Tajikistan on the Protection of Population and Territories against Natural and Man-Made Disasters
- The Law on Hydro-meteorological Activity
- The Law on Wildlife Management
- The Law on Protection of Atmospheric Air
- The State Ecological Program
- The State Program on Ecological Education and Formation of Population
- The Qualifier of Extreme Situations of Natural and Anthropogenic Character
- The Law on the Protection of Population
- The Law on the Status of Rescuer

2) Organizational Arrangement for Disaster Management

In accordance with the Disaster Management Law, the Government of Tajikistan had created several executive bodies and established the organization for disaster management.

Fig. R.1.3.1 shows the organizational chart of the national disaster management system in Tajikistan.

*

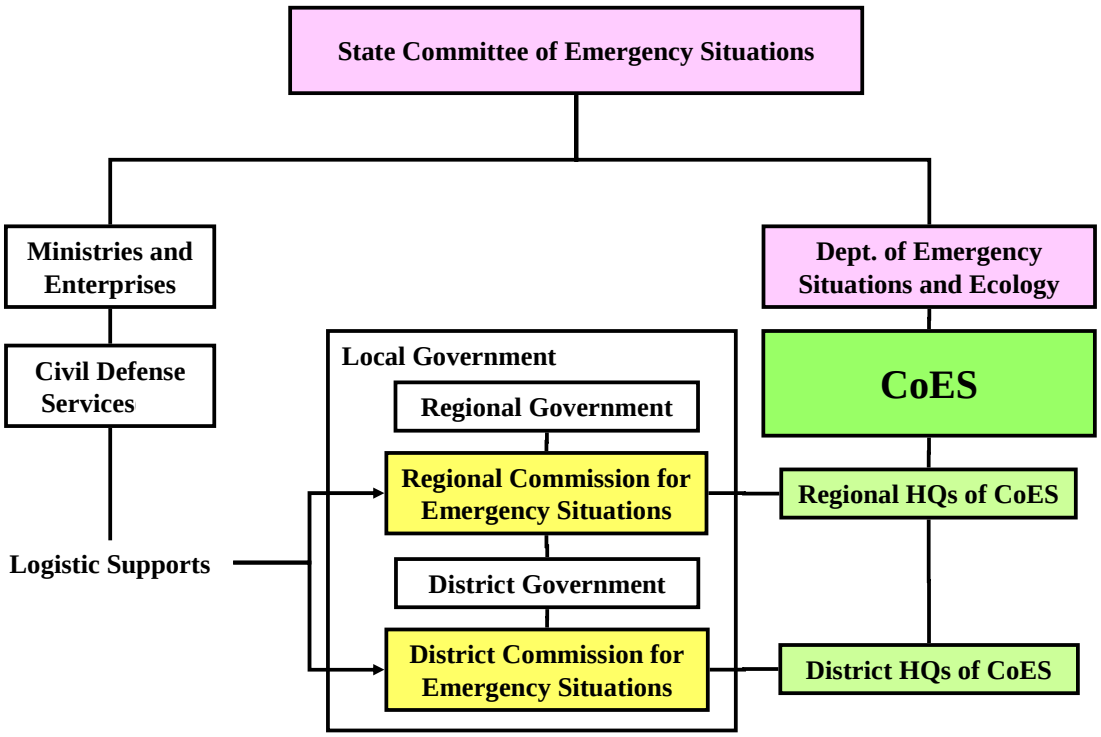


Fig. R.1.3.1 Organizational Chart of the National Disaster Management System in Tajikistan

The duties and responsibilities of the executive bodies constituting the organization are as described below*.

a) Powers on Disaster Prevention of the Government of Tajikistan

Under the provision of the Disaster Management Law, the Government of Tajikistan has powers to perform as follows:

- To issue laws and normative acts of the President of the Republic of Tajikistan, resolutions and regulations;
- To organize scientific researches;
- To organize development and ensure implementation of special national programs;
- To define objectives, functions, implementation procedures, rights and duties of regulatory bodies of the executive power, and perform management of the national disaster prevention and recovery system;
- To ensure creation of the national financial reserves and material resources for disaster recovery and determine procedures for the use of the said reserves

* This summary is derived from the English version of the provision of the Disaster Management Law translated by UNDP

- To perform financial and resource provision of disaster prevention and recovery forces and facilities, and to provide them with special equipment and other logistical and technical means;
- To establish and control the manufacturing process, storage conditions, transportation conditions and procedure for the use of radioactive and other hazardous substances following safety measures;
- To take decisions on the direct management of disaster recovery and on the provision of assistance, should a disaster occur;
- To determine the procedure for the involvement of civil defense troops of the Republic of Tajikistan in disaster recovery operations; and
- To exercise control over the various ministries, institutions and local executive bodies related to disaster prevention.

b) Powers of the State Committee of Emergency Situations

Under the provision of the Disaster Management Law, the State Committee of Emergency Situations has powers to perform as follows:

- To implement measures aimed at preparedness and readiness of forces and facilities required for the protection of population and territory against disasters, community training and in emergencies;
- To implement evacuation measures in emergency situations;
- To perform, in an established procedure, collection and exchange of information for population and territory protection against disasters, and timely warn and inform the population of a disaster risk or the effective disaster prevention;
- To organize and perform salvage and rescue activities and maintain public order throughout the rescue activity; in case their own forces and facilities are insufficient, apply for help from the Government of the Republic of Tajikistan;
- To implement funding of population and territory protection activities against disasters;
- To create financial and logistical reserves for disaster recovery;
- To promote sustainable institutional functioning in emergency situations; and
- To create, within the regulatory executive bodies of the Republic of Tajikistan, permanent management bodies authorized to resolve the issues of population and territory protection against disasters.

c) Powers of Regional and District Governments

Under the provision of the Disaster Management Law, the regional and district governments have powers to perform as follows:

- To implement measures aimed at preparedness and readiness of forces and facilities required for the protection of population and territory against disasters, community training and in emergencies;
- To implement evacuation measures in emergency situations;
- To perform, in an established procedure, collection and exchange of information for population and territory protection against disasters, and timely

warn and inform the population of the disaster risk or the effective disaster prevention;

- To implement funding of population and territory protection activities against disasters;
- To create financial and logistical reserves for the disaster recovery;
- To organize and perform salvage and rescue activities and maintain public order throughout the rescue activity; in case their own forces and facilities are insufficient, apply for help from the Government of the Republic of Tajikistan;
- To promote sustainable institutional functioning in emergency situations; and
- To create, within the self-governance bodies, special commissions authorized to solve the issues of population and territory protection against disasters.

d) Committee of Emergency Situations and Civil Defense (CoES)

The Disaster Management Law mandates the Committee of Emergency Situations and Civil Defense as the national body to perform national management and coordination of the activities of regulatory bodies for the protection against disasters, as well as the following tasks:

- To develop public policy proposals for population and territory protection against disasters;
- To exercise state control over the readiness of forces and facilities in emergency situations and over the implementation of measures aimed at population and territory protection against disasters;
- To develop and implement measures aimed at disaster prevention, protection of lives and health of the population, material and cultural assets, as well as at disaster recovery and mitigation;
- To promote the readiness of regulatory bodies, forces and facilities for the activity in an emergency situation;
- To perform management of forces and facilities in disaster recovery, and to establish control points, warning and communication systems;
- To promote development and implementation of target programs and scientific research aimed at disaster prevention and recovery;
- To take decisions obligatory, within its competence, for implementation by ministries, institutions, enterprises, agencies and organizations, government officials and citizens;
- To organize search and rescue and other emergency activities in case of a disaster;
- To participate in the state project and decision expertise relating to the production and social facilities; and
- To organize community trainings, and to ensure preparedness of civil servants and civil defense units in emergency situations.

1.3.2 Activities of the Committee of Emergency Situations and Civil Defense

CoES performs disaster management and coordination with the agencies concerned regarding its functions and organization. The main functions of CoES are as follows:

- Information management

- Evaluation of disaster events
- Rescue works
- Emergency restoration works
- Communications
- Training

Emergency Management Center chaired by the First Deputy Chairman of CoES has been implementing the above functions along with some departments and centers. Fig. R.1.3.2 shows the organization chart of Emergency Management Center.

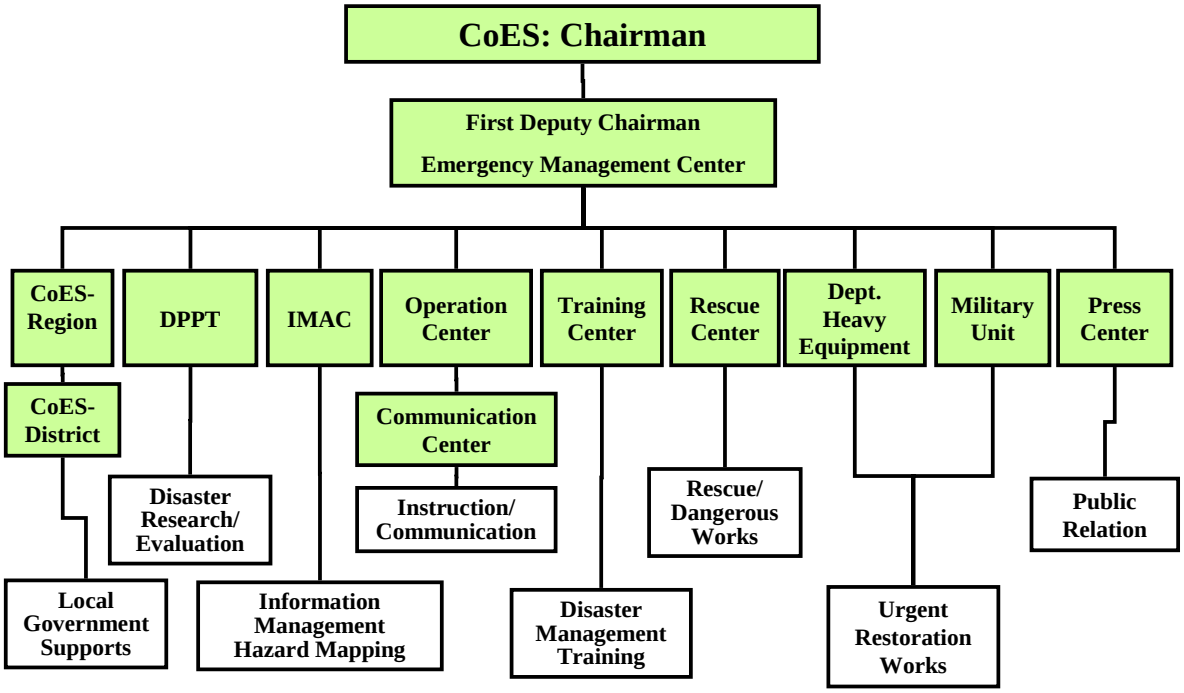


Fig. R.1.3.2 Organization Chart of CoES

The functions of the main departments and centers of the organization of the Emergency Management Center are described as below.

1) Information Management and Analysis Center (IMAC)

One of the key functions of CoES regarding disaster management is placed on the Information Management and Analysis Center (IMAC), which receives disaster information from the Hydrometeorology Agency daily weather report and, based on its database, analyzes it. After the analysis and assessment, IMAC reports the results to the Operation Center, which, in case required, instructs the Communication Center to inform the regions and districts through their communication tools such as short wave radios.

IMAC came into existence in 2004 under the Disaster Risk Management Program funded by Switzerland with UNDP support and in cooperation with REACT (Refer to Subsection 1.3.5). IMAC's objectives and key functions are as follows:

a) Objectives

- To perform comprehensive analysis, reliable storing and transmission of disaster information with application of modern technologies;

- To assist in development and implementation of government programs focused on protection of people and land against disaster; and
- To organize coordinated and mutually beneficial collaboration with relevant sections of CoES and with other agencies concerned, as well as with international organizations concerned.

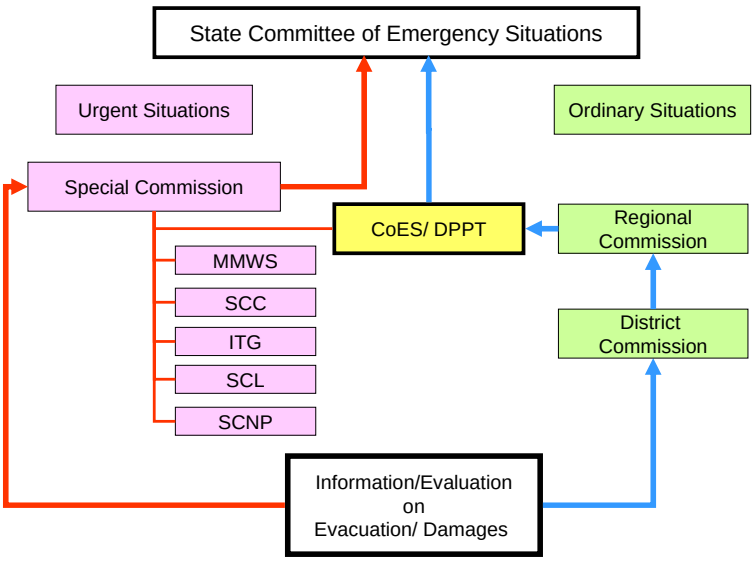
b) Key Functions

- With respect to disaster information, collection, processing, storing, and transmission;
- With respect to disaster situation, advise on emergency of monitoring, forecast, prevention, mitigation, and restoration;
- Preparation of risk maps; and
- Preparation of the Geographical Information System (GIS), to include disaster information and risks.

2) Department of Protection of Population and Territories

The Department of Protection of Population and Territories (DPPT) collects information on damage due to natural disaster. Initially, the information collected by the district commissions of emergency situations is sent to the regional commission. The regional commission compiles the information and sends it to the department. Finally, the department sends the report including the disaster damage record to the State Committee of Emergency Situations (SCES).

The SCES sometimes organizes the Special Commission after a request is made by the local government. The Special Commission consists of 6 personnel belonging to CoES, MMWR, Committee of Construction, Institute of Geology, State Committee of Land, and the State Committee of Preservation of Environment and Forestry respectively. A member from DPPT is the representative of SCES.



DPPT: Department of Protection of Population and Territories
SCC: State Committee of Construction
ITG: Institute of Tajik Geology
SCL: State Committee of Land
SCNP: State Committee of Natural Protection

Fig. R.1.3.3 Position of CoES in Disaster Evaluation

3) Rescue Center

The Rescue Center of CoES has rescue activities to save human lives from disasters and activities to train applicants for rescue work such ass lifesaving, diving, fire fighting, mountain rescue, dangerous works, rescue facility operation, etc., with issuance of a license.

During the 2005 flood in Hamadoni, personnel of the Rescue Center performed activities for two months, as follows:

- Secure peace and order for evacuees;
- Secure safety for urgent restoration works on dikes;
- Implement the dangerous works of electrical restoration in the inundation areas; and
- Implement works near the border areas.

4) Department of Heavy Equipment

CoES is the agency responsible for the restoration of infrastructures from certain kinds of damage such as general damage not under the jurisdiction of any other government agency. Its Department of Heavy Equipment implements this responsibility through direct management or outsourcing. The department has its own heavy equipment such as power shovels, bulldozers and dump trucks, with operators and mechanics.

During and after the 2005 flood, the department dispatched equipment and operators to Hamadoni for urgent restoration work in cooperation with the contractors of the government.

5) Military Unit stationed in Hamadoni District

CoES maintains a military unit in Hamadoni (hereinafter, the “Hamadoni Unit”). One of its duties is to provide emergency restoration work for infrastructures in the area, including flood prevention work. The Hamadoni Unit possesses some heavy equipment, cranes and dump trucks.

Utilizing its own equipment and personnel, the Hamadoni Unit performed dike restoration in Hamadoni in 2005. It used the metal forms for concrete block fabrication provided by the JICA Study Team, and produced concrete blocks to repair the damaged portion of the dike.

6) Operation Center and Communication Center

After CoES has decided that the situation has reached its critical level, the Emergency Management Center gives instructions to the Operation Centers on taking countermeasures or evacuation. The instructions are transmitted by the Communication Center to the regional commissions through. For Hamadoni District, instructions are at first transmitted to the Operation Center of CoES in Kulyab Sub-Region which informs the Regional Commission, and then to the District Commission in Hamadoni District. The communication is made with high-frequency radio equipment.

The Operation Centers also maintain communication with the general public and local government offices for information or confirmation of disaster events if they really happened.

Fig. R.1.3.4 shows the flow of communication regarding disaster management.

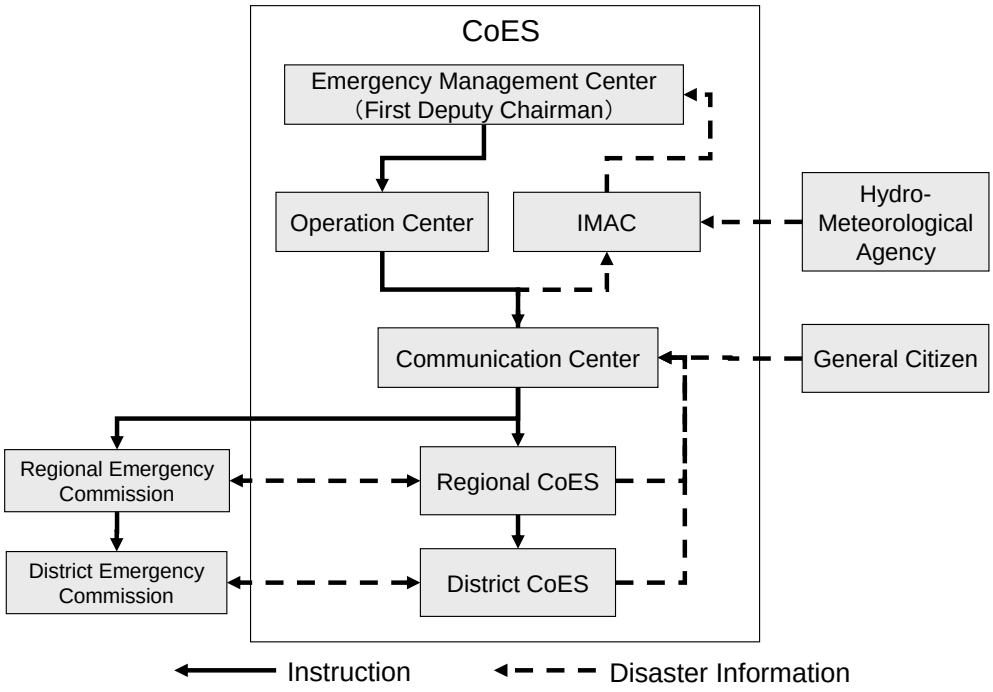


Fig. R.1.3.4 Flow of Communication in Disaster Management by CoES

7) Training Centers

a) Training and Methodology Center in Dushanbe

CoES has training and methodology centers for emergency and civil defense. These are located in Dushanbe (hereinafter, the "Dushanbe Training Center"), Sughd Region, Tobei Chumuhry Region, Khorgan-Chube Sub-Region and Kulyab Sub-Region of Khatlon Region, GBAO and Rasht Zone in GBAO.

The Dushanbe Training Center provides training courses for administrative level personnel of the central government and the Capital City of Dushanbe. The other centers provide training for personnel concerned in their respective regions or zones.

The trainings cover issues on legal systems, organization, preparedness, action and planning for emergency and civil defense. Certain kinds of disaster like floods are not included in the training courses except the course on Catastrophic Risk Reduction, which has topics on flood as a part of the subject. Personnel certified to have completed the training course have duties to disseminate the contents of the training to others in the organization they belong.

b) Training and Methodology Center in Kulyab Sub-Region

The Training and Methodology Center of CoES in Kulyab Sub-Region (hereinafter, the "Kulyab Training Center") provides training courses for personnel concerned in emergency and civil defense in Kulyab Sub-Region. There are four categories of trainees as listed below.

Category 1: Staff in charge of emergency and civil defense in of district and jamoat offices

Category 2: Teachers, principals of schools and so on

Category 3: Firefighters, staff of medical organizations and so on

Category 4: Managers of firms and construction firms, and so on

The Kulyab Training Center is still using the facilities provided in the Soviet Union Era. Some international NGOs provide assistance in the rehabilitation of the building and facilities, but problems on the lack of materials for training still remains.

8) Press Center

The Press Center is in charge of the public relations activity of CoES. UNDP has been supporting the enhancement of the capability to disseminate CoES's activity with the establishment of the CoES's Home Page on the internet.

1.3.3 Present Condition of Food Disaster Management in Hamadoni District

The Commission on Emergency Situations in Hamadoni District is responsible for implementing disaster management. It consists of members from the Hamadoni District Office, eight jamoats and the CoES District Office. For disaster management, the commission conducts the following activities:

- Collection of information and making decisions on instructions in emergency situations
- Warning and communication
- Guiding the resident on evacuation

Tajikmeteorology performs flood forecasting and informs the forecast as weather bulletin to the public through CoES. Tajikmeteorology has a hydrological observation station at Khirmanjo, 117 km upstream of Hamadoni District, and uses the observed data for the forecasting.

CoES transmits forecasting information after evaluation to the Hamadoni District Office or the Commission of Emergency Situations in Hamadoni District through the operation and communication centers. The Hamadoni District Office disseminates the warning or instruction for evacuation to the public through the local government structure if the commission decides to issue a warning or instruction for evacuation.

Fig. R1.3.5 shows the flow of communication in the present flood management system of Hamadoni District.

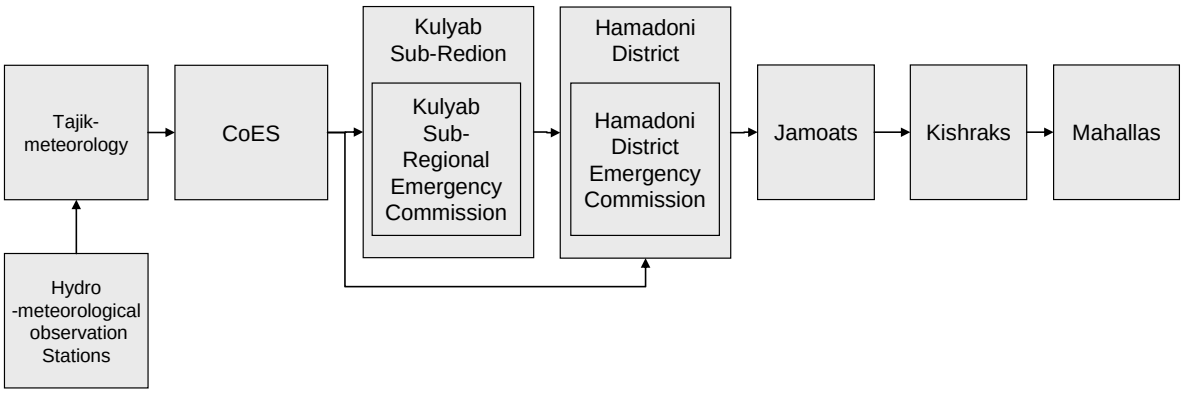


Fig. R 1.3.5 Flow of Communication in the Flood Management System of Hamadoni District

1.3.4 Organizations Related to Disaster Management

CoES has the responsibility of coordination among the different organizations to promote the implementation of countermeasures for the various kinds of natural disasters. Some of the organizations are members of the Working Group organized for the Study. The organizations concerned in natural disaster are as described below.

1) Member Organizations of the Working Group

a) Ministry of Melioration and Water Resource (MMRW)

MMRW has the responsibility to develop and maintain water resources, water supply for drinking water and irrigation water, and flood mitigation works. Its jurisdiction covers planning, design, construction, restoration and maintenance of the facilities.

b) Design Institute for Water Resources Facilities (DIWRF)

DIWRF is one of the institutes under MMRW and has the responsibility to implement design of the structures and supervision of construction works of water resources facilities including flood protection dike.

c) Hydrometeorology Agency (Tajikmeteorology)

Tajikmeteorology has the responsibility to observe hydrological and meteorological phenomena and to maintain the observation facilities.

d) State Control Inspection of Water (SCIW) of the Ministry of Agriculture and Nature Protection

SCIW is one of the departments under the Ministry of Agriculture and Nature Protection, and is responsible for the control of water rights and water quantities for users. It also controls the areas along rivers within certain meters of width, depending on the flow of river discharge.

e) Scientific Research Center on Land (Tojikkoinot)

Tojikkoinot is one of the agencies under the State Institute of Science and Technology, and is responsible for land use regulation and topographic mapping, as well as data management.

f) State Geology Department (Tojikgeology)

Tojikgeology is one of the departments under the direct administration of the central government, and is responsible for the research and analysis of geological phenomena, and the management of geological information and technology including landslides, mudflows and debris flows, which sometimes induce natural disasters to the population and the territories.

2) Other Organizations

There are other organizations concerned in natural disasters including floods, as follows:

a) Agency of Forestry and Hunting Administration (AFHA)

AFHA is one of the agencies under the Ministry of Agriculture and Nature Protection, and is responsible for the development of forestry for nature protection and timber production, as well as the control/administration of hunting wild animals and birds.

b) State Institute of Seismology (SIS)

SIS is one of the state institutes under the central government, and is responsible for conducting research on seismological phenomena as well as the management of seismological information and technology.

1.3.5 International Cooperation on Natural Disasters

1) Regional and Bilateral Cooperation

a) Rapid Emergency Assessment and Coordination Team (REACT)

There is the Disaster Management Partnership in Tajikistan; namely, the Rapid Emergency Assessment and Coordination Team (REACT), which was established in 2001 to promote the sharing of information, logistics and other resources between partners active in the disaster management sector, including the Committee of Emergency Situations and Civil Defense. REACT that involves over 65 states, local and international organizations and entities meets regularly to coordinate and share experiences on issues related to various areas of disaster management, including preparedness, response, mitigation and capacity building activities with national bodies. During emergency, the partners work closely together, coordinating responses and assistance, informing the situations over the world with new bulletins through the internet.

Participating organizations, 65, consist of 16 governmental organizations, 7 international cooperation organizations like JICA and ADB, 9 units of United Nations, 28 international non-government organizations (NGOs) and 5 local NGOs.

b) Cooperation in Central Asia

i) **Background**

The Japanese government held the second foreign ministers conference at Almaty in Kazakhstan on June 25-27, 2007, as venue of the dialogue on Central Asia including Japan, to evaluate the progress of cooperation under the new framework set up in the first foreign minister's conference and to discuss future cooperation, especially the promotion of regional cooperation in Central Asia. During the conference, the Japanese government expressed its cognizance, as mentioned below.

To realize effective regional cooperation, it is inevitable for countries in Central Asia to take proactive actions and to build-up the relation of mutual trust among them. The Central Asian countries have the determination to promote more cooperation overcoming various difficulties for sustainable socio-economic development of the whole region and each of the countries concerned. The Japanese government reaffirmed the intent to complement such proactive efforts of the Central Asian countries and to support the regional cooperation to promote cooperation with each other.

In addition to the above cognizance, the Japanese government also brought forward nine issues to proceed with regional cooperation, as follows:

- Counter-terrorism and Narcotics
- Diffusion of Antipersonnel Landmines
- Poverty Reduction
- Health Care
- Environmental Conservation
- Disaster Management
- Energy and Water

- Trade and Investment
- Transportation

In connection with the above, the Japanese government introduced this Study as one of the Japanese practical examples of Disaster Management by stating that it has started the Study on National Disaster Prevention for Pyanj River.

ii) **Practices of Regional Cooperation**

The Asian Disaster Management Conference took place in Astana, Kazakhstan on June 25-27, 2007. As part of the conference, carried out was a follow-up meeting for trainees who took seminar courses on disaster management in Japan. The meeting participant from Tajikistan was Mr. Kataev Abdujabbor, Deputy Chief of Hamadoni District and one of the counterpart personnel in the Study who worked with the JICA Study Team in formulating the communal disaster management plan and in performing the proactive part of the Evacuation Exercise in the Study. His presentation in the meeting involved practices on disaster management planning and the results of the evacuation exercise thereby contributing to regional cooperation.

c) Bilateral Cooperation

The Committee of Emergency Situations and Civil Defense of the Republic of Tajikistan has forged and signed in February 1998 an agreement with the Committee of Emergency Situations of the Russian Federation in the field of prevention and response in situations of emergency that are natural and anthropogenic in character.

It is necessary to note that the said cooperation had successfully been strengthened. Executed were similar agreements with Kyrgyzstan and Ukraine. Within the framework of international cooperation, an agreement between the Republic of Tajikistan and the Swiss Confederation in the field of emergency situations was signed and the Swiss Cooperation Office in Tajikistan was established at the end of 1998.

2) The International Fund for Saving the Aral Sea (IFAS)

Two major rivers drain into the Aral Sea; namely, Amu Darya and Syr Darya, which originate in the Pamir Highlands. Amu Darya is the Pyanj River in the territory of Tajikistan.

From 1960 to 1990, implemented were large-scale programs of land development in the Aral Sea Basin. The implementation of these programs has doubled the extent of irrigated areas and the volume of extracted discharges. Consequently, however, the water flow into the Aral Sea has decreased, and in 2002, the water level became lower by more than 21 meters since 1960. The water surface area had also shrunk to only one third.

To overcome the ecological crisis and to improve the socio-economic situation in the Aral Sea basin, the heads of Central Asian governments in year 1993 created the International Fund for Saving the Aral Sea (IFAS) based on the recognition of the world community that the situation in the Aral Sea is one of the greatest catastrophes of the 20th century.

IFAS has carried out its activities based on the decisions of the Council of Heads of States and the IFAS Board, IFAS regulations, agreements on the status of the International Fund for Saving the Aral Sea and its organizations, etc. The basic directions of IFAS activities are as summarized below.

- Financing and crediting of joint interstate ecological programs: Scientific/Practical programs and projects aimed at saving the Aral Sea and the recovery of ecological

situations in districts subjected to disaster by the Aral Sea, and the solution of general socio-ecological problems of the region

- Financing of joint fundamental and applied researches: Scientific-technical developments on the rehabilitation of ecological balance, rational usage of the natural resources and environment protection
- Creating and maintaining functions of the international system of ecological monitoring, database and other systems on the environmental conditions of the Aral Sea
- Mobilization of funds to undertake joint measures for river basin, water and land resources development, and flora and fauna protection
- Financing of joint scientific-technical projects and developments of trans-boundary water resources management
- Participating in the implementation of international programs and projects on the Aral Sea Saving and Aral Sea basin ecological recovery

Tajikistan is one of the original member countries of IFAS and it occupies most parts of the Pamir Highlands. Since the country has been drawing water for irrigation from the Pyanj River, it is one of the most important member countries of IFAS for saving the Aral Sea and recovery of ecology in the Aral Sea Basin.

1.4 LEGAL FRAMEWORK OF EENVIRONMENTAL AND SOCIAL CONSIDERATIONS IN TAJIKISTAN

1.4.1 Environmental Laws, Regulations and Standards

The Constitution of the Republic of Tajikistan (November 1994) addresses environmental issues and lays the foundation for all environmental legislations prevailing in the country. Article 44 of the Constitution states: “Every person is obligated to protect nature and historic and cultural monuments.” Article 13 stresses the importance of flora, fauna, water, air and other natural resources, and requires the Government to guarantee their effective utilization in the interest of the nation. Healthcare and security of the people against natural disasters are provided under Articles 38 and 46. Social rights, freedom of economic activity and equality of citizens before the law are guaranteed under Articles 8, 12 and 17.

The environmental law of Tajikistan is composed of the republican law, government resolutions, and decrees of various ministries/committees, some of which are described in Table R.1.4.1.

Table R.1.4.1 Summaries of Environmental Legislations Prevailing in the Republic of Tajikistan

Law/Resolution	Brief Contents
Constitution of the Republic of Tajikistan - 1994 (Article 44)	Obligation of citizens to conserve natural, historic and cultural environments.
Law on Utilization of Wildlife - 1994	Protection of wildlife and their habitats as well creation of favorable conditions for their reproduction and growth.
Law on Air Protection - 1996	Protection of air quality, introduction of measures for pollution control and improvement of air quality.
Resolution on State Control of Environmental Protection and Use of Resources - 1994	Establishes the role, functions and tasks of state in inspecting human and economic activities to assess their compliance with law and regulations.
Resolution on State Ecological Program - 1997	Defines fundamental goals and tasks for ecological-economic development of the country.
Resolution on Unauthorized Collection of Substances - 1990	Regulates use of medicinal plants found in nature.
Law on External Economic Activities - 1993	Defines external economic relations of the country and insures protection of rights, interests and properties of participants in external economic activities.
Criminal Code - 1998	Defines and classifies the social crimes and sets punishment terms for the criminals.
Law on Ecological Expertise - 2003	Requires the conduct of environmental impact assessment for large projects, prevention of negative impacts of economic/ human activities on environment, and creation of database on environmental status of the country.
Law on Nature Protection - 1993 (Amended in 2002)	Identification of activity and stages of projects for which environmental impact assessment (EIA) should be undertaken, and its mandatory review by state ecological expertise upon completion.

1.4.2 Environmental Impact Assessment (EIA) Requirement and Procedures

In accordance with the Law on Ecological Expertise - 2003, nineteen (19) types of projects in Tajikistan as listed below require environmental clearance with the conduct of a full scale environmental impact assessment.

- Power plants
- Steel industries
- Asbestos, cement, asphalt and concrete producing factories
- Chemical and petrochemical plants
- Highways, railways, and airport construction
- Oil and gas conveyance pipeline establishment
- Refineries and petroleum storage facilities
- Establishment of water intake structures and water supply facilities
- Hydro-technical structures (dam and reservoir)
- Forest utilization and establishment of industrial vineyards
- Sewage and waste treatment facilities
- Creation of dumping site for industrial waste and radioactive materials
- Mining activities (limestone, sand, gravel, clay)

- Large scale drilling for petroleum, gas ands coal
- Large storage facilities for oil, gas, chemical and petrochemical products
- Establishment of dye and non-ferrous industry
- Chemical industry with a complete (full) cycle
- Pumping of large volume of groundwater (more than 10 MCM/year)
- Exploitation and enrichment of large amount of ARKD coals

However, the projects proposed under the Study are the construction of river training structures and non structural measures, so that the proposed projects are not required to obtain environmental clearance certificates. The actual practices also proves that the construction works of the river training structures are not required to have environmental clearance, because MMWR and CoES have never been required to obtain environmental clearances for the previous and the ongoing river training works of the same kind as the proposed works.

1.4.3 Procedure of Environmental Impact Assessment (EIA)

The procedure to be taken by project proponents to obtain an environmental clearance for their projects is as graphically illustrated in Fig. R.1.4.1.

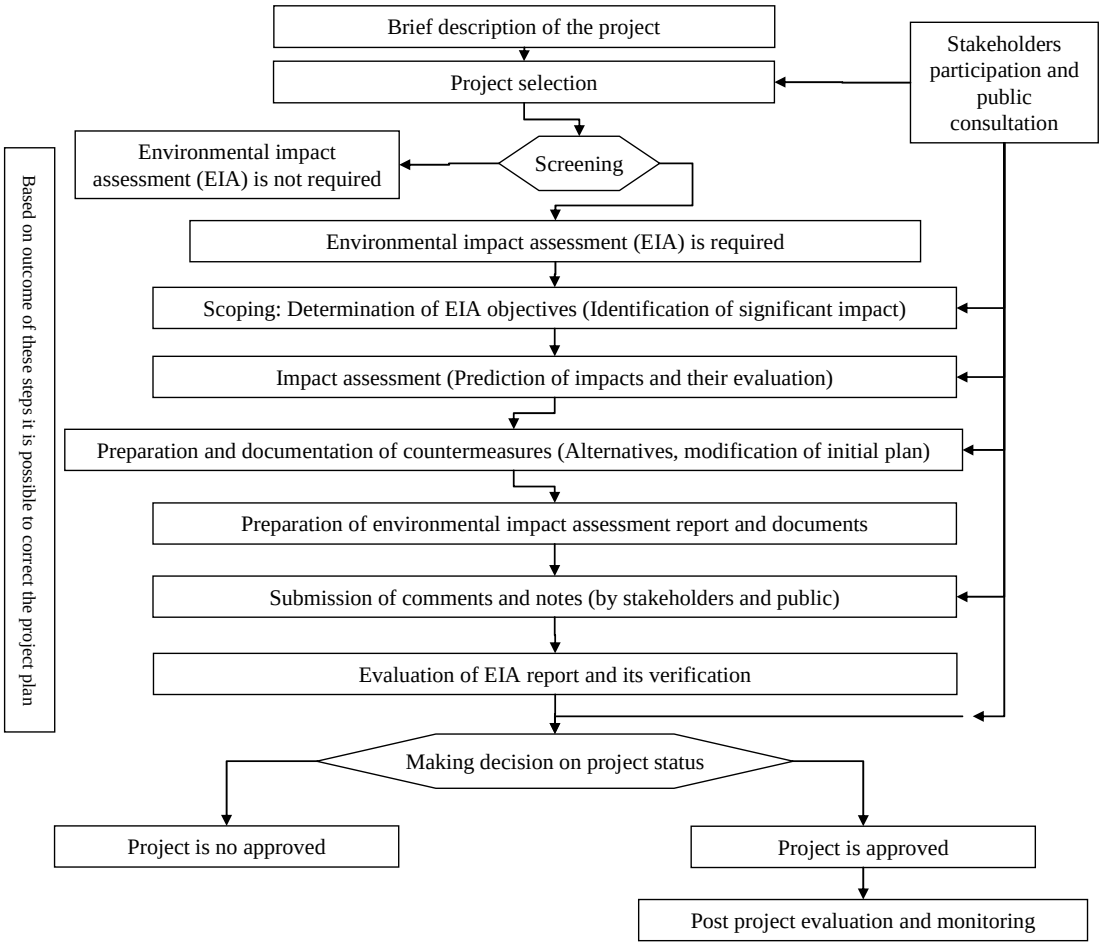


Fig. R 1.4.1 Procedures to Obtain the Environmental Impact Assessment Certificate

Inviting outside environmental experts to participate in the review of project documents and provide their comments, and the holding of public consultation meetings to disclose project information and grasp people's views, are also stipulated in the Law on Ecological Expertise of 2003.

1.5 PAST FLOOD EVENTS

1.5.1 Chronicle of Flood Events

The JICA Study Team had collected records of past major flood events in the whole Tajikistan territory from the CoES (Department of Protection of Population and Territory) and the ADB report (see Reference 2), as summarized in Table 1 and Table 2 in the Annex of Sector 1 of the Supporting Report. As noted from the collected data, Tajikistan had suffered from disasters over the years, such as debris flow, flood and landslide. Records for the 1970's were, however, unavailable during the Study.

From the records mentioned above, only extracted were the flood events concerning the Pyanj River Basin, as summarized in Table R.1.2.1 in Sector 1 of the Supporting Report. According to this table, 40 flood disasters occurred during the past 45 years despite the absence of records for the 1970's.

Focusing on the Hamadoni District, seven flood disasters had occurred during the past decade, as shown in Table R.1.5.1. In the 2005 flood, the Hamadoni District received the biggest damage amounting to some 7 million US dollars. According to MMWR, washed out was the Metintugay Kishlak along the Dehkonobod Canal and inundated was the protected inland area in the 2004 and 2005 floods of the Pyanj River, respectively.

Table R.1.5.1 Past Flood Events in Hamadoni District

Item No.	Date	Damage Condition	Damages ('000 US Dollar)	Discharge at Hamadoni (m^3/s)
1	1996	Due to the rise of water level in the Pyanj River, dikes of irrigation canals were breached causing floods at Border Checkpoint No. 7 and No. 8.	N/A	N/A
2	1998/7	Dike partially damaged	N/A	4,294
3	1999/7	Dike partially damaged.	N/A	2,849
4	2003/4	One hectare of land affected by heavy rainfall	N/A	N/A
5	2003/6	Dike partially damaged	N/A	3,190
6	2004/7	Damaged were 8 houses and 6 bridges, 0.68 km of flood protection structures, and private company buildings; 47 hectares of agricultural land affected	184	N/A
7	2005/6	Damaged were 266 houses; 3 facilities, including education, medical, social and cultural facilities; 4.4 km of roads, 3 bridges, 5.2 km of flood protection structures, and 7.1 km of canals and lodgments	7,026	4,254
	2005/7	The central area of Hamadoni was without electricity because an electric transformer broke down.	N/A	

Sources: Documents from IMAC, Department of Protection of Population and Territory, and interview with a member of the WG..

1.5.2 The 2005 Flood in Hamadoni

In 2005, the water level of Pyanj River significantly increased in the early part of June, and continuously increased to the highest level recorded in June 26. The water level later decreased but rose again in June 28, reaching its second highest level in July 14. Then, it gradually

subsided until the water level became the lowest in December. (Refer to the graph in Fig. R.1.5.1 regarding the water level measured at Khirmanjo Gauging Station.)

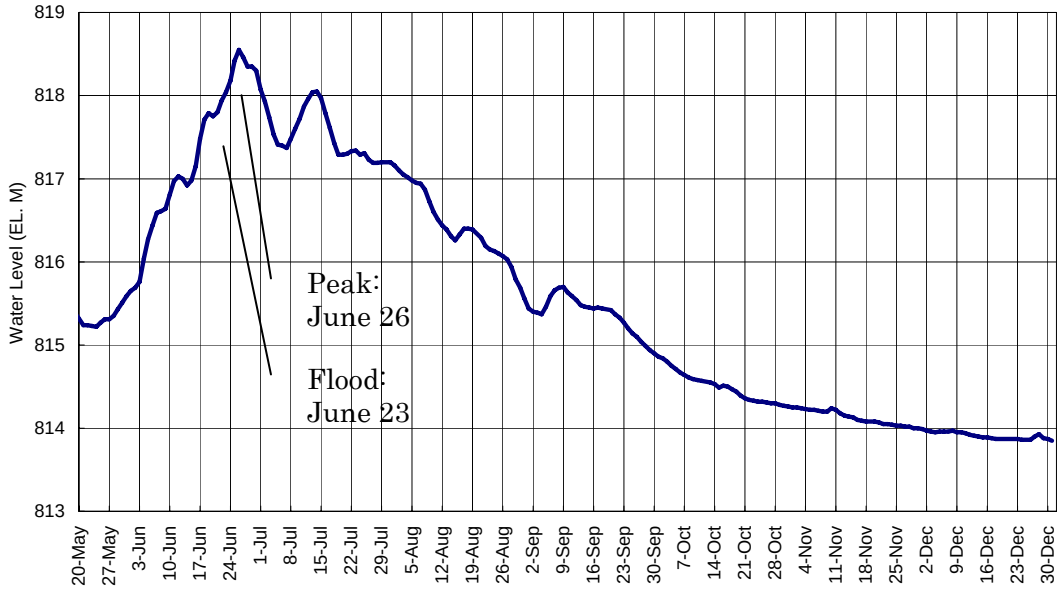


Fig. R.1.5.1 Water Level of the 2005 Flood at Khirmanjo Station

The broken dike along Pyanj River triggered the flood in the morning of June 22, 2005. Personnel of CoES and MMWR tried to restore the dike using bulldozers, sandbags and gabions, but in spite of their effort, the breach became wider on the night of June 23rd.

The discharge from the broken dike rushed along the bank nearby the fishponds which later eroded, and then through the irrigation canal including the canal in a part of Panjob Jamoat, into the inland area where some house foundations scoured. After that, the flood proceeded to the town of Metintugay in Turdiev, bringing much fear to the residents, and then continued to Kalinin and Dashti Gulo jamoats tracing the existing stream channel. Fig. R.1.5.2 show traces of the 2005 flood and its inundation area.

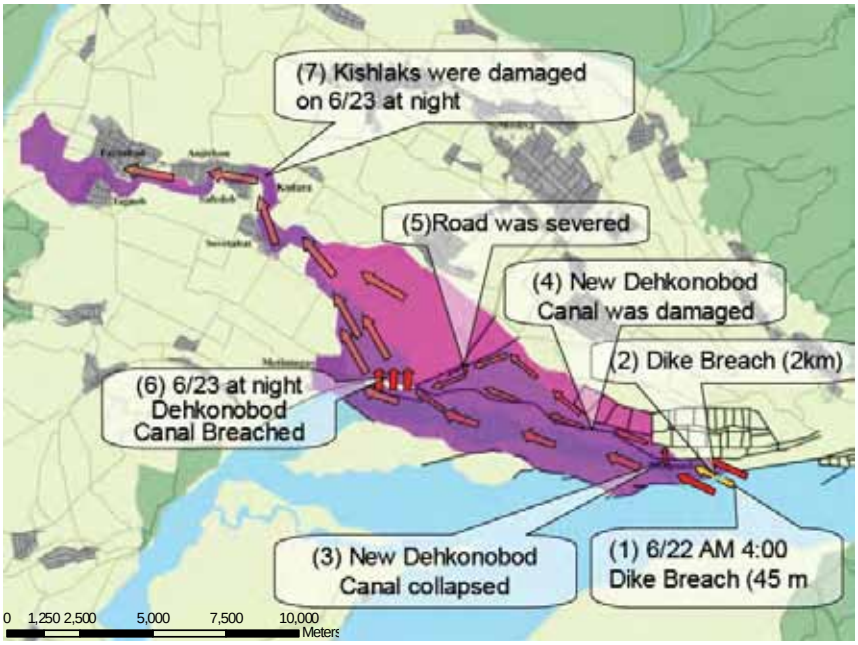


Fig. R.1.5.2 Traces of Flood and Inundation Area of the 2005 Flood

Inundation was around 0.5 to 1.0 m in depth and lasted for two or three weeks. Some 11,509 people or 1,519 families were evacuated to safe shelters (refer to Table R.1.5.2), and around 130 families were finally transferred to relocation houses provided by the government.

Table R.1.5.2 Information on Relocation of Flood-Affected Families in Hamadoni on 25 July 2005

25 July 2005

by: Ministry of Emergency Situation and Civil Defence

№	EVACUATED FROM:	EVACUATED TO:	NUMBER OF FAMILIES	NUMBER OF PEOPLE
1	**Jamoat Turdiev**	**Sayod village (tent camp), Hamadoni District Centre, relatives houses (Hamadoni)**	*780*	*6292*
	- village Metantugai	- // -	451	3537
	- village Savetobod	- // -	242	2055
	- village Beshkepa	- // -	72	581
	- farm № 1	- // -	15	119
2	**Jamoat Kalenin**	**PTU -17, iron-concrete factory (Betonzavod), school № 38 (Hamadoni)**	*377*	*2458*
	- village Kodara	- // -	73	563
	- village Safedob	- // -	32	182
	- village Anjircon	- // -	272	1713
3	**Jamoat Panjob**	**PTU -17, relatives houses (Hamadoni)**	*65*	*463*
	- village Mohiparvar	- // -	65	463
4	**Jamoat Dashtigulo**	**Buston, Grachev villages (Farhor district). Village Sayod, relatives houses (Hamadoni district)**	*297*	*2296*
	- village Tagnob	- // -	223	1725
	- village Faizobod	**hospital, relatives houses (Hamadoni)**	74	571
	TOTAL (in district)		*1519*	*11, 509*

CHAPTER 2. FEATURES OF THE STUDY AREA

2.1 FEATURES OF THE RIVER BASIN

2.1.1 General Features of the Pyanj River Basin

The Pyanj River Basin, the largest river basin in Tajikistan, is as large as 82,500 km^2 at the head of Hamadoni Alluvial Fan and occupies 58% of the whole territory of Tajikistan (143,100 km^2). Pyanj River is the right bank tributary of the Amu Darya, which originates in the Pamir Mountain Range at the highest region of Central Asia where the mountains are as much as 6,000 m in height. Sedimentation from the above watercourses forms the Hamadoni Alluvial Fan at 400 m to 550 m in altitude. The radius of the fan in Tajikistan is 25 km and the area is about 470 km^2.

The estimated annual average precipitation in this basin is 450 mm, of which more than 90% occurs during six months from December to May. Based on the results of hydrological analysis (see Sector 2 of the Supporting Report), precipitation has the general tendency to increase from upstream of the Pamir mountain range to Hamadoni, ranging from 100 mm to 600 mm.

Melting snow and glaciers often generate serious damage to the Study Area (Hamadoni Alluvial Fan) between May and August. According to the hydrological analysis in the Study, the maximum flood discharge at Khirmanjo were 4,370 m^3/s in 1969, and the peak discharge of the 2005 flood that damaged the Hamadoni District was 4,149 m^3/s. In addition, the annual mean discharge and the average annual maximum discharges at Khirmanjo were 900 m^3/s and 3,000 m^3/s, respectively.

The temperature gets warmer from the Pamir mountain range down to the Hamadoni Alluvial Fan, from approximately minus 2.5°C to 17.0°C. According to the data measured by Tajikmeteorology in 2005, the daily average temperatures around the Hamadoni Alluvial Fan vary between minus 2.6°C and 33.3°C. The hottest months are generally July and August (extreme maximum of more than 40°C has been recorded), and the coldest temperature normally occurs in the last half of January.

2.1.2 Morphology of Pyanj River

1) River System

As shown in Fig. R.2.1.1 in Sector 2 of the Supporting Report, the Pyanj River system consists of five major tributaries up to the Hamadoni Alluvial Fan. They are the Shokhdara, Gunt, Bartang, Yazgulom and Vanj rivers, and Pyanj river main stream. There are also small mountain torrents and three natural lakes in the basin; namely, Sarez Lake, Yashikul Lake and Zorkul Lake, all of which have been formed naturally by the filling up of river by landslide materials. The total length of the Pyanj River is 921 km, and the length from its source up to Hamadoni is 800 km. At the Hamadoni Alluvial Fan, Pyanj River breaks into a number of branches. (Table R.2.1.1 and Fig. R.2.1.1)

Table R.2.1.1 Features of Mainstream and Branches of River System in the Study Area

River Name	River Length (km)	Catchment Area (square km)
Pyanj River, R1	801.7	82,534
Gunt River, R5	267.5	13,464
Shakhdara River, R6	117.0	4,228
Bartang River, R4	226.3	29,938
Murgab River (Sarez Lake)	303.7	20,122
Yazugulom River, R3	74.4	2,435
Vanj River, R2	90.3	2,050

Fig. R.2.1.1 The Pyanj River System

The discharge of Pyanj River highly depends on the rise of temperature, because the melting of snow and glaciers, mostly, produces it. Fig. R.2.1.2 shows the average mean monthly discharge at Chubek with the temperature taken at Khorog in the central part of the Pyanj River Basin. The figure shows that river discharge increases in March together with the rise of temperature; the discharge peaks in July with the highest temperature, and the discharge descends following the lowering of temperature.

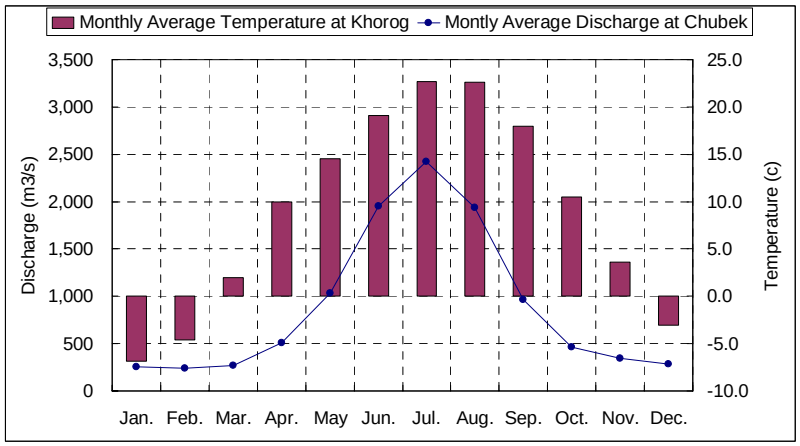


Fig. R.2.1.2 Averaged Mean Monthly Discharge (1967-2005)

2) Slope of Pyanj River

Fig. R.2.1.3 shows the outline of the riverbed slope of the Pyanj River including its tributaries. Alphabetized letters in the figure indicate the locations.

The main stream of the Pyanj River extends to around 800 km in length with 5/1000 in average riverbed slope, which is milder than the slope of the other tributaries. The Bartang and Gunt rivers have similar features of riverbed as the Pyanj mainstream, while the Vanj, Yazugulom, Shakadara and a part of Gunt rivers have steeper riverbed slopes because of the topographical characteristics of the Pamir Highlands, as described in Section 2.1.4.

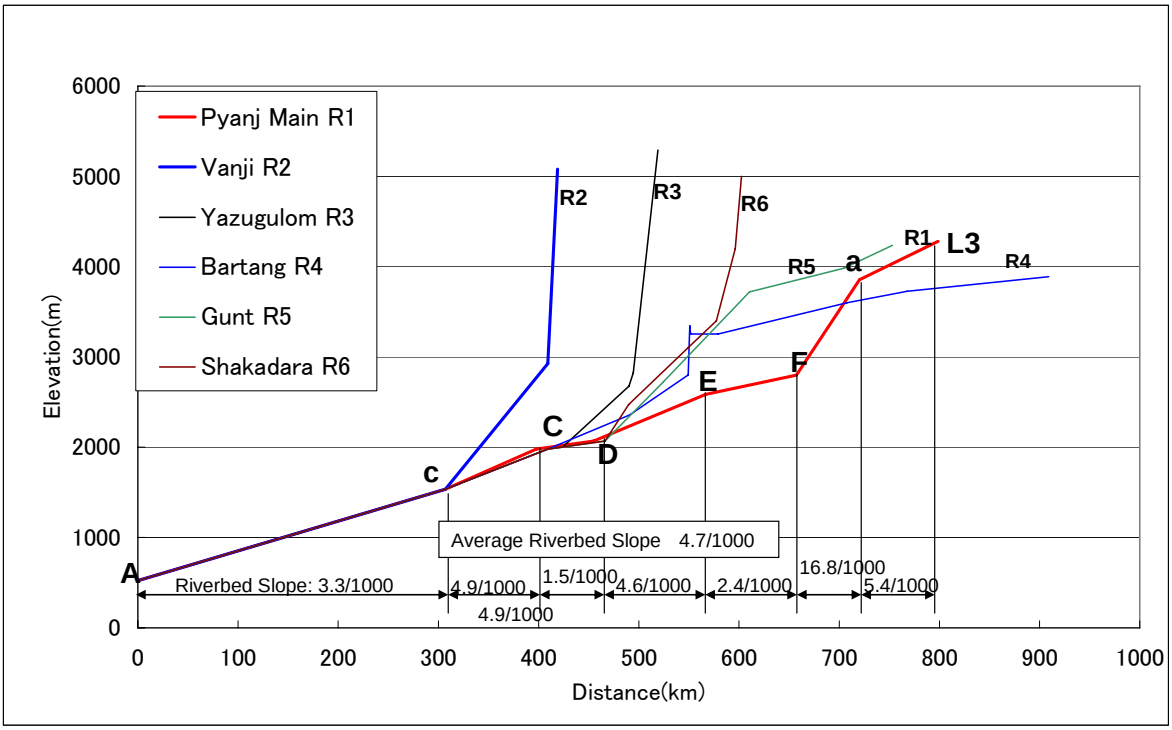


Fig. R.2.1.3 Longitudinal Profile of Pyanj River and its Tributaries

2.1.3 Geology

The Study Area, Hamadoni District, belongs to the Tajik Depression Zone, and the Pyanj River Basin extends over the Pamir Highlands. Loose sand-gravel layers cover the Hamadoni Alluvial Fan. Floodplain deposits cover the area along the river in the basin, and deposits of Cainozoic Tertiary Era and Quaternary Era spread over the Tajik Depression Zone.

The depression zone has two major faults, Peter the First and Darvaz-Karakul, formed in hilly topography with unconsolidated conglomerate, partly with halite dome of Jurassic Era and weathered rock of Paleozoic Era. Over those rocks, loess accumulates in the north side of Pyanj River. Over the Pamir Highlands, rocks ranging from Palaeozoic Era to Palaeogene Era exist. Fig. R.2.1.4 shows the conceptual geology in this area.

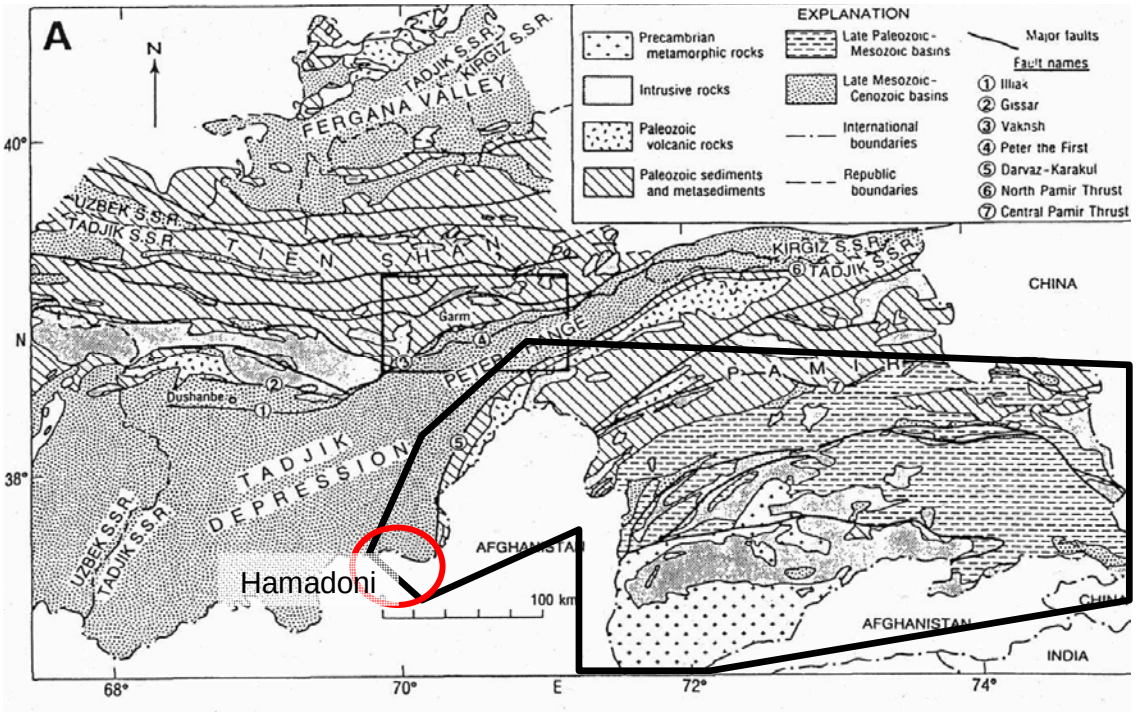


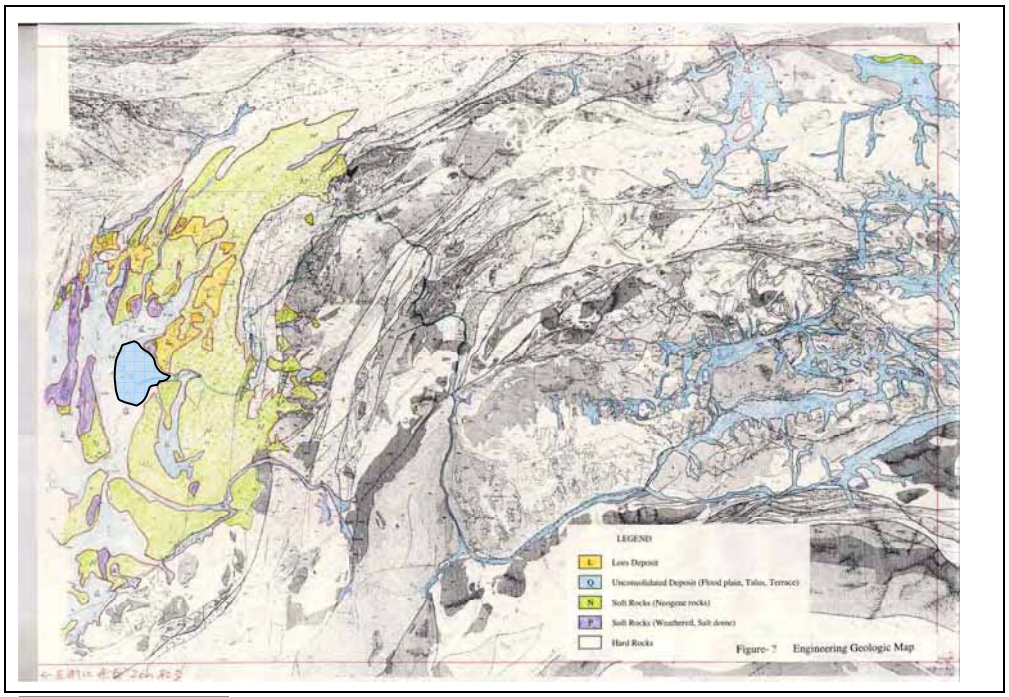
Fig. R.2.1.4 Geological Map of the Tajik Depression Zone in Pamir Highlands

Table R.2.1.2 gives an outline of the geological composition and engineering geological condition of the Pyanj River Basin.

Table R.2.1.2 Outline of Geological Condition of Pyanj River Basin

Era	Period	Geology/Layers	Places in the Pyanj River Basin	Characteristics	Engineering Viewpoint
Neozoic	Quaternary	Loess	Downstream-most, north of Pyanj R	Sand with clay	Vulnerable to gully erosion
		Present riverbed deposits, Floodplain deposits, Terrace deposits	Downstream-most, middle reach to upstream	Sand with clay/ Round gravels	Vulnerable to bank erosion by flood
		Debris Deposits	Upstream	Sand with clay/ Angular gravels	Vulnerable to bank erosion by heavy rain
		Terrace Deposits	Downstream-most	Sand with clay/ Round gravels	Vulnerable to erosion
	Neogene	Mainly Conglomerate	Downstream-most	Soft rocks	Vulnerable to erosion; source of soil and sand production
	Palaeogene	Base Rock	Mountains in upstream	Hard rocks	Source of gravel production
Mesozoic	Jurassic	Halite Dome	Hilly areas in downstream-most, north of Pyanj R	Soft rocks	Easy to elute
Paleozoic	Permian	Base Rocks		Weathered soft rocks	Source of sand and gravel production
Mesozoic Cretaceous to Palaeozoic		Base Rocks	Mountain in middle to upstream	Hard rocks	Source of gravel production

Considering the geological characteristics and the engineering viewpoint on resistibility to erosion, the engineering geological map in this area has five categories, as shown in the Fig. R.2.1.5. This map suggests that parts of the loess deposits; the unconsolidated deposits in the floodplain, talus and terrace; the soft rocks of Neogene; and the weathered soft rocks and salt dome are the main sources of sediment in the Hamadoni Alluvial Fan Area.



: Loess Deposits
: Unconsolidated Deposits (Floodplain, Talus, Terrace)
: Soft Rocks (Neogene Rocks)
: Soft Rocks (Weathered, Salt Dome)
: Hard Rocks

Fig. R.2.1.5 Engineering Geological Map of the Pyanj River Basin

Fig. R.2.1.6 is a map classified according to slope inclination. In the blue area with more than 30 degrees shown in the figure, very sharp valleys are dominant along the river in the upstream reach.

Both the results of examination of the engineering geological map and the slope inclination map suggest that the main sources of sediment at the Hamadoni Alluvial Fan are the areas of Neogene conglomerate in the depression zone and the sharp slope along the river course.

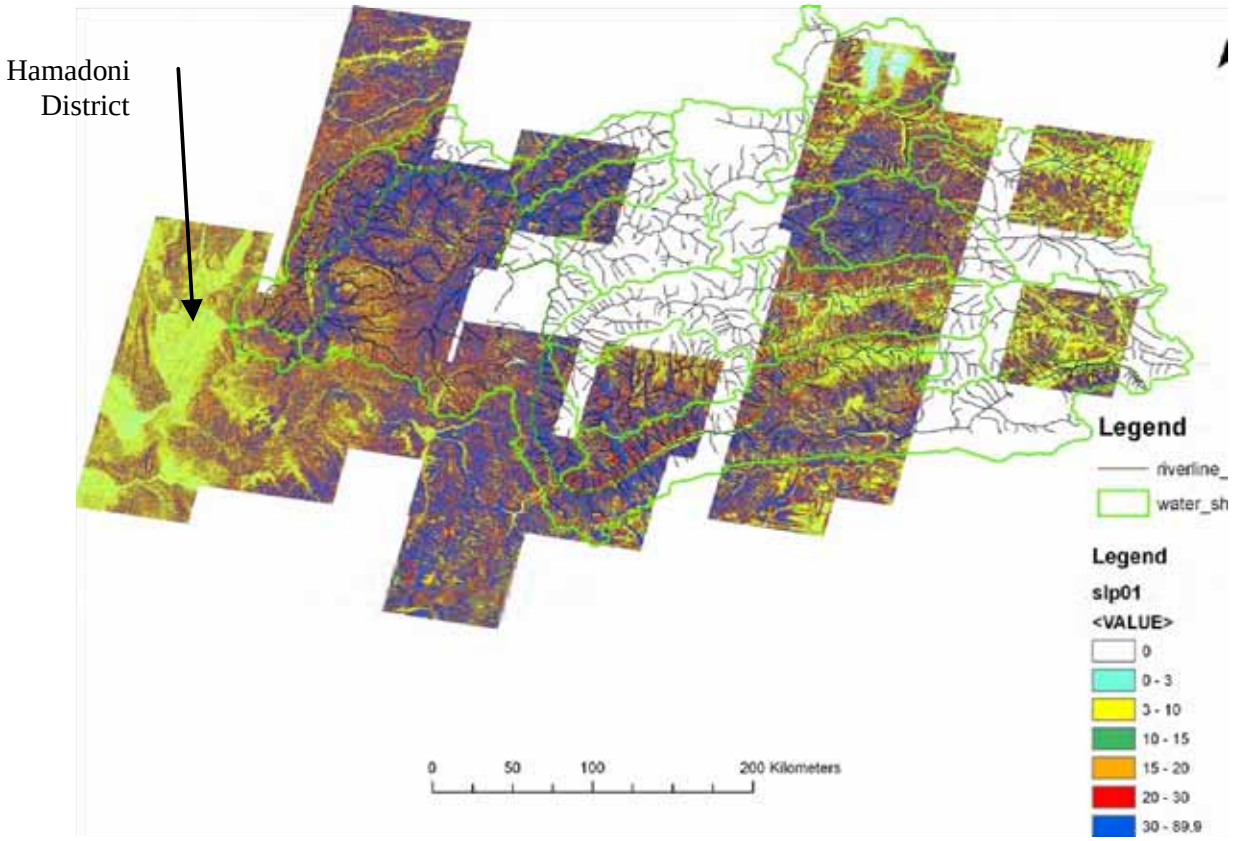


Fig. R.2.1.6 Slope Inclination Map of Pyanj River Basin

2.1.4 Topographical Features of Pyanj River Basin with Respect to Sediment Production

1) Outline of the Topographical Features of Pyanj River Basin

The Pyanj River Basin from the upstream of Chubek, the location of which is shown by point "A" in Fig. R.2.1.7 is delineated as follows:

To the West and North the basin is delineated by the mountain range separating the basin from the Vaksh River, and to the East towards China, by the mountain range of five thousand meters separating the basin from the Gobi Desert. The border to the South is the mountain range of seven thousand meters serving as the boundary with Afghanistan and Pakistan. This boundary then extends to the West through the 3,000-meter mountain range, and closes the basin territory at Chubek.

The topographical features of the whole basin are as follows:

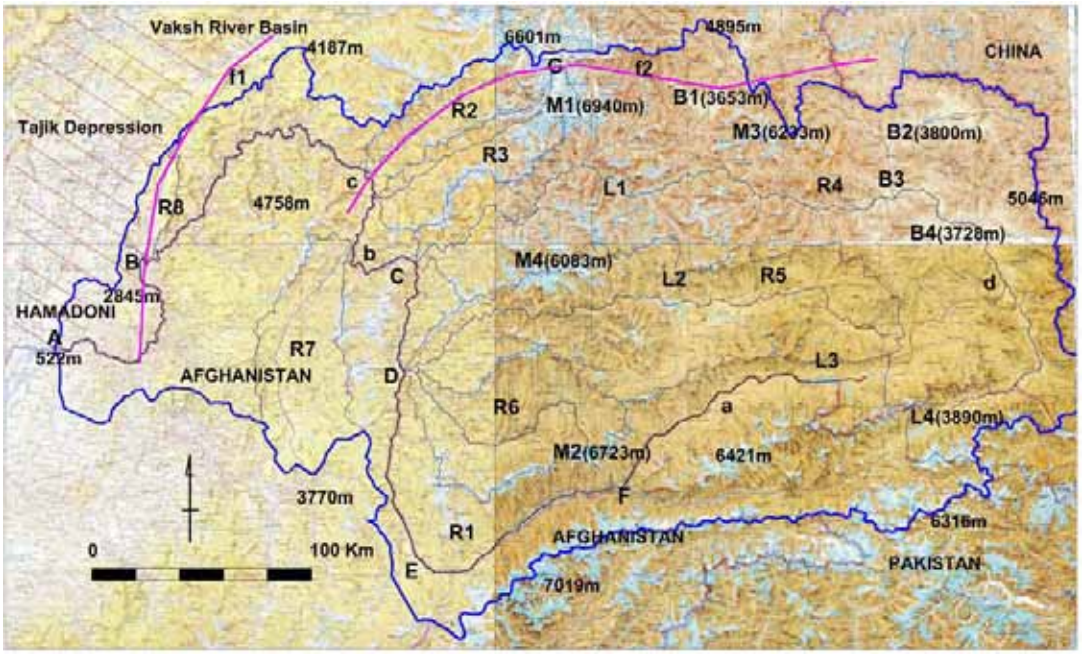
The mountain range with summits of over six thousand meters in elevation lies at the central part of the basin from north to south. In the eastern side the highland of more than four thousand meters in elevation spreads, while in the western side is the mountainous area declining toward the Tajik Depression Zone where Hamadoni District including Chubek (Point "A") is located. Therefore, the riverbeds on the eastern side of the central area of the basin such as R4, R5 and R1 have milder slopes, while the western side riverbeds such as R2, R3, R5 and R6 have steeper ones. (Refer to Fig. R.2.1.7)

Fig. R.2.1.7 shows the river course direction reflecting the geographical structure in this area, as also shown in Fig. R.2.1.4. The directions of the river course of the Pyanj mainstream (R1) around point "B" in Fig. R.2.1.7, Vanj River (R2), Yazugulom River (R3), Tagsheb River (R7) and Obitinob River (R8) goes from the northeast to the southwest following the direction of the geological faults of Darvaz-Karakul and the west side of the Central Pamir Thrust. In addition, the other rivers such as Bartang (R4), Gunt (R5),

Shakhdara (R6) and the Pyanj mainstream upstream (point "E") have the direction conforming to the direction of the eastern part of the Central Pamir Thrust.

According to the Engineering Geological Map, the soil of Loess and soft rock, which consists of conglomerate in Neogene, is vulnerable to erosion. They lay on the west side of Tangshed River (R7) and Obitinob River (R8) as shown in Fig. R.2.1.7, while unconsolidated riverbed materials lay along the rivers R4, R5, R6 and R1 upstream of point "E".

The results of reading analysis of satellite images conducted by the JICA Study Team show that the area between R2 or R3 to R7, and the extension of R8 or between Darvaz-Karakul Fault and Central Pamir Thrust Fault, has more collapse-wise micro-landforms and active sediment productive landslides than the other areas.



LEGEND:

Mark	Place	Mark	River Basin	Mark	Lake	Mark	Basin
A	Chubek	**R1**	Pyanj Main Stream	**L1**	Sarez	**B1**	Zartoshkol
B	Khirmanjo	**R2**	Vanj	**L2**	Yashilkul	**B2**	Ranchkul-Kuragon
C	Rushan	**R3**	Yazugulom	**L3**	Zorkul-Kokdzigit	**B3**	Murgob
D	Khorog	**R4**	Bartang	**L4**	Chakmaktin-Bshute	**B4**	Toktomushbek
E	Ishkashim	**R5**	Gunt				
F	Karabar	**R6**	Shakhdara		**Glacier**		
		R7	Tangsheb	**G**	Fedchenko		
		R8	Obitinob				
Mountain Name							
M1	Rebolyutsiya				**Geological Fault**		
M2	Karl Marks			**f1**	Darvaz-Karakul		
M3	Ofitzeroni Sobetu			**f2**	Central Pamir Thrust		
M4	Patkhor						

Fig. R.2.1.7 Topographic Map of Pyanj River Basin

2) Topographic Features as to Sediment Production of Pyanj River Basin

In general, one of the major causes of sediment production is the freeze-thaw cycle in the cold place or highland area because the repetition of freeze-thaw process of water in cracks of massive rocks breaks the rocks into pieces. Therefore, there is much potential for sediment sources over the river basin.

According to the satellite image analysis, there are many landside shapes over the river basin, but they are mostly massive rockslides that do not cause production of much sediment because of their size. Sometimes the massive rockslides block the river flow creating natural reservoirs and basins as well as moraines, which is debris transported by glacier movement.

Such natural reservoirs and basins have functions to capture sediment produced by the freeze-thaw cycle. From the productivity and capturing function of sediment, extrapolated is that, mostly, sediment is supplied to the Hamadoni Alluvial Fan Area from the area between the assumed lines R3-R7 and the extension of R8, or between lines of the Darvaz-Karakul Fault or f1 and the Central Pamir Thrust Fault or f2.

2.1.5 Hydro-Meteorological Information of Pyanj River Basin

1) Observation Stations

Hydro-meteorological observations in Tajikistan have been conducted since 1926. The Tajikmeteorology operates hydrological observation stations at 97 places and meteorological stations at 58 places over the Tajikistan territory. Among the hydrological and meteorological stations in the Study Area are 20 and 21 places, respectively. Records of observation data since 1960 are available, but many parts are missing.

a) Hydrological Observation Stations

Hydrological observations consist of two kinds; one is daily water level gauging and the other is periodical water velocity measuring. The latter is to obtain relation formulas between water level and flow quantity. Generally, the relation formula in the hydrological field is known as the H-Q curve or rating curve. Interpreted into flow quantity with the rating curve is daily-observed water level.

There are four hydrological observation stations along the Pyanj River in Tajikistan territory. They are located at Ishkashim, Shidz, Khirmanjo and Nizhni Pyanj, among which the first three stations are still operational. Khirmanjo Station is the nearest to Hamadoni District, covering 77,595 km^2 among 82,534 km^2 or 94% of the catchments of the Study Area. Fig. R.2.1.8 shows the location of hydrological observation stations.

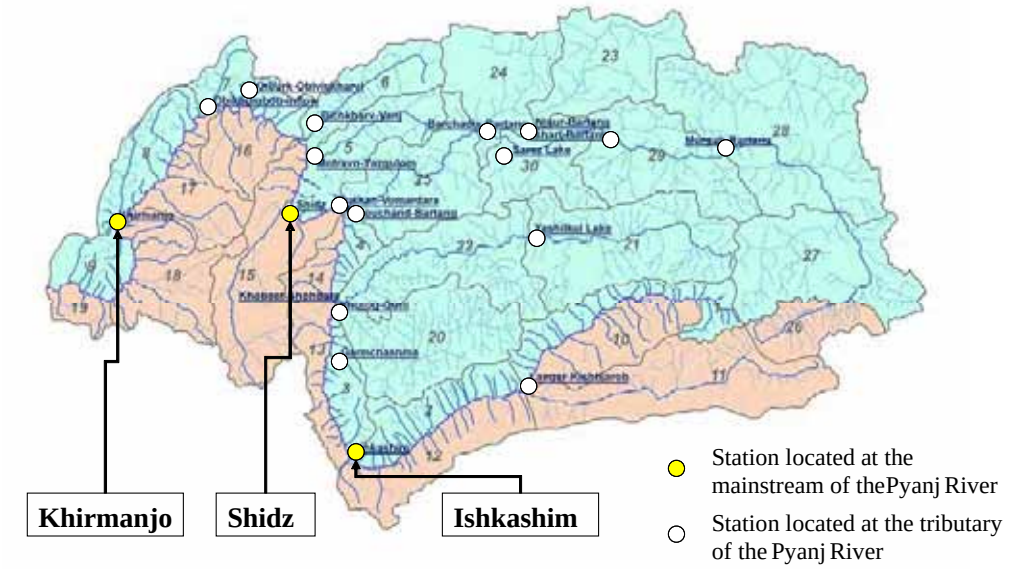


Fig. R.2.1.8 Location of Hydrological Stations in the Pyanj River Basin

b) Meteorological Observation Stations

Shown below are the meteorological observation parameters, but there are many missing observation data in the records.

Table R.2.1.3 Meteorological Observation Parameters

Recorded items as daily observation data	Recorded items as monthly average observation data
・ Precipitation ・ Temperature ・ Humidity ・ Barometric Pressure ・ Wind Direction & Velocity	・ Evaporation ・ Solar Radiation

Fig. R.2.1.9 and Table R.2.1.4 show the locations of meteorological gauging station in the catchments of the Study Area.

Fig. R.2.1.9 Location of Meteorological Stations in the Pyanj River Basin

Table R.2.1.4 Location of Meteorological Station in Pyanj River Basin

Name of Station	Elevation (m. MSL)	Position	
		Latitude	Longitude
Shaimak	3,840	37° 32’	74° 49’
Bulunkul	3,744	37° 42’	72° 57’
Javoshangoz	3,410	37° 21’	72° 27’
Ishkoshim	2,524	36° 43’	71° 36’
Murgab	3,576	38° 10’	73° 58’
Irkht	3,300	38° 10’	72° 38’
Sovnob	2,800	38° 18’	72° 28’
Kara-kul	3,930	39° 01’	73° 33’
Khorog	2,077	37° 30’	71° 30’
Navobod	2,566	37° 40’	71° 50’
Rushan	1,978	37° 57’	71° 33’
Khumrogi	1,737	38° 17’	71° 20’
Darvoz	1,279	38° 28’	70° 53’
Parkhar	447	37° 29’	69° 23’
Khovaling	1,437	38° 21’	69° 59’
Murminabad	1,191	38° 07’	70° 02’
Kulyab	512	37° 55’	69° 47’
Moskovski	489	37° 37’	69° 39’

2) Precipitation

a) Distribution of Precipitation in Pyanj River Basin

Summarized from the data of the selected meteorological stations with relatively well-maintained observation data is the precipitation data in the period between 1983 and 1991 as shown with monthly average precipitation and average annual total precipitation on the map (Fig. R.2.1.10). This figure suggests that the average annual total precipitation tends to increase from the east toward the west, or from the upstream toward the downstream of the river basin.

Among the meteorological stations indicated in the figure, the station covering the upstream area of the river basin where Shaimak, Bulunkul and Ishkashim are located had recorded the average annual total precipitation of less than 200 mm, indicating very little precipitation and not much monthly variation throughout a year.

On the other hand, the stations located in the western area from around Rushan have more than 300 mm. In addition, the western area has more precipitation in the period from December to June than the other periods of the year. Therefore, the former period with maximum amount of monthly precipitation in March is considered as the rainy or wet season, and the latter period or from July to November could be the dry season.

Given below are the definitions of arid and semi-arid areas classified as dry land area according to annual precipitation as proposed by UNEP in 1997:

Arid Area: Annual precipitation is less than 200 mm with rainy season in winter, and less than 300 mm with rainy season in summer.

Semi-Arid Area: Annual precipitation is less than 500 mm with rainy season in winter, and less than 800 mm with rainy season in summer.

Based on the above definitions, Rushan belongs to the semi-arid area and Shaimak, Bulunkul and Ishkashim belong to the arid area. Therefore, the boundary between arid and semi-arid areas could be drawn, as shown by the red broken line on the map in Fig. R.2.1.10.

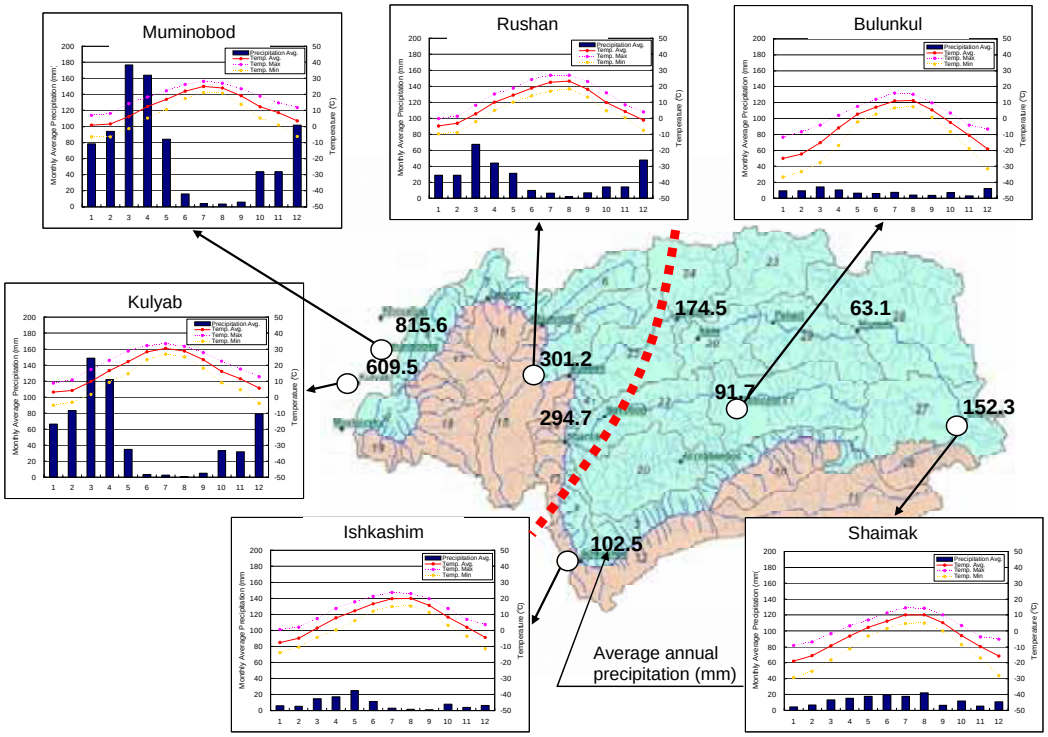


Fig. R.2.1.10 Precipitation Distribution in Pyanj River Basin

3) Temperature

Monthly average temperatures between 1983 and 1991 are summarized and shown in Fig. R 2.1.11. The figure shows that Shaimak and Bulunkul have monthly temperatures below zero during the time from October to April with almost 10°C in the warmest month, which is the boundary condition between the Cold Zone and the Polar Zone based on the climate classification proposed by Köppel. In addition, the figure shows that Ishkashim and Rushan have less than -3°C in the coldest month defined as the Cold Zone, and Munimobod and Kulyab have average temperatures of between 18 and -3°C in the coldest month, defined as the Temperate Zone.

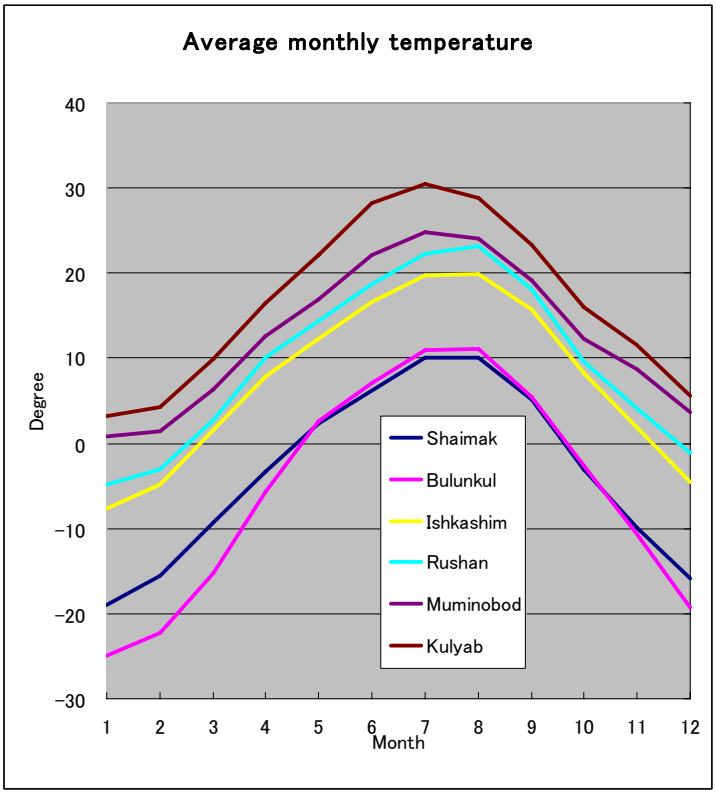


Fig. R.2.1.11 Average Monthly Temperatures of Selected Meteorological Stations in Pyanj River Basin

Fig. R.2.1.12 shows the relation between the average annual temperatures and the elevation of the same stations used in Fig. R.2.1.11. According to this figure, the average annual temperature tends to decrease depending on the increase in elevation of the station. The rate of decrease in temperature is 0.65℃ per 100m increase in elevation.

This illustrates the well-known phenomenon that temperature decreases by 0.6℃ for every 100m increase in elevation. Considering the effect of temperature decrease according to elevation, classified into the Polar Zone in the river basin are the areas located above elevation 4,000m.

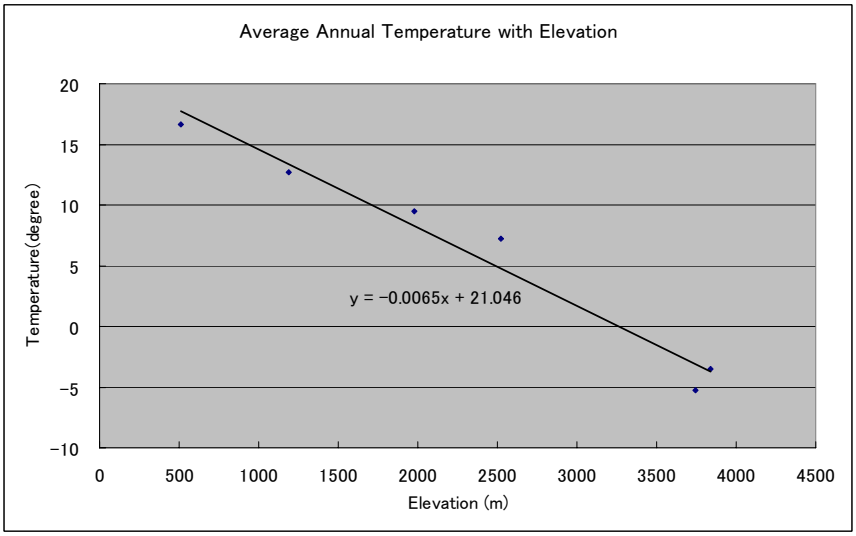


Fig. R.2.1.12 Average Annual Temperatures with Elevations of Selected Meteorological Stations in the Pyanj River Basin

4) Annual Total Discharge

Table R.2.1.5 and Fig. R.2.1.13 show the annual total discharge calculated using the data of Khirmanjo during the period from 1967 to 2005. Totally, 30 years of record are available among 39 years, because some records do not cover years completely or cover only parts of the year.

The average annual total discharge for 30 years from 1967 to 2005 is 24.3 billion m^3. The maximum is 32.2 billion m^3 in 1978 and the minimum is 16.1 billion m^3 in 1997.

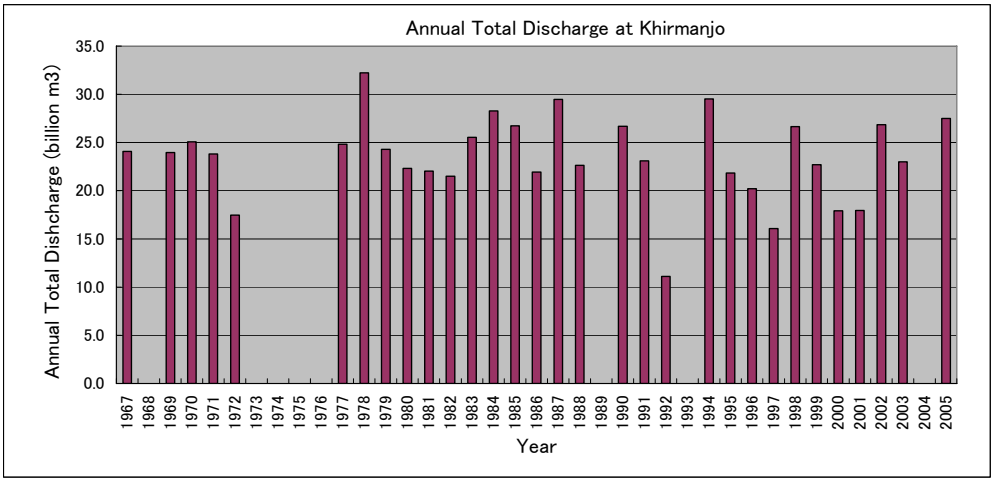


Fig. R.2.1.13 Annual Total Discharge at Khirmanjo (1967-2005)

Table R.2.1.5 Annual Total Discharge at Khirmanjo (1986-2005)

Khirmanjo			
year	Annual Total Discharge(Billion m3)	year	Annual Total Discharge(Billion m3)
1967	24.1	1987	29.5
1968	-	1988	22.6
1969	24.0	1989	-
1970	25.1	1990	26.7
1971	23.8	1991	23.1
1972	-	1992	-
1973	-	1993	-
1974	-	1994	29.5
1975	-	1995	21.8
1976	-	1996	20.2
1977	24.8	1997	16.1
1978	32.2	1998	26.6
1979	24.3	1999	22.7
1980	22.3	2000	-
1981	22.0	2001	18.0
1982	21.5	2002	26.9
1983	25.5	2003	23.0
1984	28.2	2004	-
1985	26.7	2005	27.5
1986	21.9	-	-
Average		**24.3**	

2.2 FEATURES OF HAMADONI ALLUVIAL FAN

2.2.1 General Features

The Pyanj River breaks out of the Pamir Highlands to a basin surrounded by hilly terrain with 1,000 to 1,500m in elevation, forming an alluvial fan at Chubek, Hamadoni. The alluvial fan is

around 470 square kilometers in area, opening toward the west in a circular arc of around 105 degrees. The summit of the fan is located near the Chubek Intake. Known to have run in several branches, the Pyanj River presently runs in two ways: one is to Afghanistan, the Darkad River, and the other is along the dike in parallel with the border.

The fan changes its characteristics at elevation 470~480m where the districts of Hamadoni and Metintugay are located. The upper section from this zone has slopes ranging 1 to 250 and 300, steeper than the lower section. The topographic units are small holms fish-scale in shape cancellous-wise, so that the river channels are not fixed and the river courses are not clear. The lower section where the main streams are fixed has slopes ranging 1 to 300 and 600, and the clear old rivers are traceable.

2.2.2 Transition of River Course

The locations of river courses in the satellite images taken in the 1970's to 2005, as indicated in Fig. R.2.2.1, suggest that the main stream of the Pyanj River in the fan area has transited from south to north or from the Afghanistan side to the Tajikistan side. The transition of river courses is as follows:

- The images from 1972 to 1986 show that there are more than five branches running over the Hamadoni alluvial fan area, which are shown with broken lines in the images.
- The Darkad River, which is indicated with the boldest broken line among the river lines and located in almost the middle of the fan area, is considered as the mainstream of the Pyanj River in the fan area, judging from the width of the trace of river in the satellite images of 1972 to 2005.
- From 1972 to 1986, found is a wide vegetated area, as indicated by the yellow circle with letter "A". However, the upstream part of the vegetated area reduced toward the downstream in the 1986's image. In the images of 1995 to 2005, the vegetated area has disappeared and the remaining traces of holms seem to be under water.
- From 1972 to 1986, found are some streamlines as indicated by the pink broken lined circle with letter "B". However, the streamlines get much fainter in the 1995 and 1999 images. In the 2005 images, the streamlines have almost disappeared from the pink circle.
- The mainstream of Darkad River got wider in the 1995 and 2005 images compared to the previous years' images. The stream on the Tajikistan side also became wider than the other streams in the 2005 image.

The results of interpretation of the satellite images mentioned above are as follows:

- The river course of the Pyanj River in Hamadoni Alluvial Fan has changed in the period from 1986 to 1995, because:
  - The big holm indicated by the yellow circle reduced toward the downstream.
  - The river courses in the Afghanistan side indicated by the pink broken-lined circle started to vanish in 1995, and finally disappeared in 2005.
  - The Darkad River and the Tajikistan side branch flow got wider in 1995 to 2005.
- One of the causes why the river course has changed is the rising land height on the Afghanistan side - indicated by the pink broken-lined circle in the images - that has pushed the river course toward the Tajikistan side.
- The phenomenon of the gradual vanishing of river lines on the Afghanistan side suggests that sediment deposits caused the rising of land on that side.

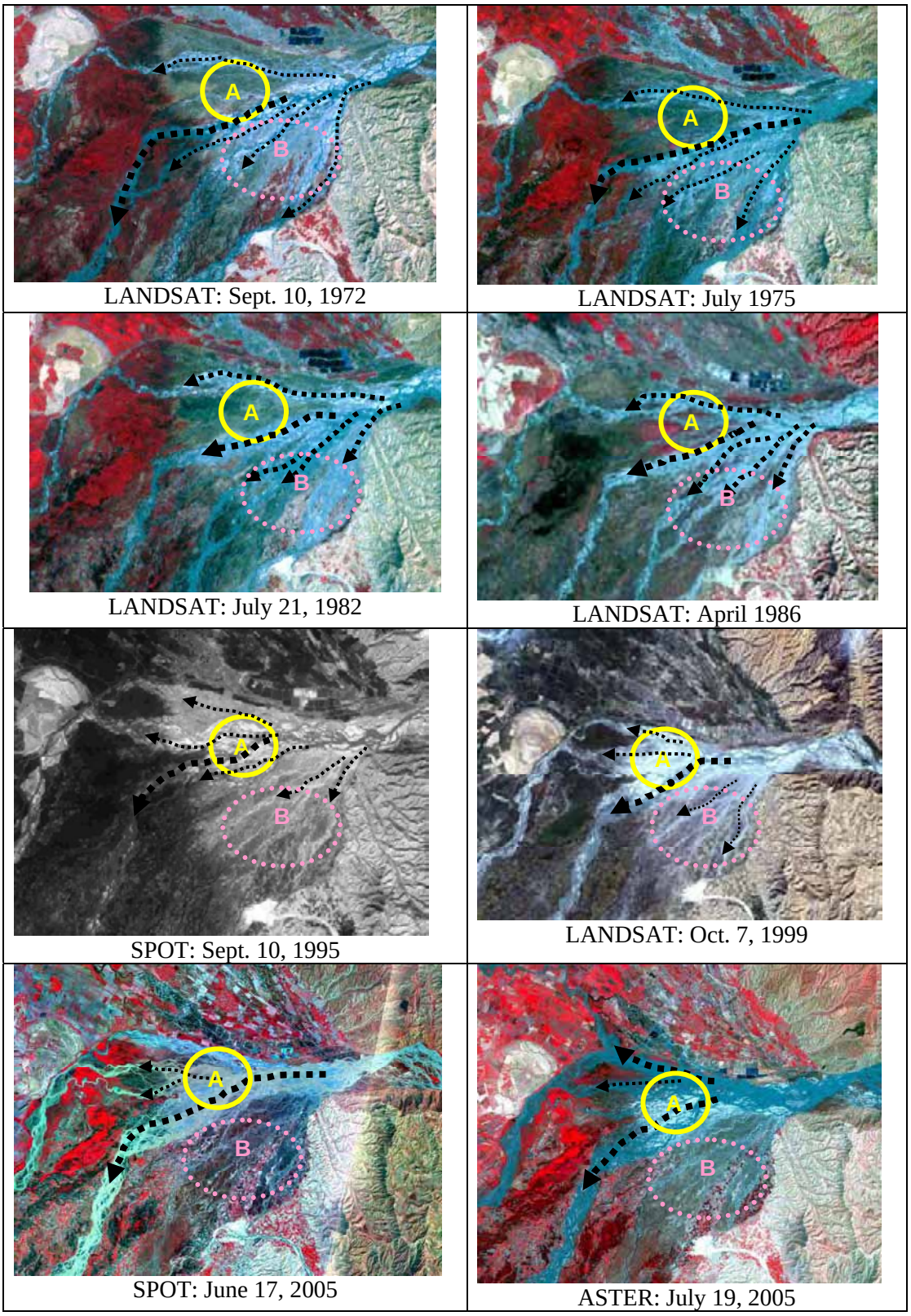


Fig. R.2.2.1 Satellite Images of River Course Transition

2.2.3 Sediment Balance

Sediment at the small tributaries and the slope surfaces at the upper and middle Pyanj River Basin are conveyed through floods or debris flow and the coarse materials are deposited in the

composite fan and alluvial cone up to the middle river basin. In addition, the portion of sediment not deposited on the way to the middle basin might accumulate in the riverbed at a relatively wider valley or small flood plain. Furthermore, lakes such as the Sarez, Yashikul and Zorkul also impound sediment from the upstream and the sediment accumulates in the wider part of the riverbed in the main course of Pyanj River or main tributaries.

As described above, sediment caught in various ways is temporarily stored at the upstream and the middle parts of the basin. Hence, the presumable theory of transportation of sediment yield is that the sediment yield generated from the lower part of the Pyanj River Basin and conveyed from the narrow way through Khirmanjo contributes to the accumulation of sediment yield in the Hamadoni Alluvial Fan.

Part of the sediment conveyed through the narrow valley accumulates on the alluvial fan or further downstream. To confirm the balance of sediment, calculated was the competency of transportation of sediment at the top and at the edge of the fan. As the result of calculation, the amount of deposits on the alluvial fan was estimated to be about 6 million m^3 (MCM) per year, which is equivalent to sediment with the depth of 2 to 3 cm per year.

Fig. R.2.2.2 illustrates the process of conveyance of sediment from the upstream to the alluvial fan.

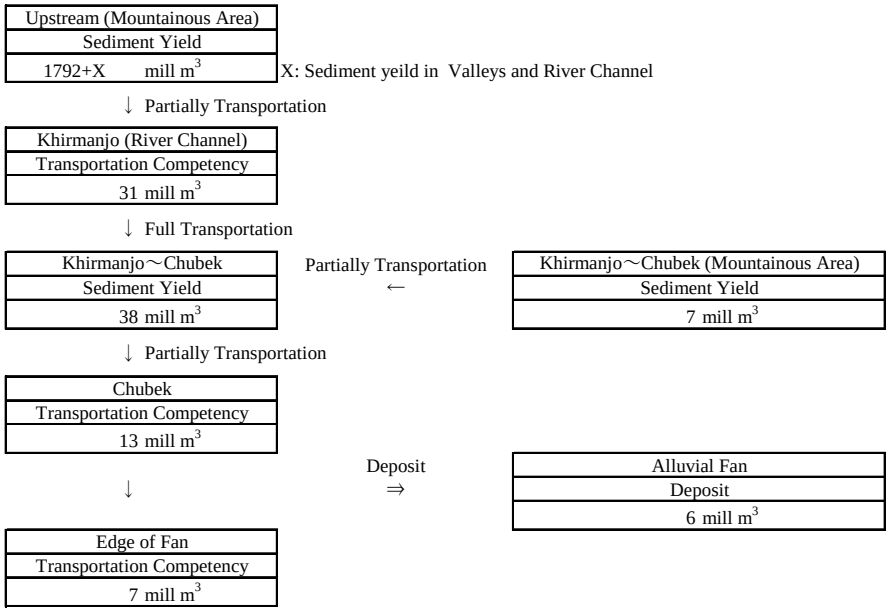


Fig. R.2.2.2 Sediment Balance in Pyanj River Basin

2.3 MECHANISM OF FLOOD

Some factors cause flooding in the area. Some of them are directly connected and some indirectly connected to the causes. These factors combine to increase the flooding potential and damage, as explained in more detail below.

(1) Snow and runoff are the direct causes of flood in case the amount of melting snow exceeds the natural or manmade flow capacity of the river. The amount of snow-melt depends on the quantity of snowfall in winter and heat in the following spring and summer in certain catchments. Since there are many tributaries in river basins having different areas and features, the combination of these factors control the intensity of flood discharge or flooding at a certain area.

(2) Meandering, which results from bank erosion and sedimentation, either give adverse or beneficial effects. In meandering, the river changes its direction of flow toward the

eroded bank. Sedimentation creates or moves holms in the branches and makes the flow direction change. Some flows go toward populated areas and some go to the wilderness. The former case causes flooding and damage.

(3) Engineering, which is the basis of understanding what happens during a flood, of analyzing the flood phenomenon, of planning prevention works, of designing and constructing prevention structures, and of maintenance on the facilities and structures, is one of the factors of flooding. Improper engineering sometimes intensify not only failure of prevention works but also flood damage.

(4) Vulnerability against flood, which depends on the capacity of the government and durability of communities against floods, is also among the factors. The immediate and appropriate response by government and community can minimize the damage or recover the people's living condition sooner. Itemized below are the required capacities:

a) Institution and organization to prepare the necessary arrangements for prevention and restoration work and to provide immediate response at any stage of flooding;

b) Preparedness to prepare the flood hazard map and the evacuation plan with implementing arrangements;

c) Information management to implement effective flood risk management with collection, analysis, storing and transmission of information on floods; and

d) Effective, timely, and immediate response and flood fighting.

2.4 PRESENT CONDITION OF MEASURES IN HAMADONI DISTRICT

Discussed in this section is the present condition of countermeasures against flood in Hamadoni District.

2.4.1 Structural Measures

There are three aspects of structural measures in the Hamadoni area. The flood protection dikes are to protect Hamadoni District from floods, while the intake guide dike is to secure the intake of water for irrigation supply in Hamadoni and Farkhor districts. On the other hand, the spillway guide dike is to release the spilled water from the intake facility without any adverse effect against the intake and to protect Hamadoni District from floods by keeping the flood flows away from the banks of the river.

1) Flood Protection Dike

The flood protection dike is composed of two components; one is the main dike and the other is the spur-dike. The latter is to protect the main dike from erosion.

a) Main Dike

After the 2005 flood, CoES started to restore a part of the broken dike with government funds. MMWR did the other part and the irrigation canals, with allocation from both government funds and a part of the ADB loan for the irrigation rehabilitation project; namely, 4.5 million Tjs. and 7 million USD, respectively. With the work completed in April 2005, the irrigation facility was able to resume irrigation water supply on time for the planting of cottonseeds for the 2006's harvest.

CoES restored the dike with riverbed material for embankment, concrete blocks and gabions for slope protection, and concrete blocks for foot protection and spur-dikes. MMWR did with the same material for embankment and slope protection but constructed the spur-dikes were with embankment. DIWRF designed these restoration works.

Fig. R.2.4.1 shows parts of both the restoration works done by CoES and MMWR.

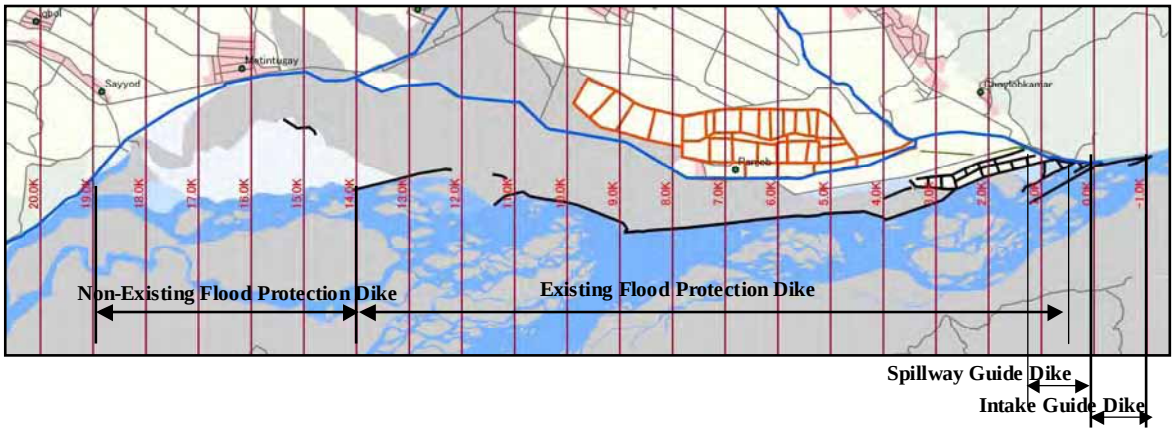


Fig. R.2.4.1 Layout of Flood Dike along Pyanj River in Hamadoni

The design of the existing dike is in the form of embankment with slope and foot protection works. The design of slope protection works is in three ways: one is made of gabions, one is concrete blocks and the other is a combination of both works. The design of foot protection works is with concrete blocks.

The existing spur-dikes came in two designs: one is made of embankment with slope and foot protection works in the same way as the main dike, and the other is made of concrete blocks.

Fig. R.2.4.2 shows the typical design cross-sections of the spur-dikes.

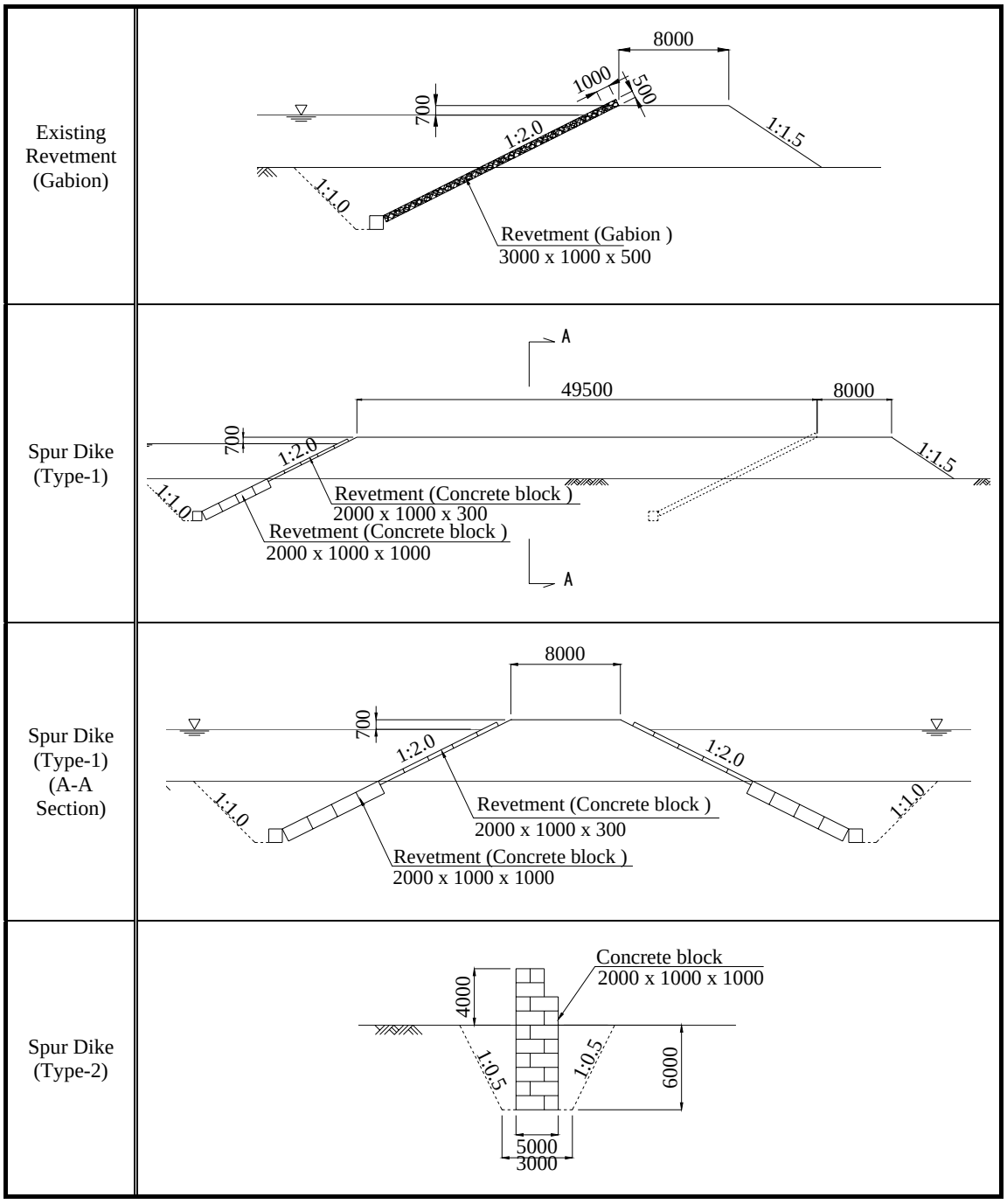


Fig. R.2.4.2 Typical Cross-Sections of Spur-dikes

b) Spur-dike

There are some kinds of spur-dike constructed in different sections of the dike. Some are made of concrete blocks and some are embankment protected with concrete blocks with different angles of alignment and different lengths. Some are functioning to promote sedimentation in front of the dike slopes while some are mal-functioning to leave the slope eroded.

There are some indicators to evaluate the effectiveness of spur-dike as suggested by the advisory committee on spur-dike design, as follows:

- Width-Length ratio of existing holms
- Ratio between lengths of existing spur-dike and of sediment adhered to it

2) Intake Guide Dike

The Intake Guide Dike (hereinafter referred to as the IGD) consists of embankment and spur-dikes designed with concrete blocks. The IGD had suffered damages from flood flows every year. CoES had restored the IGD washed out by the 2005 flood.

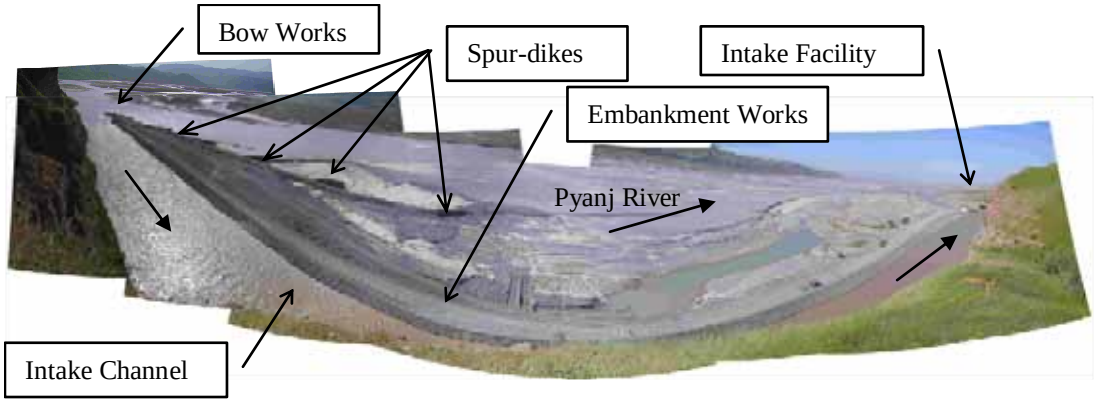


Fig. R.2.4.3 Intake Guide Dike (Photo taken on March 23, 2006)

The restoration work used concrete blocks for the bow protection works and riverbed materials for the embankment. The bow protection of concrete blocks anchored to the existing concrete block spur-dike slowly moved and loosened because of erosion at its base.

3) Spillway Guide Dike

The Spillway Guide Dike (hereinafter referred to as the SGD) consists of embankment and spur-dikes designed with concrete blocks. The SDG had suffered from erosion by flood flows every year.

The MMWR had restored and improved the SGD with some extension of dike length and with additional spur-dikes, as shown in Fig. R.2.4.4:

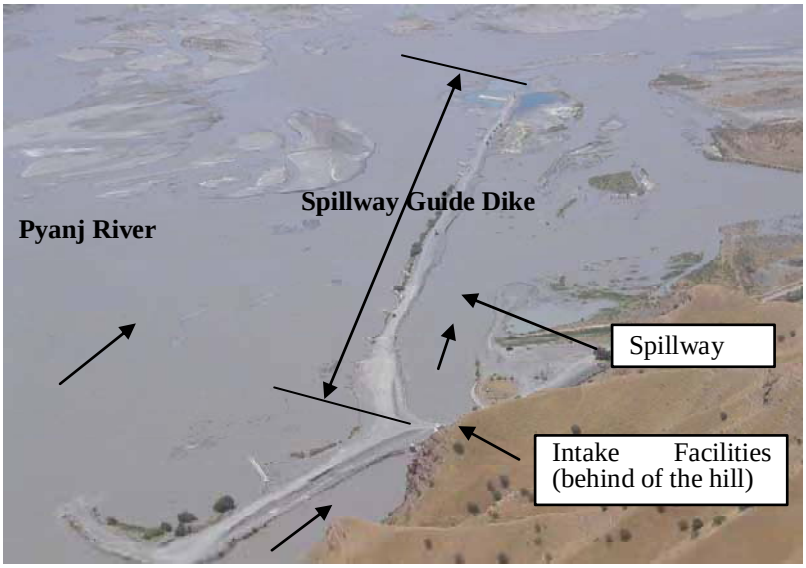


Fig. R.2.4.4 Spillway Guide Dike (Photo taken on June 2, 2006)

2.4.2 Non-Structural Measures

The present condition of the non-structural measures against flood damages in Hamadoni District is as described in the previous item 1.3.3.

2.5 PROBLEMS ON FLOOD MANAGEMENT

2.5.1 Problems of Structural Measures

1) Flood Protection Dike

a) Problems on Riverbed Transition

The mainstream of the Pyanj River has been moving for years, which is natural for rivers in an alluvial fan. As shown by the chronological changes of the mainstream in the satellite images, the river has been moving from south to north, approaching the existing dike. Especially after the 2005 flood, the mainstream has been running along the dike.

The river course movement from South to North means that land on the Afghanistan side is expanding, and the width of the river course will decrease as long as the dike exists. If the mainstream intrudes to the inside area of the existing dike, the south side bank would expand into the Tajikistan side. Consequently, the construction works have a political purpose, because they will work to stop the reduction of land area of the Tajikistan side.

Another problem is that river course narrowing would induce the increase in river flow velocity and scouring force, and the river water level. The design of the bank should consider these factors to determine the design bank height higher and the slope and foot protection works harder. Fig. R.2.5.1 shows a conceptual drawing of the river course movement and its effect.

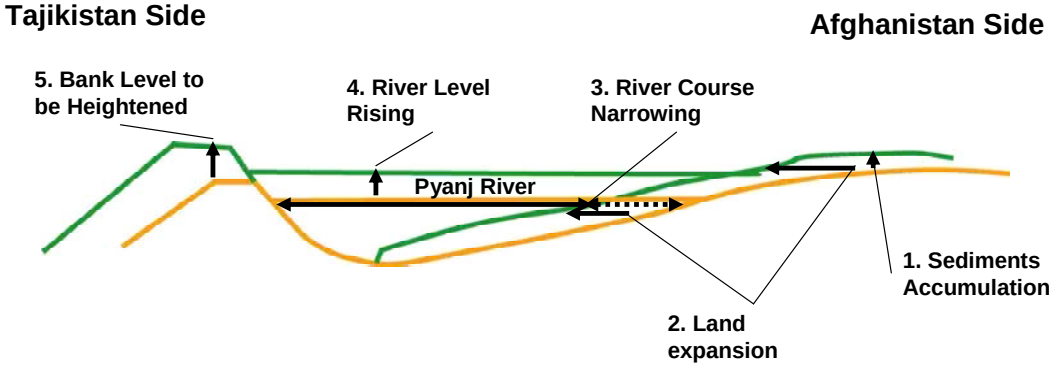


Fig. R.2.5.1 Conceptual Drawing of River Course Movement and Effect

A local condition may increase the intensity of flood. It is the existence of holms, which have developed along the river course. At the holms, river flow changes direction toward the dike in some areas. Some of them have remained stable for a long time; some of them have appeared and disappeared. (Refer to Fig. R.2.5.2)

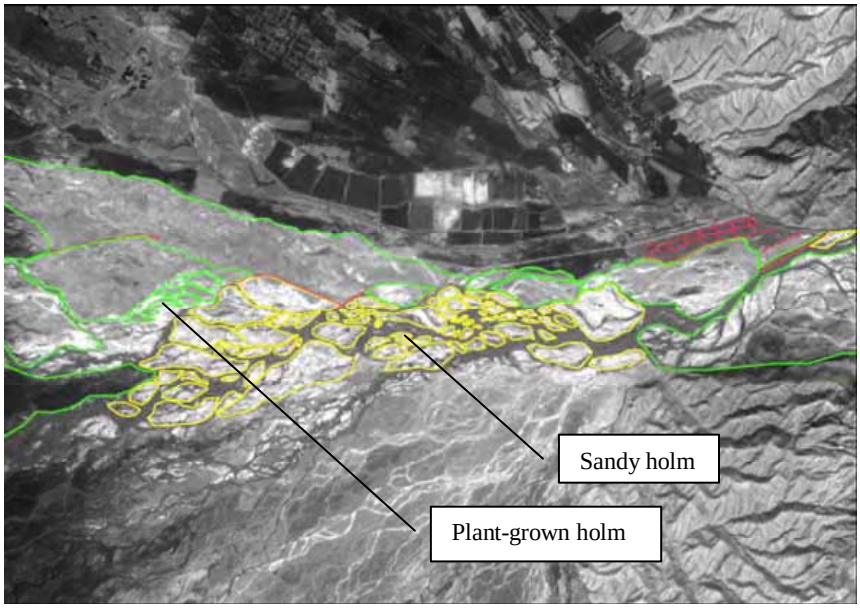


Fig. R.2.5.2 Holms in Pyanj River

b) Problems on Dikes and Spur-dikes

Some portions of the existing dikes have suffered from damage at their foot and slopes. Some causes of destruction of dikes and spur dikes are erosion induced by high velocity of river flow and wash-out of embankment material from the spaces between concrete blocks or stones in gabions. Fig. R.2.5.3 shows the condition of damage.

Slipped Concrete Blocks

Washed-out Gabions

Fig. R.2.5.3 Destruction of Existing Dike in Hamadoni District

In addition to the causes mentioned above, the site investigation suggests that the short foot protection length and the irregular concrete block arrangement poorly protect some sections of the existing dike.

Another reason regarding the failure of the present dike works is the short construction period. The dike restoration works after the 2005 flood had to be done within a limited time, only from November to April, preferring to cover the required areas under such limited conditions to prevent floods from intruding to the cultivated lands in the 2006 flood season. Therefore, some portions of the dike remain vulnerable to erosion because the work was too fast for the dike to attain the proper quality.

There are some spur-dikes constructed in the recent years. Even though some of them have deformation at fore-end, they are mostly successfully functioning to protect the dike slopes, as shown Fig. R.2.5.4.

Sediment deposit in front of gabion | Length of sediment appears as designed

Fig. R.2.5.4 Sediment Deposits behind Spur-dike in Hamadoni District

c) Interruption of Irrigation Supply

Flood in the Study Area after the flood protection dike was broken first attacked the irrigation canal located along the river in Hamadoni between the inland area and the dike. Once the canal was destroyed, irrigation water supply to the cotton fields was interrupted for 10 months from June 2005 to April 2006 in not only the Hamadoni District with 8,000 ha but also the Farkhor District with 12,000 ha which brought losses to both districts due to the reduced production of cotton . All areas of Farkhor depend on the irrigation canals that supply water from the Pyanj River through the Chubek Intake Facility. (See Fig. R.2.5.5)

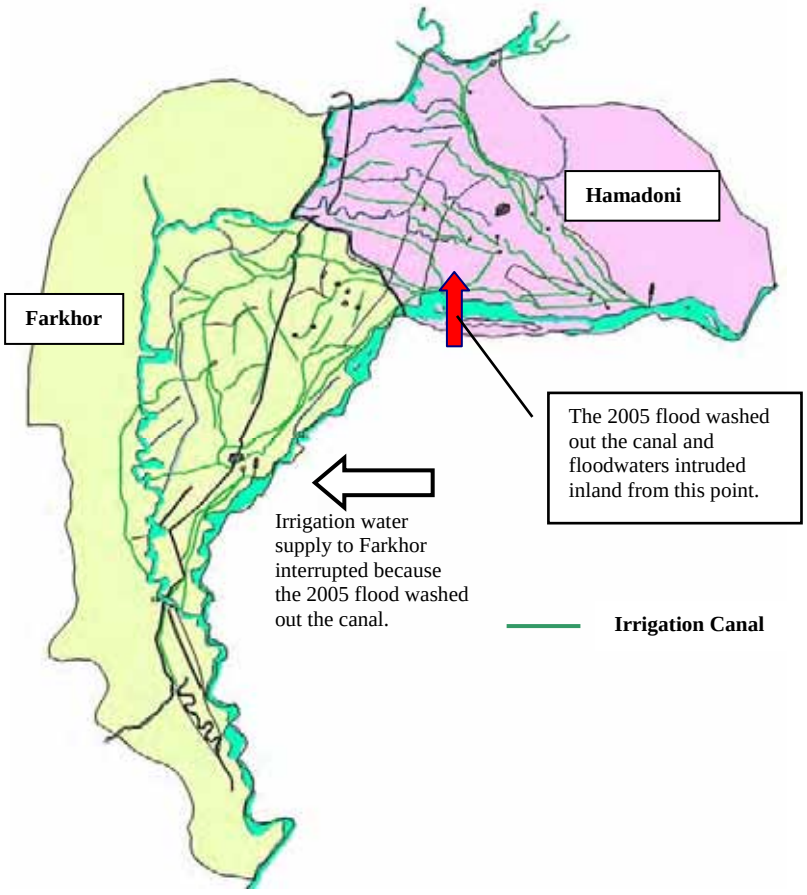


Fig. R.2.5.5 Collapse of Irrigation System in Hamadoni and Farkhor Districts due to the 2005 Flood

2) Intake Guide Dike and Spillway Guide Dike

Outlined below is the problem on guide dikes.

- River flow has been close to the bow site frequently attacked by river water, so that the shallowly placed concrete blocks of the protection works have washed out while the deeply placed concrete blocks of the spur-dikes based on the design of 8 meters in depth from the riverbed surface have remained.
- It may be all right to take into account the above-mentioned design depth of 8 meters, but the problem arose from the method of constructing the bow works under the condition of fast current of river flow.
- The intake guide channel has too much flow capacity comparing to the intake weir capacity so that much water always spills into the spillway guide channel, flows rapidly in the channel and induces bank erosion along the inside of the Spillway Guide Dike.
- The inside portions of the intake and spillway guide dikes have been eroded because of the too light protection works installed to resist the intake and spillway flow.
- The river flow also subjected the riverside of both guide dikes to erosion.
- Spur-dikes guard both guide dikes, but the interval of spur-dikes was too wide to protect the bank of guide dikes against erosion effectively.

3) Evaluation of Method of Construction of Existing Structures in the Study Area

The countermeasures employed for flood protection in the Study Area are conventional and common measures throughout the world. However, the MMWR has been improving the design of dikes, spur-dikes and concrete blocks through the experiences gained on construction works implemented in the recent years. As the result of improvement, many of the spur-dikes are functioning effectively, but damage occurred in some parts of the structures.

One form of damages is the sliding down of the slope protection works due to erosion at the foot of the bank slope, as shown in Fig. R.2.5.3. Probable reasons for such erosion are as follows:

- The too short length of the base of the slope protection works
- Improper installation of concrete blocks on the slopes such as irregular piling
- Wash-out of embankment materials through the spaces between concrete blocks or between stones in gabions
- Improper size of mesh of the gabion or the too small size of stone compared to the mesh size
- Loose packing of stones in gabions

In addition to the above, lessons learnt were not utilized for the next step of implementation although some practices have resulted as good practices like the placement of a series of spur-dikes, the result of which is as shown in Fig. R.2.5.4. Good practices in the Study Area have resulted in the following:

- The spillway guide dike has functioned well to divert the river flow away from the inland area, securing a wide flood-free-zone.
- Some parts of the dike have functioned well because of the slope protection with gabions.

- Some parts of the spur-dikes have functioned well with the proper arrangement of the series of spur-dikes.

4) Coordination and Disaster Engineering Arrangement

The Disaster Management Law has duly authorized the CoES to coordinate the functions of organizations concerned to promote the implementation of disaster management. There are some governmental organizations related to natural disaster but most of them stand on the scientific basis except the Design Center of MMWR. Disaster management should be on the engineering basis and named as disaster engineering to bridge the scientific and managerial or implementation expertise.

The present structure of CoES does not count on expertise on disaster engineering as well as department for coordination with the other organizations concerned. As shown by the CoES's organizational chart in Fig. R.1.3.2, there are two kinds of organizations involved in national disaster management; namely, scientific organizations like the State Institute of Seismology and the implementing agency organizations like the MMWR. Although the implementation of flood protection works belongs to MMWR, it is not clear which organization has the responsibility to implement measures against the other natural disasters, or to make financial investments, whether the project is self-financed or foreign-assisted.

Therefore, for the coordination of disaster management, required is not only disaster engineering but also financing or institutional arrangement to implement the disaster prevention works that should closely relate to the non-structural measures of disaster management as discussed in Subsection 2.5.2.

2.5.2 Problems of Non-Structural Measures

1) Institution and Organization

The Disaster Management Law provides the basic fundamental requirements of disaster management in Tajikistan. As established under this law, CoES is the organization responsible for disaster management and coordination with other organizations concerned. It is performing the duties and responsibilities under its organizational structure, as described in Subsection 1.3.2.

However, found were several issues requiring the improvement for disaster management through the study on the organization and activities of CoES, as follows:

a) Required Organizational Structure for National Disaster Management

One of the most important duties of CoES regarding the required disaster management is to formulate a general policy on disasters, which shall be composed of the following components:

- A basic law on disaster management
- An organization to implement the countermeasures stipulated in the basic law
- A basic plan of national disaster management

Already provided are the first two items with the enactment of the Disaster Management Law and the establishment of CoES. However, the basic plan of national disaster management has not been prepared yet.

As for disaster management on the local level, the local government should be responsible for its implementation as stipulated by the Disaster Management Law. Local disaster management plans should also consist with the provisions of the

national disaster management plan. Therefore, the national disaster management plan should include guidelines to assist the local governments in preparing a proper and effective plan. In addition, the national disaster management plan should give directions to the organizations concerned in conducting researches on or implementation of countermeasures against the disasters.

CoES also has duties to disseminate the national disaster management plan over the country as well as to assist the local governments in preparing their local disaster management plans that would reflect the local characteristics according to the guidelines. To the end that CoES carries out its duties as mentioned above, the due adjustment of organizational structure is therefore required.

b) Coordination with Organizations Concerned

Many kinds of natural disasters have happened over the country so that CoES has to promote disaster management of various disaster events. With respect to natural disaster events, many research institutes with expertise are involved with not only floods but also landslides, debris flows, mudflows, earthquakes and so on. In addition, various implementing organizations are involved in the recovery from damages under their jurisdiction, like the Ministry of Transportation and Communication, which is involved in the recovery from road damage.

Therefore, CoES has to receive advice from the research institutes and exchange information on disasters with the other implementation organizations. It should proceed with the preparation of the national disaster management plan, provide assistance in the preparations and practices of the local levels, and provide countermeasures against the disasters. Such necessity of advices and exchanges of information would require the establishment of an advisory commission on national disaster management.

c) Disaster Engineering Arrangement

Observation and analysis of the phenomenon of natural disasters belong to the respective institutional organizations according to the respective fields in which the phenomena belong. In addition, the countermeasures against disasters belong to the respective implementing organizations according to the objectives of the countermeasure.

However, the field which each phenomenon belongs to is sometimes difficult to define and the kind of countermeasure to be done is not always defined clearly. Therefore, it is the duty of CoES to make a preliminary survey to study the phenomenon in the disaster area and to decide on which organizations are required to take the detailed survey for the implementation of countermeasures.

In addition, before or right after the disaster events, or while preparing for the disasters, a preliminary cost estimate is required for the provision of funds for research and countermeasures. It is also the duty of CoES to prepare such cost estimates for the above-mentioned purposes.

To carry out the duties mentioned above, the capacity necessary to bridge the scientific and managerial or implementation expertise or to evaluate the disaster events in a comprehensive way is required for the organizational sections and personnel of CoES. Such capacity belongs to the field of disaster engineering.

Further elaborated below are the disaster engineering capacities required for CoES:

- The capacity to investigate and evaluate the situation and advise the State Committee of Emergency Situations on the seriousness of the disaster;

- The capacity to know the causes of natural disaster phenomena and to understand the mechanism;
- The capacity to estimate the amount required to recover from the damages on the preliminary stage, and for further research and taking countermeasures to prevent repetition; and
- The capacity to possess basic knowledge ranging broadly over the fields of natural disaster in order to carry out the duties mentioned above and to coordinate with the organizations concerned.

2) Preparedness

One of the important duties of CoES is to provide the tools for local governments to provide preparedness against disasters as a part of the communal disaster management according to the Disaster Management Law.

IMAC has been carrying out information management including hazard mapping and other plans connected to the implementation program of communal disaster management, but it is still on the preparation stage. Urgently needed are the implementation program especially on flood hazard recognition, the evacuation plan, and the warning and communication system for flood events that may happen the following year. The problems of each item are as discussed below.

a) Hazard Mapping and Evacuation Planning

There are some conditions related to the preparation of the hazard map and evacuation plan in Hamadoni District, as described below.

- There are two barriers against flood in the Study Area; one is the flood prevention dikes and the other is the dikes of the irrigation canal. The latter dikes have some resistance against flood after the flood prevention dikes are broken.
- Some jamoats have hilly places for evacuation but some do not have such areas because of flatness of their locations.
- There are a few roads laid for the routes to the evacuation places in the project site.

Some villages and jamoats already have unwritten evacuation plans. They also have previously planned evacuation places without definite routes; hence, during the 2005 flood, many people were puzzled on which route to take to the evacuation places.

b) Forecasting/Warning/Communication

The Hydrometeorology Agency has a 10-year-plan to rehabilitate the gauging stations. Among them, the Khirmanjo hydraulic gauging station should be restored as soon as possible because only this station has available data for the Hamadoni people to prepare for floods. Presently, in case the water level ascends to 70 cm in every 12 hours, the critical water rising level, CoES is informed. The information is important for the preparation of evacuation.

In general, flood events happen from two main causes; one is the overtopping of flood flow from the dikes, and the other is the destruction of dikes due to erosion or piping induced by flood flow or river water pressure, respectively.

In Hamadoni District, the flood season starts from June and lasts until August. The high water levels of river flow last for three months, so that even though there is no possibility of overtopping, the flood flows and high water pressures may deteriorate the

dike condition; the former would cause erosion of the dikes and the latter, piping. Therefore, it is important not only to forecast the water level rising but also to observe and evaluate the current situation of the dikes.

There are some reminders to scrutinize the method of flood forecasting, warning and communication in the Study Area, as follows:

- The melting of snow brings floods in this area, so that knowing the snow-melting mechanism is important to guide the forecasting of flood occurrence. It is widely known that closely related to the rise or fall of temperature and precipitation is the quantity of snow-melt. In this area, precipitation could be negligible because the melting of snow starts in the dry season. Therefore, in connection with flooding, it is necessary to forecast the peak flow. The records of temperature and flood discharge of the 2005 flood suggest that the temperature inclination or temperature rising ratio is one of the important factors because compared to the other years with less floods, 2005 has shown a sharp temperature rise in May and June. In addition, it is also necessary to take into account the snow accumulation and reach time or running time of the flood between two points, the upstream and the downstream.
- Already provided with shortwave radios is the internal communication system between the government and CoES like the system between CoES Dushanbe and the Hamadoni District office. However, poorly provided is the communication system from the district to the jamoats and from the jamoats to the kishlaks and mahallas or residents.
- Not utilized systematically for the evacuation is the local information on water level because there is no water level gauging station at the river site in Hamadoni District.
- Not yet provided is the observation system on dike conditions during flood. In addition to this system, to be considered are checkpoints to determine the dike's vulnerability to erosion or overflow in the observation system's implementation.

3) Emergency Services

a) Rescue Services

CoES should take actions for national and international arrangements for emergency services in cooperation with REACT. It should arrange international cooperation through the framework of REACT and through an information network, which will disseminate the disaster information around the world.

One of the problems is the shortage of equipment and materials required for rescue activities. A group of experts well organized and experienced on disaster rescue operations is also required to operate the Rescue Center.

b) Flood Fighting

MMWR has the responsibility to maintain and restore the structural measures against floods in Hamadoni District, including flood fighting. In case of fault or damage, the MMWR would require the contractor to restore the structure at his own expense or under the coverage of the guarantee. However, it is not clear how the MMWR will conduct regular monitoring after the termination of the guarantee period of the contractor.

The Department of Heavy Equipment of CoES has the capacity to participate in emergency restoration works for infrastructures damaged by disasters including floods. Its responsibility covers the whole country and it has its own heavy equipment like dump trucks and bulldozers, but some of them are too old to operate.

The military unit of CoES stationed in Hamadoni District also has the capacity to work on restoration works as well as emergency or regular works in Hamadoni District using its own personnel and heavy equipment like cranes and dump trucks. The unit had worked on the restoration of the dike in 2007, fabricating concrete blocks using the metal forms provided by the Study Team for the pilot project.

Both organizations have common problems; namely, the lack of equipment and proper technology for emergency work and operation training with machines, and the lack of personnel required for flood fighting.

2.6 PROBLEMS ON PYANJ RIVER AS AN INTERNATIONAL RIVER

There are several common issues between Tajikistan and Afghanistan on the Pyanj River as an international river. Hence, both countries should mutually cooperate to challenge the issues or solve the problems listed below:

- Roles of both countries governing the water resource area of the Pyanj River as an international river;
- Border issues between both countries;
- Water resources development; and
- Flood risk management and prevention.

Described below is the background of such problems.

1) Issue on Amu Darya as an International River

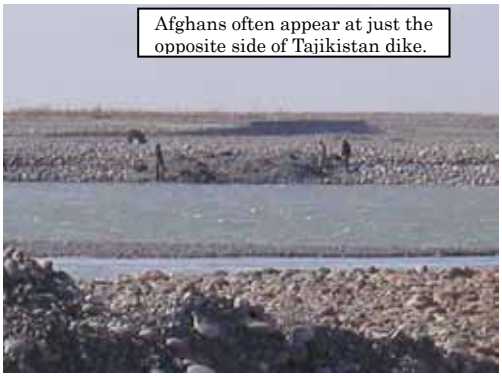
The Pyanj River, called by the international name Amu Darya, runs along the borders of Tajikistan, Afghanistan, Uzbekistan and Turkmenistan and drains into the Aral Sea at the downstream end.

In the recent years, however, the drawdown of the water level of the Aral Sea has become an international issue. To solve the problem, the International Fund for Saving the Aral Sea (IFAS) was established (refer to Subsection 1.3.5).

Since Tajikistan, as well as Afghanistan, has jurisdiction over the area where the Amu Darya originates, it has a sort of responsibility to contribute to the solution of this international issue.

2) Issue on the Border between Tajikistan and Afghanistan

In the Study Area, the borderline between Tajikistan and Afghanistan, which was setup along the channel of Amu Darya or Pyanj River by the Soviet Union, is from the Pamir Highlands to the Hamadoni Alluvial Fan. (Refer to: "The Soviet–Afghanistan War, General Staff Introduction.")


Afghans often appear at just the opposite side of Tajikistan dike.

However, the Pyanj River had ramified into several channels in the Hamadoni Alluvial Fan; hence, the definition of the borderline has become ambiguous. Therefore, it is necessary

for both countries to continue negotiations to define the borderline.

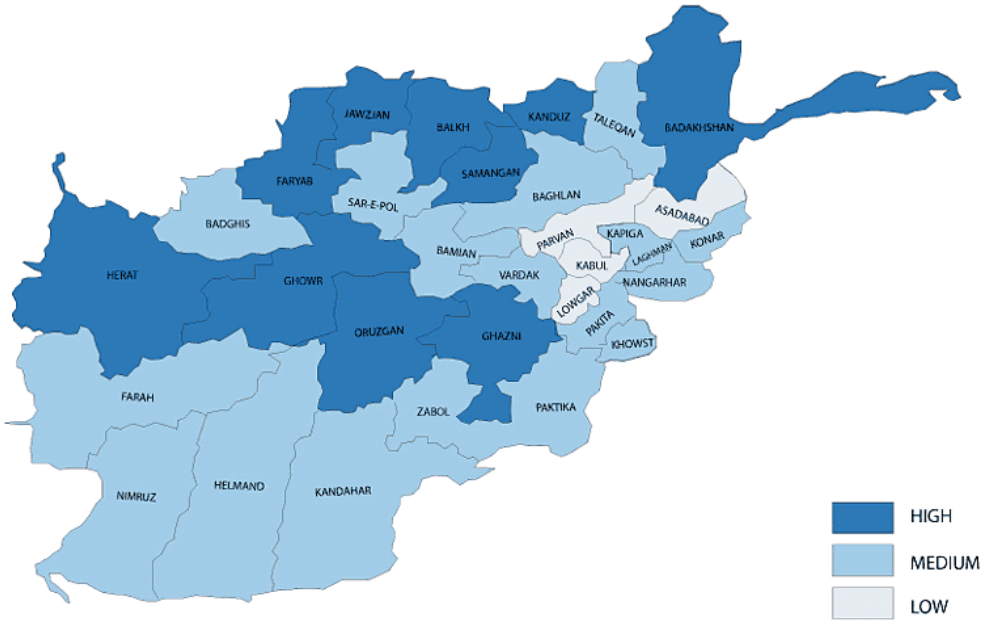
The border issue has become more serious than before because the main flow of the Pyanj River now runs adjacent to the dike, which is the edge of the Tajikistan territory, and Afghan people often appear just at the other side of the river channel. When Tajikistan started extension work on the existing dike after the 2005 flood, Afghanistan alerted Tajikistan to cancel its plan to extend the alignment of the dike toward the Afghanistan side. Therefore, Tajikistan had to give up the plan. In addition, Afghanistan in 2006 refused the plan of Tajikistan to construct temporary diversion works of the river flow of the Pyanj River toward the Afghanistan side, so that the construction work by MMWR became considerably delayed.

3) Water Resources Development

According to the agreement made between the Soviet Union and Afghanistan in 1946, Afghanistan has the right to take 9 cubic kilometers (about 285 m^3 per second) of water from the Pyanj River annually. The present annual intake is 2 cubic kilometers (based on the report of the Social Economic Council of the United Nations) and Afghanistan is planning to take more water from the Pyanj River for irrigation development.

4) Overview of Flood Risk and Disaster Management of Afghanistan

According to the Flood Risk Map prepared by the Afghanistan Government, the flooding area in Afghanistan spreads along the Pyanj River, as shown in Fig. R.2.6.1. In addition, it has been reported that Afghanistan also suffered damage during the 2005 flood. Damaged were grain production and orchards in 168,000 hectares of land.



(Refer to Department for Disaster Preparedness, Afghanistan)

Fig. R.2.6.1 Flood Risk Map of Afghanistan

With regard to the institutional structure of flood risk management, the Department for Disaster Preparedness and the National Commission on Disaster Management in Afghanistan are responsibilities for disaster management. The disaster management structure of the department and the commission is similar to the Tajikistan's structure, as shown Fig. R.2.6.2.

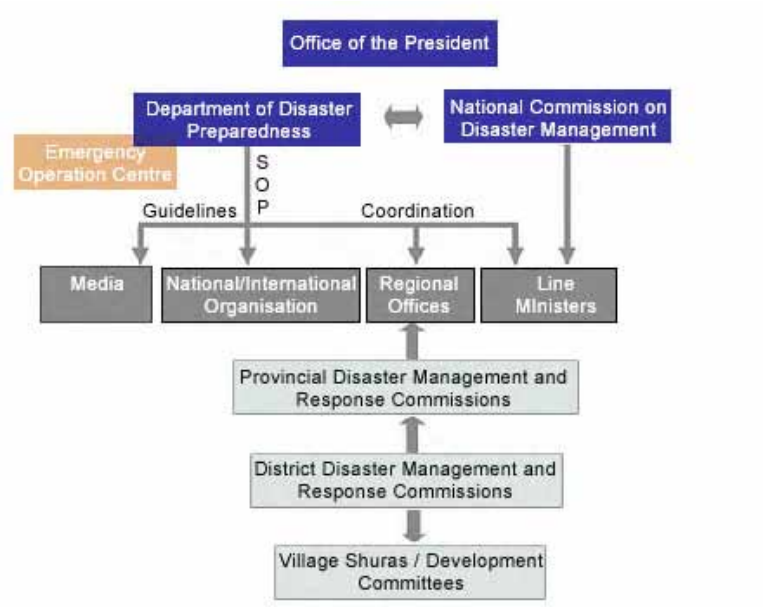


Fig. R.2.6.2 Institutional Structure of the Disaster Management System in Afghanistan