CHAPTER 3. FRAMEWORK PLAN

3.1 FRAMEWORK PLAN OF THE INTEGRATED PYANJ RIVER MANAGEMENT PLAN

As discussed in the previous chapters, the water flow of the Pyanj River is intervened by the natural, social and international conditions of the river basin. Therefore, the planning of flood management for Hamadoni District, which is the main purpose of the Study, should take into account various fields and stakeholders in the whole river basin. The Integrated Water Resource Management (IWRM) has been introduced and employed widely over the world to achieve such a purpose.

In order to apply the concept of IWRM to the Study, the position on the flood management planning for Hamadoni District should be elucidated. To this end, the Study has to be made according to the following procedures:

(1) Prepare the Integrated Pyanj River Management Plan (IPRMP) based on the concept of IWRM as the framework plan of flood management for Hamadoni District.

(2) Prepare the framework focusing on the planning of flood management for Hamadoni District by selecting the components directly related to the flooding of the district. The framework shall include the problems to be solved for efficient flood management.

(3) Examine the flood management plan and propose to solve the problems mentioned above as the master plan of flood management for Hamadoni District.

This chapter, Chapter 3, includes the study on the above Items (1) and (2), and the following chapter, Chapter 4 includes Item 3.

The framework plan of countermeasures for the above challenges is shown in Fig. R 3.1.1.

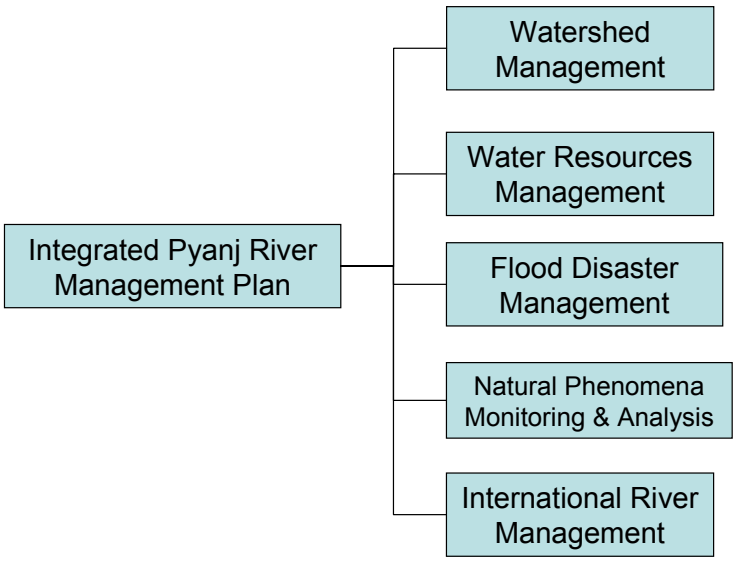


Fig. R.3.1.1 Framework of the Integrated Pyanj River Management Plan

Details of the framework plan are as described in the following sections.

3.1.1 Pyanj River Watershed Management

As discussed in Subsection 2.1.5, the river basin belongs to the arid and semi-arid zones, and the arid zone belongs to the polar zone. Therefore, the basin has poor vegetation and the severe climatic conditions bring about the difficulty of cultivation of crops in the basin. Therefore,

people have to depend on pasturage for their way of living. In general, however, pasturage without the proper management plan often hampers the growth of vegetation.

Under the circumstances, it is supposed as a likely situation that the water retention capacity of the land is poor and sediment discharge is plenty. Therefore, water-sediment disasters such as flashfloods, mudflows, debris flows and landslides often happen during the snow-melting period.

Considering these situations, the proposed watershed management in the basin should consist, as follows:

- ForestManagement
- Rangeland Management
- Disaster Management

1) Forest Management

Forest management is under the jurisdiction of the Agency of Forestry and Hunting Administration (AFHA). Under the severe climatic conditions as mentioned in Subsection 2.1.5, the basic studies on matters such as kinds of trees to be grown or forestry maintenance should be done. The basic knowledge accumulated by AFHA during the Soviet Union Era should be utilized for such studies. Tree-planting programs are implemented all over the country in every rainy season, but implementation is without any integrated nationwide plan and depends on the local government concerned.

In consideration of the above situation, it is proposed that forest management for the Pyanj River Basin should be planned with the following directions:

- The climate, geology and soil conditions should be studied to understand characteristics all over the country including the Pyanj River Basin. Based on the study results, the appropriate forestation map should be prepared.
- Based the appropriate forestation map and in coordination with the organizations concerned with water-sediment disasters, a master plan should be prepared to implement forestation according to financial availability and priority in urgency.
- Based on the said master plan, forestation including the tree-planting program in the country should be encouraged.

2) Rangeland Management

For vegetation growth in an arid area, it is required to harmonize the forest management with natural environmental conservation and pasturage, which is one of the few ways of livelihood. To achieve this purpose, it is required to study pasturage applicable areas by the same methodology as the forest management mentioned above, and to study the present land uses, means of livelihood, behavioral patterns and so on. In this regard, it is proposed that rangeland management should be planned with the following directions:

- The organization for rangeland management should be established.
- The available land for pasturage in the whole country should be surveyed taking into account, meteorology, geology, soil, topography and livelihood pattern, and how to keep consistency with the forest management plan.
- Taking the present condition of pasturage into consideration, as well as the consistency between rangeland management and the land conservation plan such as forestation plan, the nationwide master plan for rangeland management should be formulated.

3) Disaster Management

The Pyanj River Basin has been suffering every year from water-sediment disasters such as flood, flashflood, debris flow and landslide due not only to snow-melt but also to rainfall in the rainy snow-melting season. While the CoES is responsible for disaster countermeasures, the scientific institutions such as the Geology Department have the responsibility to monitor the phenomena and to research on their causes. Under the circumstances, it is proposed that disaster management as part of the Pyanj River Basin Management should be planned with the following directions:

- To promote compilation and analysis of basic data owned by the respective institutions, as well as site survey in the areas at the time of disaster events or the areas where disasters are predicted.
- To promote the survey of topographic characteristics using land survey and satellite images of disaster event areas and disaster predicted areas.
- To establish the Advisory Committee on Natural Disaster Prevention with CoES placed at the center.
- Based on the above-mentioned studies and cooperation of the advisory committee, the natural disaster management master plan should be formulated together with risk-maps and hazard maps.
- Capacity building for disaster management by CoES and the institutions concerned is necessary.

3.1.2 Pyanj River Water Resources Management

At present, water of the Pyanj River is utilized mainly for irrigation in the Hamadoni, Farkhar and Pyanj districts in Tajikistan without any problem of water shortage. Afghanistan, Uzbekistan and Turkmenistan also take irrigation water from the Pyanj River. Therefore, the International Fund for Aral Sea Saving (IFAS) was established considering the role of Pyanj River as an international river called by the name "Amu Darya" as mentioned in Subsection 1.3.5. Since Tajikistan is located at the most upstream area among the countries concerned, it has the international responsibility as water-origin country of resources conservation.

Under the circumstances, water resources management should consist, as follows:

- Water Quality Management
- Water Utility Management

1) Water Quality Management

It is supposed that there are few pollutants presently affecting the water quality of Pyanj River in the Pamir Highlands, the uppermost part of the river basin. However, there is concern on the use of fertilizers and agrichemicals in cotton farming areas, which could become pollutants to trigger water contamination.

At present, water quality management is under the jurisdiction of the Ministry of Agricultures and Nature Protection (MANP). Like the organization concerned, equipment and facilities for water quality tests have deteriorated after Tajikistan acquired its independence in 1991. Considering the current situation, water quality management is proposed to involve the following:

- Compilation and analysis of water quality data of rivers and lakes.
- Rehabilitation and improvement of equipment and facilities for water quality tests.

- Comprehension of the present condition of water quality all over the country based on actual water quality tests.
- Review and improvement of water quality criteria and standards.

2) Water Use Management

Presently, MANP has jurisdiction on the use of river water, groundwater and dry riverbed. In the Pyanj River Basin, presently, there are a few opportunities to develop new projects to significantly increase usage of river water and groundwater. However, at least, it is required to arrange an inventory of water-right holders and of the present utilization of dry riverbeds.

3.1.3 Pyanj River Flood Disaster Management

The Pyanj River Flood Disaster Management has been implemented as dual issues to promote river water as irrigation water and to prevent floods. The former is to construct and maintain the intake facility and guide dikes, while the latter is to construct flood prevention dikes to protect the facilities and residents from floods. However, the construction of dikes may have a critical influence on the opposite side or the Afghanistan side when the river course is changed. In this regard, a careful approach to river improvement planning is required.

With respect to flood disaster management, the dike construction works mentioned above as well as disaster management has been implemented by CoES as part of emergency situations management.

Under the circumstances, the proposed Pyanj River Flood Disaster Management should consist, as follows:

- River Disaster Management
- Communal Disaster Management

1) River Disaster Management

River disaster management has been under the jurisdiction of MMWR, which had implemented planning, construction, operation and maintenance of structural measures based on technology developed during the Soviet Union Era. However, the Pyanj River has new problems with respect to planning and design that could bring morphological changes and influences to Afghanistan, as mentioned in Subsection 2.6.

In addition, the 2005 flood had brought the lesson that once the dike is destroyed, severe damages happen. In this regard, in addition to the improvement and reinforcement of the dike, it is required for MMWR to promote communal disaster management in coordination with CoES and the local governments concerned.

Under the circumstances, the proposed River Disaster Management should involve the following:

- Enhancement of capacity for planning, design, construction, operation and maintenance of the river dikes.
- Promotion of implementation of improvement and reinforcement of river protection works.
- Promotion of coordination and cooperation with Afghanistan.
- Promotion of cooperation among CoES and the local governments concerned in communal disaster management.

2) Communal Disaster Management

The communal disaster management should be promoted by CoES, as the core organization, in cooperation with the local governments concerned. To achieve this objective, disaster management should involve the following:

- Promotion of capacity enhancement and technology on disaster management.
- Formulation of the master plan of nationwide communal disaster management.
- Promotion of implementation of disaster management activities based on the master plan.

3.1.4 Natural Phenomena Monitoring and Analysis

The frameworks discussed above should be supported by scientific monitoring and analysis of natural phenomena that cause natural disasters by the institutions concerned. In Tajikistan, the following institutions were established during the Soviet Union Era:

- Hydrometeorology Agency (Tajikmeteorology)
- Department of Geology
- Department of Seismology

The activities of these institutions have slowed down because of the degradation of facilities and equipment for monitoring and the lack of training for new researchers after Tajikistan acquired its independence in 1991. The monitoring data and research documents have been kept without proper processing and analysis.

Under the circumstances, the proposed framework of natural phenomena monitoring and analysis is as described below.

1) Improvement of the Existing Monitoring System

The Hydrometeorology Agency already has a long-term program for the rehabilitation and improvement of the existing monitoring system. The program covers 38 hydrological observation stations and 30 hydro-meteorological observation stations all over the country. It seems that additional stations are required for the existing system.

The Departments of Geology and Seismology are also in the same situation as the Hydrometeorology Agency. Especially, the facilities for the natural disaster forecasting system should be provided with priority due to its urgency.

2) Compilation and Analysis of Existing Data and Documents

In the case of Hydrometeorology Agency, which has been directly involved in the Study, the JICA Study Team provided cooperation and assistance in the compilation of data that had accumulated for more than 30 years of operation. This should be a good sample for the other institutions concerned to promote the processing of existing data and documents. The compilation and analysis of existing data and documents are required in the preparation of flood risk and hazard maps necessary to develop the disaster management for the Pyanj River Basin, as mentioned in Subsection 3.1.1.

3) Training of Researchers and Observers

In parallel with the improvement of the existing monitoring systems as mentioned in Item 1) above, as well as the compilation and analysis of existing data and documents, training for researchers and observers should be provided, especially for the new personnel recruited after independence.

3.1.5 International River Management

The Pyanj River, called internationally as Amu Darya, is related to not only Tajikistan but also the other three countries especially Afghanistan, which lies on just the opposite side of Tajikistan as mentioned in Subsection 1.3.5. Therefore, imperative are decisive actions, as follows:

- Afghanistan's cooperation is required in the construction of a diversion channel necessary for the dike's construction work by Tajikistan.
- The river engineering works should be designed for the benefit of both countries.

In connection with the international river management, the proposed framework to promote joint development and management as well as coordination by the countries concerned are as follows:

- Establishment of an international river coordination structure
- Establishment of a structure for the exchange of engineers and researchers

1) International River Coordination Structure

The international river coordination structure could not be established without consultation and agreement with the other countries concerned. Therefore, as the preparatory stage, the establishment of the Pyanj River Coordination Commission is proposed.

2) Structure for Exchange of Engineers and Researchers

To set up and launch the above international coordination structure, the exchange of engineers and researchers is indispensable. Therefore, it is required to have a structure for exchanges such as the regional cooperation that has been initiated by the Japanese Government.

3.1.6 Framework Plan for Integrated Pyanj River Management Plan

Fig. R.3.1.2 shows the framework of the international river management plan.

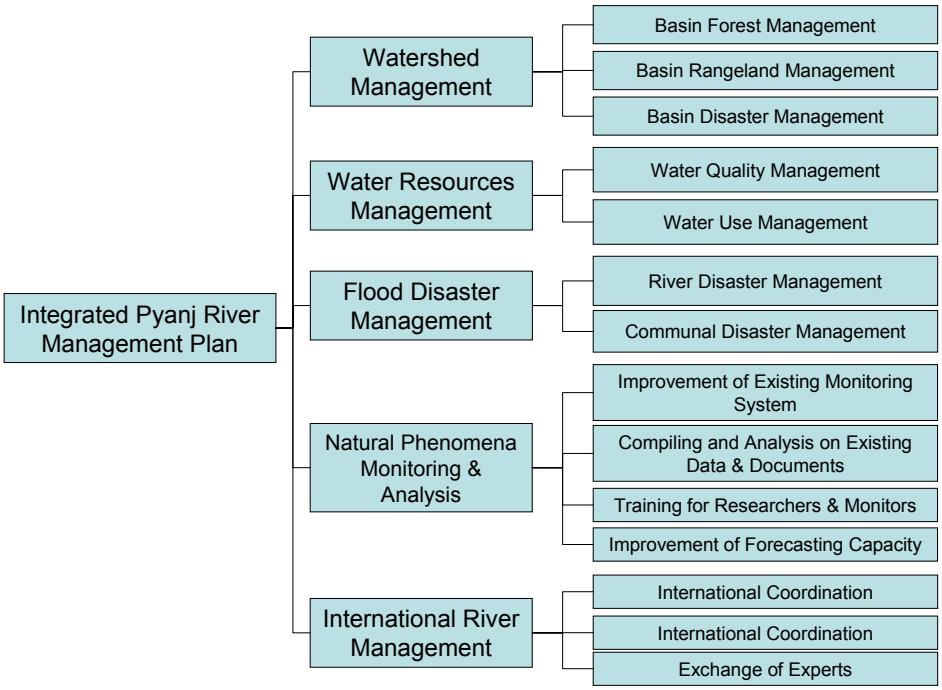


Fig. R.3.1.2 Detailed Framework of the Integrated Pyanj River Management Plan

3.2 FRAMEWORK OF COUNTERMEASURES

This section presents the framework of the proposed countermeasures, focusing on the causes and effects of floods in Hamadoni District within the framework of Flood Disaster Management of the Integrated Pyanj River Management Plan.

3.2.1 Causes, Effects and Countermeasures

Floods in Hamadoni District happen due to the following causes:

- Melting of snow is the direct cause of floods;
- Transition of the river course due to sedimentation intensify floods; and
- Lack of engineering experience on structural and non-structural measures also contributes to the magnitude of flood damages.
- Little preparedness increases the vulnerability of the communities to flood damages

The synergistic result of the causes mentioned above intensifies the scale of flood, increase the impact of flood, and give more adverse effects to residents, livelihood, production, economy and infrastructure in the district and the surrounding areas. Therefore, countermeasures should be taken in every stage of consequence of the cause-event-effect to mitigate the intensity and impact causing adverse effects to the communities.

Fig. R.3.2.1 is a conceptual figure showing the consequences of flood mitigation along with the required countermeasures in the framework plan.

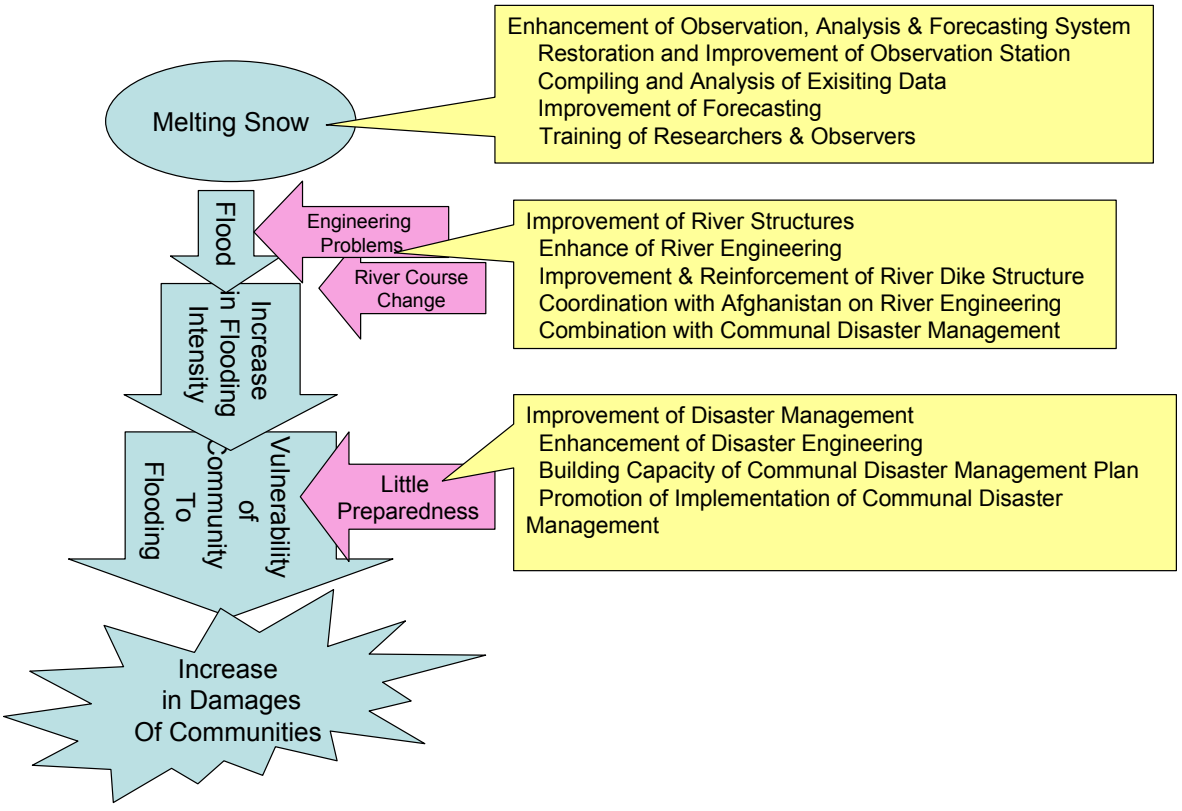


Fig. R.3.2.1 Consequences of Flood Mitigation in the Framework Plan

Table R.3.2.1 gives an outline of the countermeasures for the framework plan.

Table R.3.2.1 Required Countermeasures for the Framework Plan for Flood Disaster Management

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 Communal Disaster Management	Enhancement of disaster engineering and management 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
	Enhancement of the communal disaster management system in Hamadoni District in cooperation with CoES (NSM)	Promotion of activities on communal disaster management

The countermeasures mentioned above are classified into structural and non--structural measures. The basic concept of each kind of countermeasure is described in Subsections 3.2.2 and 3.2.3 below.

3.2.2 Basic Concept of Structural Measures

As shown in Table R.3.2.1, the structural measures are to improve and reinforce the river structures or dikes. From the economical viewpoint, improvement or reinforcement of the existing dike is generally more economical than the construction of a new dike. On the other hand, if the river course is located farther away from the present position, the cost may be more economical than improvement works on the existing course.

To confirm the effectiveness of alternative measures, the Study Team had conducted hydraulic analysis of the hydrological data from the Hydro-Meteorology Agency and the geographic data taken by satellite. According to the results described in Supporting Report Sector 2, extension of the intake guide dike and channel excavation would change the alignment of the river course toward the Afghanistan territory and thus increase bank erosion and flood flow compared to the existing condition in the Afghanistan side (see Fig. R.3.2.2). Therefore, the Study Team could not propose such design without Afghanistan's concurrence, and this is beyond the Team's control. Instead, the Study Team proposes that the design alignment of dike should follow the existing one.

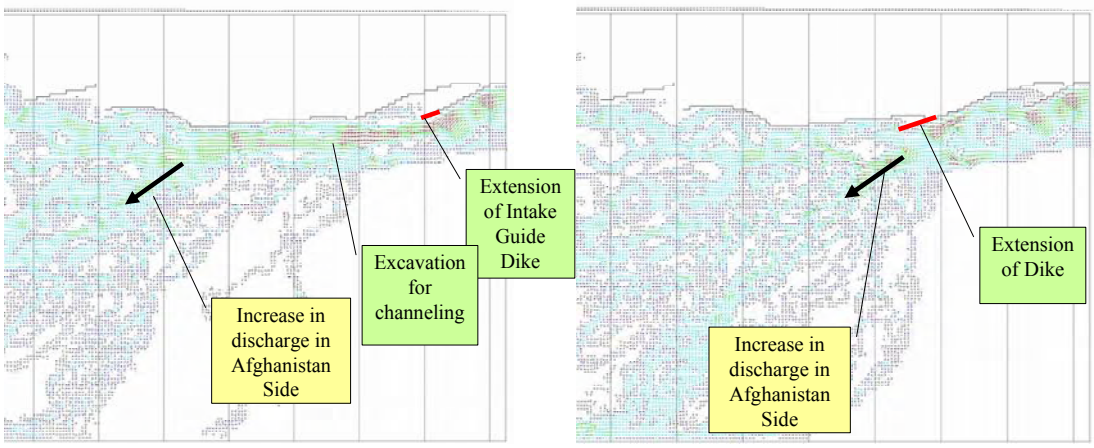


Fig. R.3.2.2 Influence of Change of Design Alignment of the Pyanj River Dike to Afghanistan

The basic requirements for the improvement and reinforcement of river structures are given below.

1) Over the Full Length of Existing Dike

Reinforce the existing dike structures to increase resistance against bank erosion using an economical method considering easy maintenance, and follow the existing alignment of dikes.

2) Intake Guide Dike (IGD)

Reinforce the existing dike structures to ensure the existing intake capacity and to increase resistance against bank erosion by proper placing of spur-dikes and installation of slope and foot protection works.

3) Spillway Guide Dike (SGD)

Reinforce the existing dike structures to ensure the existing spillway capacity for stable water intake at the intake facility and to increase resistance against bank erosion by proper placing of spur-dikes and installation of slope and foot protection works. Although the purpose of the SGD is to secure a stable water intake, it has been functioning as a flood protection dike to divert the river flow away from Hamadoni District's inland area. Hence, the Study Team proposes that the SGD should be designed as a flood prevention dike and the design length of the SDG should adhere to the existing one in order to avoid the above-mentioned negative impact against Afghanistan side.

4) Flood Protection Dike (FPD)

Design the alignment of the FDP to adhere to the existing one because the change of direction of the dike would affect the Afghanistan territory, and reinforce the existing dike structures to increase resistance against bank erosion by proper placing of spur-dikes and installation of slope and foot protection works.

3.2.3 Basic Concept of Non-Structural Measures

The basic concept of non-structural measures is described below according to the framework of the countermeasures shown in Table R.3.2.1.

1) Improvement of Hydro-Meteorological Observation, Analysis and Forecasting

The Hydrometeorology Agency has jurisdiction over hydro-meteorological observation, analysis and forecasting. However, as mentioned in Subsection 2.1.5, the hydro-meteorological observation stations in the Pyanji River Basin have not been functioning well since 1991 after Tajikistan's independence. Therefore, one of the most important matters for the agency is to restore and improve the observation stations in the basin. Another important matter is to compile and analyze the recorded data that remained without processing because the compilation and analysis of previous data would provide the basis for improving forecasting accuracy. In this regard, the basic concept of the measure under this field is to resume continuous improvement of observations to increase the forecasting accuracy.

2) Watershed Management

The measures for watershed management should be initiated from the viewpoint of implementing the watershed management under conditions of arid and semi-arid zones as described in the Subsection 2.1.5. Based on the results of the study, however, the Study Team decided not to go farther than proposing the framework because too little information is available despite rare characteristics of the climate and immense area.

3) River Disaster Management

To solve the problems described in Section 2.5, the improvement of river disaster management is required from the viewpoints of implementation of structural measures and the other is enhancement of the engineering capacity of the structural measures.

The former is one of the prioritized aspects while the latter is within the jurisdiction of MMWR whose design center had carried out engineering practices since the Soviet Union Era with capacity built during that time. Therefore, the Study Team proposes only the frameworks described in Subsection 3.1.3. In addition, the basic technical acknowledges of planning, design, construction work, and maintenance and operation are transferred to counterpart organizations in the process of the establishment of master plan.

4) Communal Disaster Management

It is important for river disaster management to build up the organization and capacity of the staff to lead and integrate the disaster management activity, to formulate communal disaster management plans for the disaster management practices, and to provide the preparedness for disaster management in order to promote the actual practices of communal disaster management. Therefore, the necessary projects should be proposed to achieve the provisions mentioned above.

Such projects consist of non-structural measures and are under the jurisdiction of CoES. However, MMWR should participate in the projects because river disaster management is closely related to the structural measures under the jurisdiction of MMWR.

3.3 CHALLENGES FOR FLOOD DISASTER MANAGEMENT OF HAMADONI DISTRICT

This section presents the practical items of challenges for countermeasures against flood in the Hamadoni District within the framework of the Pyanj River Flood Disaster Management among the Integrated Pyanj River Management Plan. The challenges are described below according to category; namely, structural and non-structural measures.

3.3.1 Challenges to Structural Measures

The structural measures should be directed towards the solution of problems of the existing structures discussed in Section 2.5. Such challenges are categorized as follows:

- Challenge to Planning: Rationalized methodology to decide the required basic values for planning like the placement of flood protection dike, the design flood return period, the design flood discharge and so on.
- Challenge to Design: Basic design of the required structures to secure enough resistance of slope protection, basement and foot protection works against scouring and erosion.
- Challenge to Construction: The proper methodology of construction and supervision of the works to be made strictly according to the design.
- Challenge to Maintenance: The proper methodology to ensure sustainability of structures after construction completed.

3.3.2 Challenges to Non-Structural Measures

The challenges to the non-structural measures mentioned in Subsection 3.2.3 are listed and discussed in more detail, as follows:

- Improvement of the communal disaster management system of flood fighting and rescue activities.
- Enhancement of the capacity for flood fighting and rescue activities.
- Resumption of hydro-meteorological observation and data transmission system.
- Improvement of the organization for disaster management.
- Improvement of disaster engineering and management.
- Establishment of coordination mechanism for disaster management.
- Establishment of international coordination mechanism for the Pyanj River.

1) Improvement of Communal Disaster Management

To provide protection to the people against flood disasters, the required system should consist of information management, analysis and decision-making, dissemination of instructions on the required countermeasures including evacuation, and guidance/monitoring of the implementation of countermeasures.

According to the Disaster Management Law, local governments are responsible for disaster management in disaster areas within their jurisdiction. Hence, specifically, Hamadoni District should be responsible for disaster management and activities in the Study Area.

However, the management of information on floods is under the jurisdiction of the Hydro-Meteorology Agency, while the leading and monitoring of local governments and residents against flooding are under the jurisdiction of CoES. Therefore, the Local Government of Hamadoni District could not provide protection to the people from flooding without these agencies' cooperation.

Under the circumstances, Hamadoni District is required to involve CoES, the Hydrometeorology Agency and the other organizations concerned in building-up its communal disaster management system. Considering the present condition of the communal disaster management system in Hamadoni District as described in Subsections 1.3.3 and 2.5.2, the challenges to improve the communal disaster management of Hamadoni District for the master plan formulation are as follows:

- Information management and dissemination
- Preparedness for disaster management
- Evacuation Guidance

a) Information Management and Dissemination

At present, flood information in Hamadoni District is handled by the Hydro-MeteorologyAgency based on the observations of Khirmanjo Station. The agency first transmits the information to CoES which relays it to Hamadoni District. However, it is not clear which organization has the responsibility to observe the flooding condition at the riverside in Hamadoni District, although it is clear that MMWR has the responsibility to observe the dike condition.

Under the circumstances, the following items are proposed as the challenges to information management and the dissemination of communal disaster management:

- Establishment of the system and facility for Khirmanjo Station to observe the water level and discharge and to transmit the data to the Hydro-Meteorology Agency, CoES and Hamadoni District.
- Establishment of the system to monitor flood water level at the riverside in Hamadoni District and to inform it to the district office.
- Establishment of the system to monitor the current situation of the dikes and to report it to the district office.

b) Preparedness for Disaster Management

It is necessary for communal disaster management to have preparedness before flood events happen. The present condition of preparedness is discussed in Subsection 2.5.2, from which the items to be improved have been extracted and described as follows:

- The Emergency Situation Commission (ESC) of Hamadoni District presently consists of the district office and the local headquarters of CoES. To improve the function of the commission, MMWR is required to participate as the administrator of the dike in Hamadoni District.
- It is required to have the necessary preparedness for the people to know what to do against flooding through the preparation of hazard maps that confirm the evacuation routes and places. Based on the results of the Study, the Study Team had provided practical hazard maps for the Hamadoni District. The ESC and the communities of Hamadoni District should improve the hazard maps to make them more effective and practical by adding more detailed information based on their experiences.

c) Evacuation Guidance

Once flooding happens and evacuation is required, the system to lead residents to the evacuation places without undue delay should be activated. However, the evacuation exercise conducted by the Study Team with the cooperation of CoES and Hamadoni District in May 2007 revealed that the method of transmitting evacuation instructions from the district office to the residents is not clear. Therefore, the Study Team conducted the Pilot Project on disaster information network arrangement from June to September 2007 with the information transmission exercise in August 2007. Considering the result of the Pilot Project, the challenges to evacuation guidance are as follows:

- As mentioned above, the Study Team had provided the disaster information network containing a list of contact persons and the means of contact from

jamoats to mahallas, and this list should be updated and improved regularly. Therefore, improvement of the information network is one of the challenges to the provision of evacuation guidance in communal disaster management.

- During evacuation, there may be some people who need support or assistance in walking to the evacuation site. To provide such support, the Study Team had designed the support system with a list of supporters and supported persons in every community. The list also should be updated or improved regularly according to the latest availability of supporters and the condition of the supported persons.

2) Enhancement of Capacity for Flood Fighting and Rescue Activities

The basic requirements for the activities of flood fighting are to monitor the dikes and river condition and to urgently restore the dilapidated dikes. Since the former requirement has already been proposed in the preceding Item 1), the latter requirement is herein discussed.

Flood fighting is not a common concept in Tajikistan. Although MMWR has jurisdiction on the structural means from the viewpoint of maintenance and restoration, on the occasion of urgent rehabilitation of structures, it carries out such works under contract with contractors, whereas, CoES executes them according to the capacity of its Department of Heavy Equipment and its military unit stationed in Hamadoni District. Therefore, it is virtually difficult or almost impossible for the residents in Hamadoni District to carry out flood fighting activities by themselves because the dike portion is located in the border security zone and far away from the residential areas.

Therefore, it is more practical and useful at present and in future for MMWR and CoES to jointly carry out the urgent restoration works; namely, the military unit of CoES is able to participate in the urgent restoration works using its own construction equipment and operating with man-power for the labor intensive method like preparation of sandbags. In this regard the mechanism of the urgent restoration works implemented by the military unit of CoES under the engineering control of MMWR. Actually, the military unit of CoES had worked on urgent restoration works using the metal forms for concrete block fabrication handed over by the Study Team as a part of the technical transfer activity.

3) Enhancement of Rescue Activity Capacity

The Rescue Center has the responsibility for rescue activities under the CoES as mentioned in Subsection 1.3.2. Although the capacity of the Rescue Center has been maintained on a high level since the Soviet Union Era, some problems exist such as lack of equipment and materials for rescue work and little chance of training for new rescue workers. Therefore, the proposed challenges for the rescue work activity are as follows:

- Provision of necessary equipment and materials for rescue work activities.
- Provision of training opportunities for trainers and new rescue workers of the Rescue Center.

4) Rehabilitation of Hydro-Meteorological Observation Stations

The buildup plan has already been discussed as part of the communal disaster management system in the preceding Item 1 with respect to hydro-meteorological observation and data transmission. It has to be noted that the Hydro-Meteorology Agency has its own plan for the rehabilitation of existing hydro-meteorological observation stations in the country and the Study Team had conducted hydraulic analysis based on the compiled observation data of the Hydro-Meteorology Agency. However, the Study Team has been confronted by the lack of information for the further study to formulate the practical plan of observation station arrangement because of the vast area and the difficulty of access to the study sites.

Therefore, the Study Team proposes only the frameworks although it confirms the necessity of rehabilitation to increase the accuracy of hydro-meteorological forecasting. In addition, the Study Team proposes the installation of additional observation stations to increase the accuracy of forecasting flood events based on the knowledge obtained through the Study.

5) Improvement of Disaster Management Organization

CoES has been taking a leading role in the disaster management activities in Tajikistan, as mentioned in Section 1.3. To solve the disaster management problems described in Subsection 2.5.2, improvement of the structure of CoES is suggested as the challenge to organizational improvement, as follows:

- Reinforcement of the organization of CoES to be able to promote and formulate the master plan of national disaster management.
- Reinforcement of the organization of CoES to be able to take the leading role and provide supporting functions to the local government in the implementation of the communal disaster management.
- Equipping CoES with a public relations function to disseminate the policies on national disaster management and activities, and to help the public understand CoES's disaster management activities thereby encouraging them to participate in such activities.

6) Improvement of Disaster Engineering and Management Capacity

To promote the implementation of national disaster management, capacity enhancement of the CoES's officials involved is required along with the improvement of its organizational structure. It should be noted that the required knowledge on disaster engineering is not the specialized knowledge on each disaster expertise, but the basic scientific knowledge on disaster events and the basic engineering knowledge to prepare the preliminary design of countermeasures against particular disasters.

The training center of CoES as mentioned in Subsection 1.3.2 functions to transfer knowledge from the central level to the local level, and capacity enhancement in disaster engineering is required not only on the central level but also the local level. Therefore, the proposed challenges to enhance the disaster engineering capacity of CoES are, as follows:

- Enhancement of the capacity to identify and propose the appropriate countermeasure through research and analysis of causes and influences of disasters in the past or those forecasted in future in cooperation with the scientific institutions.
- Buildup of the capacity and enhancement of the system of dissemination of engineering knowledge from the central level to the local level.

7) Improvement of Disaster Management Coordination Capacity

As mentioned in Subsection 2.5.2, one of the important duties of CoES is to encourage coordination among the organizations concerned in the promotion of national disaster management. Several organizations are concerned over various aspects such as the research institutes to observe, analyze and forecast natural phenomena, the executing agencies to implement physical countermeasures for natural disasters, and the administrative agencies to restore facilities damaged by natural disasters.

Under the circumstances, the establishment of a coordination channel for such organizations is the challenge to improve the coordination capacity of CoES. The coordination channel should take the position as advisory commission to CoES.

8) Improvement of Capacity for International Coordination on the Pyanj River

The problems on the Pyanj River as the international river Amu Darya have been described Section 2.6. Among them, improvement of the relationship between Tajikistan and Afghanistan is an urgent concern to promote construction of the dike improvement works in Hamadoni District. In this connection, the Study Team proposes the Pyanj River Management Committee to provide the core of discussions and preparation for the necessary matters at the beginning of the formulation of the coordination channel.

CHAPTER 4. MASTER PLAN

The master plan, which is proposed in the Study, is named the Master Plan of Flood Prevention in Hamadoni District (hereinafter referred as to "the Master Plan". The contents of the Master Plan are presented in the following.

4.1 BASIC CONDITIONS AND COMPOSITION FOR MASTER PLAN

The basic conditions for the Master Plan in the Study are as follows:

- The target year is 2018, about 10 years after commencement of the Study.
- The structural design of flood protection works corresponds to a 100-year return period flood taking into account the protection of the property in Hamadoni District, which has been contributing economy through cotton production as well as in the precious plain field of this country.
- The conditions in the Study area for the economic evaluation of the Study is supposed not to change much until the target year because the economy of Hamadoni District has been highly depending on cotton production and the productivity of cotton has no inclination to increase or decrease in the future according to the past records.

The challenges to the Master Plan have been examined under the aspect of structural and non-structural measures. Some measures are directly related to the flood protection in Hamadoni District, and the others are indirectly related to flood protection and more related to natural disaster prevention. Thus, the former is defined as the master plan of Flood Prevention in Hamadoni District (the Master Plan) and the latter is defined as the Supporting Plan of Natural Disaster Prevention (hereinafter referred as the Supporting Plan).

The challenges to the Master Plan consist of structural and non-structural measures, as follows:

(1) Structural measures to prevent the flooding of Hamadoni District, including river improvement for flood prevention.

(2) Non-structural measures to mitigate flood damage in Hamadoni District and neighboring areas, including communal disaster management plan.

The Master Plan implementation period is divided into two (2) stages considering the time of completion the works will require; namely, the medium-long term period of 10 years and the short term period of 5 years. The proposed Master Plan and the Supporting Plan are described in Table R.4.1.1.

Table R.4.1.1 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 for 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 Coordination Committee

4.2 STUDY ON STRUCTURAL MEASURES

4.2.1 Outline of Structural Measures

Locations along the dike are indicated with station points placed at every 1-km interval measured as a direct distance from the basic point set on one of the piers of the intake gates. Every station point is named according to the number of kilometers prefixed to the letter K, from the basic point indicated as 0.0K. For example, the station point of 5.0 km away from the basic point 0.0K is named 5.0K. For convenience of description of the middle part between two station points, each point is named by the integral number plus 0.5. For example, the middle part between 5.0K and 6.0K is named as5.5K. Locations of station points are as shown in Fig. R.4.2.1 and Fig. R.4.2.3.

1) Evaluation of Present Condition of Structures in the Study Area

a) Function of Existing Dike

The existing dikes consist of three (3) portions; namely, the Intake Guide Dike (IGD); the Spillway Guide Dike (SGD); and the Flood Protection Dike (FPD). The IGD is designed for steady intake of river water, to protect the Chubek Intake from sediment, and to function as river training works to guide flood flow and keep it away from the facilities. The SGD is designed to secure a capacity in the waterway for spilled water from the intake, and to function as river training works like the IGD does. The FPD is designed to protect the irrigation canal and the population and territory from floods with embankment protected by revetment works and spur-dikes. (Refer to Fig. R.4.2.1)

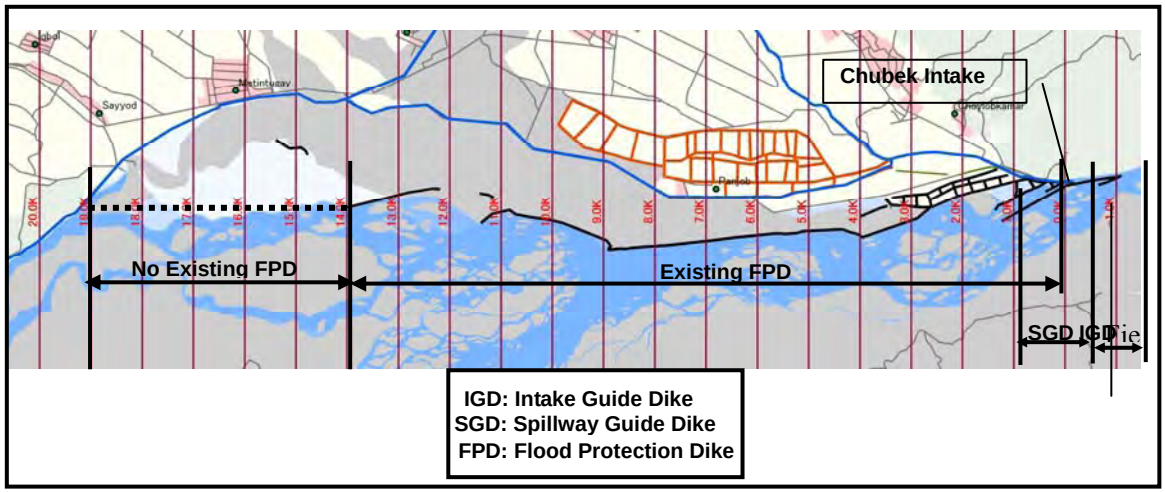
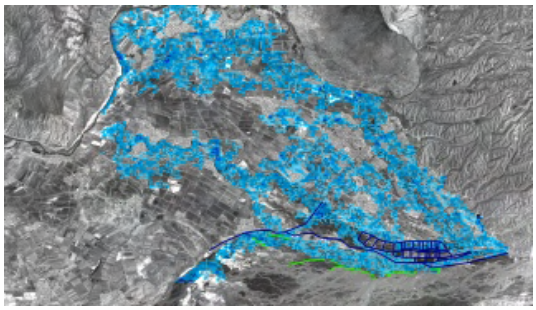


Fig. R.4.2.1 Classifications of Dike

b) Impact of Dike Breach

All of the three components work together as flood protection works in this area. As the flood analysis shows, once the dike near the Chubek Intake area is broken, flood flow intrudes into almost the whole of Hamadoni District. The river morphological feature suggests that as long as the IGD and SGD are effectively working, the FPD up to 2.0K is well protected. In case the dike between 0.0K and 2.5K is broken, the flood flow intrudes into the inland toward Moskowski and Chubek, bringing about serious damage. In case the dike between 2.5K and 12.0K is broken, flood flow goes toward the Dehkonobod Irrigation Canal and intrudes into the inland area, but if the dike at 12.0K or further downstream is broken the flood flow goes back to the riverside but not toward the inland side, according to the result of the flood analysis. (Refer to Fig. R.4.2.2)


Broken Dike at 0.0K to 2.5K

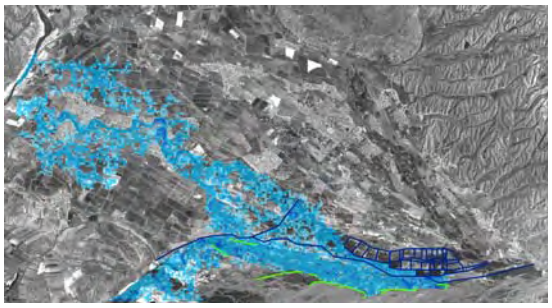

Broken Dike at 2.5K to 12.0K

Fig. R.4.2.2 Intrusion of 100-Year Return Period Flood

c) Condition of Existing Dike

The FPD has different conditions with respect to erosion, as shown in Subsection 2.4, Structural Measures. Therefore, countermeasures against flood should be designed to adjust to the sectional conditions of the Intake Guide Dike (IGD), the Spillway Guide Dike (SGD) and the Flood Protection Dike (FPD). The FPD also should be designed in sections because the present dikes are situated under different section-by-section condition, as shown in Fig. R.4.2.3.

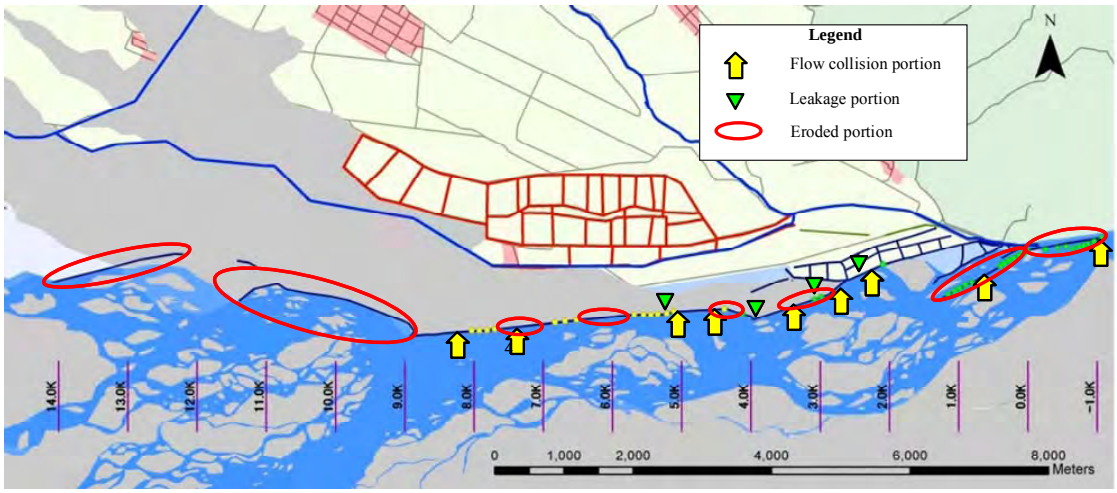


Fig. R.4.2.3 Conditions along the Existing Dikes as of October 2006

2) Classification of Applied Structural Measures

Considering the results. of the studies on morphology, hydrology (hydraulic analysis), dike setup and function of structures, the countermeasures applied at the site are classified into some categories, as shown in Table R.4.2.1 and Fig. R.4.2.4.

Table R.4.2.1 Structural Countermeasures Applied at the Site

Section	Classification	Section	Applied Countermeasure	Remarks
I	Intake Guide Dike	- 1.0K to 0.0K	Embankment with revetment works and spur-dikes (Rehabilitation)	Crest elevation is to be determined based on the existing dike; design discharge is to be 30-year-return-period to cover the existing dike feature. (Note 1)
II	Spillway Guide Dike	0.0K to 1.2K	Embankment with revetment works and spur-dikes (Rehabilitation)	The crest elevation is to be determined based on the discharge of 100-year return period. (Note 2)
III	Flood Protection Dike	2.0K to 14.0K	Embankment with revetment works and spur-dikes (Rehabilitation)	-Ditto-
IV	-Ditto-	2.0K to 8.9K	Embankment with revetment works and spur-dikes (Rehabilitation)	-Ditto-
V	-Ditto-	8.9K to 10.9K	Embankment with revetment works and spur-dikes (Rehabilitation)	-Ditto-
VI	-Ditto-	10.9K to 12.1K	Embankment with revetment works (New construction)	-Ditto-
VII	-Ditto-	12.1K to 14.0K	Revetment works with riprap (Rehabilitation)	-Ditto- (Based on the hydraulic analysis, design discharge does not flow over the existing dike in this area)
VIII	Bank Protection Works	14.0K to 17.0K	Embankment with revetment works with riprap (New construction)	-Ditto- (Based on the hydraulic analysis, design discharge does not flow over the bank in this area)

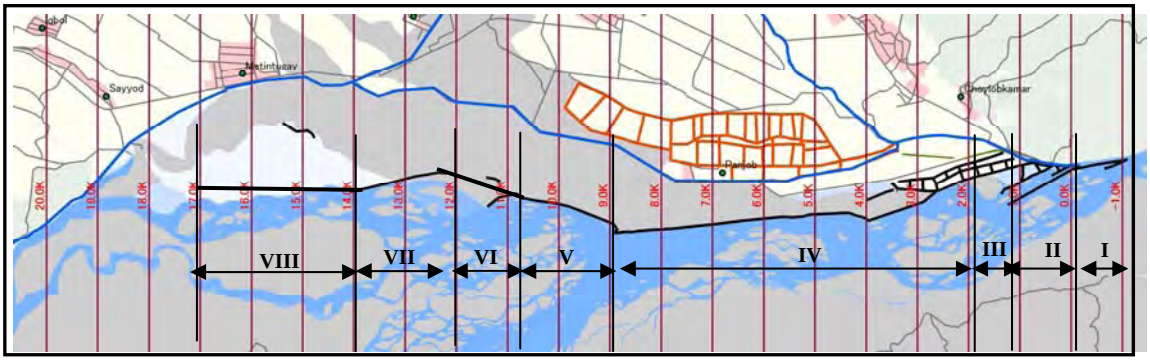


Fig. R.4.2.4 Sections of Dike

Note 1

The Intake Guide Dike (IGD) is not categorized as a flood protection dike because its function is to secure a stable intake and to protect the intake facilities from sediment. Therefore, the IGD structure is designed based on the existing feature equivalent to a 30-year return period flood. The intake facility has enough elevation at its crest against the design water level of 100-year return period with 0.2m shortage on the required freeboard of 0.7m calculated without detailed data on topography and structures.

There is a possibility that the water level in the channel enclosed by the IGD becomes higher than the water level of the river flow in the mainstream; however, this study does not include such detailed design because of lack of detailed data on topography and structures. Therefore, this study provides that IGD is designed with a lower elevation at the crest of dike to keep the channel opening to the mainstream.

It is recommended that the next stage of implementation shall include the collection of detailed data and the preparation of detailed design.

Note 2

The Spillway Guide Dike (SGD) has functions to discharge water spilled from the intake so that it is not considered as a flood protection dike. However, the SGD works well as a flood protection dike to protect the section from 0.0K to 2.0K. Without the SGD, the FPD from 0.0K to 2.0K should be rehabilitated to have enough strength against flood. To avoid duplication of investment of countermeasures, the SGD should be designed as an FPD. Therefore, the application of FPD to the countermeasure should cover the stretch from 2.0K.

4.2.2 Basic Design of Structural Measures

The basic design conditions for structural measures are as follows:

- Design return period for the design flood discharge: 100 years
- Design flow velocity for concrete blocks: 5 m/sec, which is the maximum velocity derived from the two-dimensional flow analysis in the Study.

1) Design Discharge

a) Recurrent Probability of Discharge of the Pyanj River

i) Applied Rating Curve and Estimated Annual Maximum Flood

The Hydrometeorology Agency keeps records of readings of water level in hydro-meteorological gauging stations all over Tajikistan. Among them are the water level records since 1967 of Khirmanjo Gauging Station, which is located 117 km upstream in the Study Area. Discharges are converted from water level

records through the water level–flow quantity curve or rating curve created from surveys on flow velocity and river cross-section.

Until 1991, Tajikmeteorology has been carrying out surveys on river velocity and river cross sections, and prepared rating curves, so that the Study Team utilized those existing discharge data for the period until 1991. After 1992, Tajikmeteorology had not conducted any survey so that the Study Team estimated the discharge data for the period after 1992 using the newly estimated discharge data for preparing the new rating curve. The new rating curve is made with a combination of two existing rating curves: one is the curve of 1991, which is the latest and positioned at the average level among the existing curves, and the other is the curve of 1978, which is the only curve providing data for the large scale of observed discharge. Fig. R.4.2.5 shows the newly estimated rating curve and the existing curves.

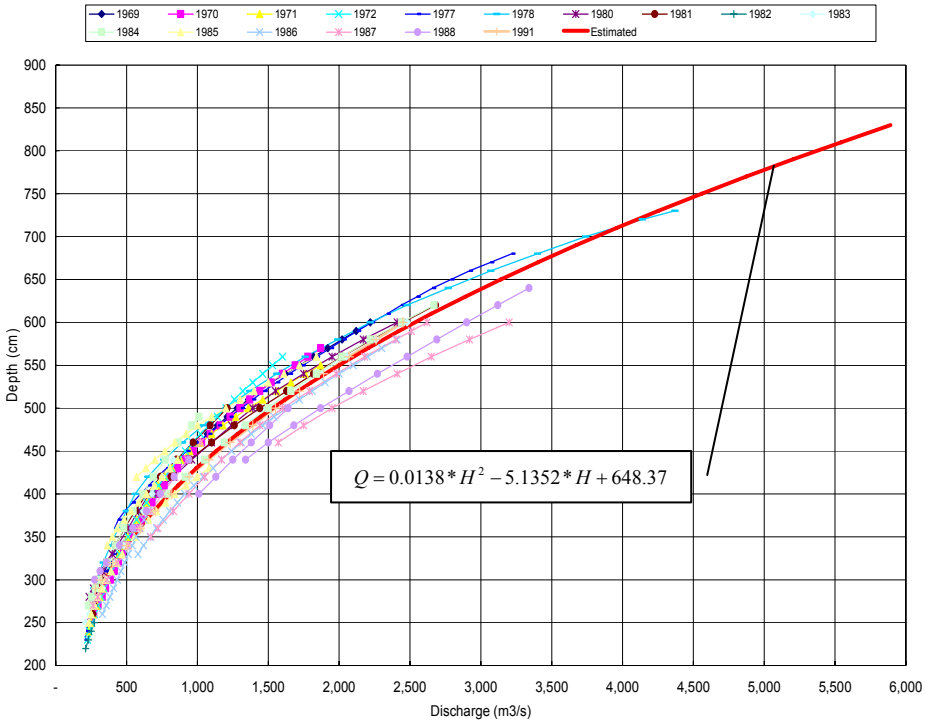


Fig. R.4.2.5 Applied Rating Curve

Utilizing the existing rating curves for floods before 1991 and the integrated rating curve for floods after 1992, data on water levels have been converted into discharges. Among the discharge data, the maximum annual discharges and dates extracted are as shown in Fig. R.4.2.6.

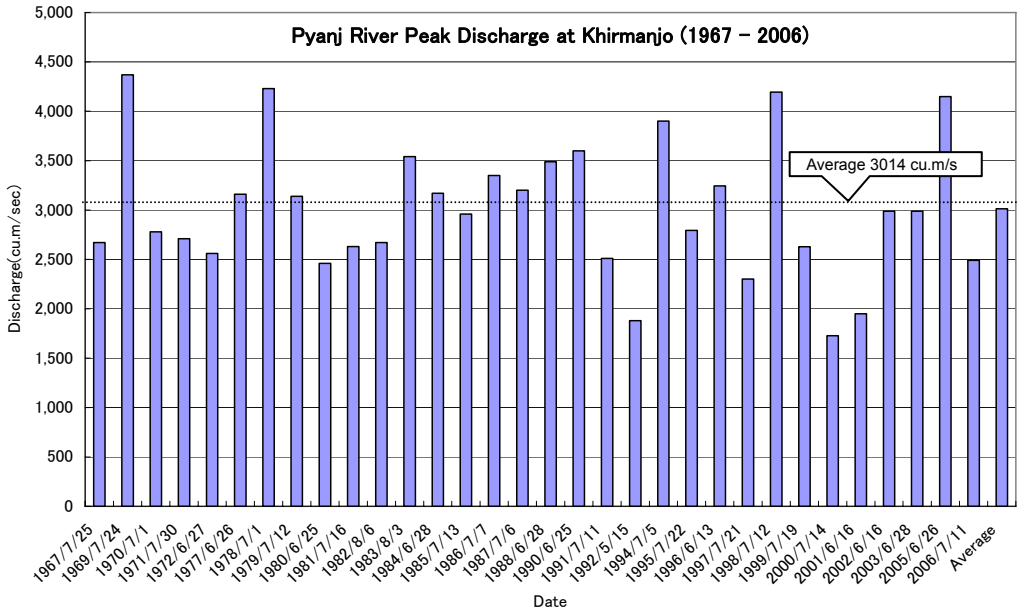


Fig. R.4.2.6 Maximum Annual Discharge at Khirmanjo (1967-2006)

ii) **Estimate of Recurrent Probability**

Data on maximum annual discharges at Khirmanjo have been plotted on probability sheet to calculate the recurrence probability using the Gumbel Method, as shown in Fig. R.4.2.7.

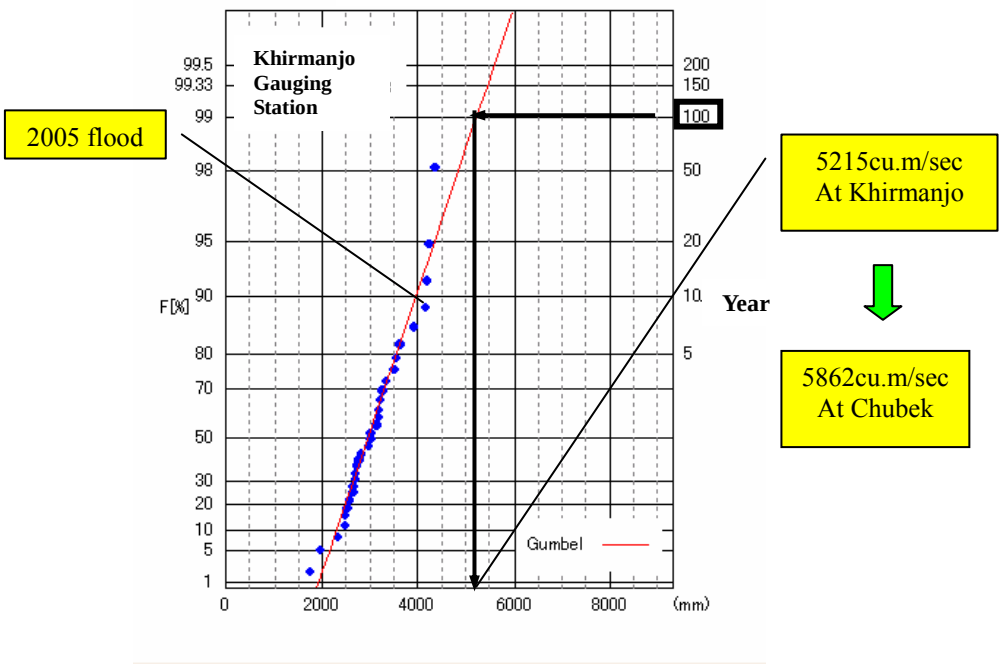


Fig. R.4.2.7 Recurrence Probability of Flood Flow at Khirmanjo

b) Design Discharge

As the design flood discharge, a 100-year return period is proposed because of the following reasons:

- In Tajikistan, flat land is so precious because it occupies only 7% of the total land area.
- Hamadoni and Farkhor have very high production output of cotton, which is one of the major export items.
- Instead of the 100-year return period, a 30-year return period is proposed for the 5-year plan as the interim countermeasure.

Therefore, as the design discharge at Khirmanjo Gauging Station, 5,215 m^3/sec is proposed.

c) Design Discharge at Chubek

For the structural design, the discharge at Khirmanjo should be converted to that at Chubek where the structure is located.

The conversion was made through run-off analysis using the Snow-Melt Run-off Method (DSRM) with characteristic functions of the digital simulation program of NAM in MIKE-11 developed by the Danish Hydraulic Institute. Fig. R.4.2.8 shows the conceptual diagram of the DSRM.

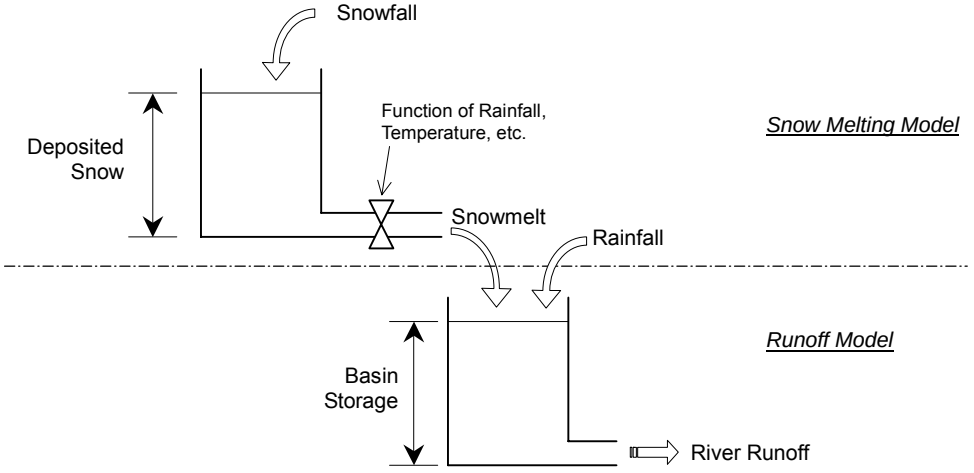


Fig. R.4.2.8 Conceptual Diagram of Snow-Melt Run-off Model

Table R.4.2.2 show the results of the calculation with comparison of observed and simulated peak discharges.

Table R.4.2.2 Results of Comparison of Observed and Simulated Peak Discharges (m^3/s)

Year	Khirmanjo		Chubek	Peak Discharge Ratio
	Observed	Simulated	Simulated	
1969	4,370	4,390	5,027	1.145
1978	4,230	4,291	4,945	1.152
2005	4,149	4,118	4,419	1.073
1990	3,600	3,632	3,989	1.098
1983	3,540	3,533	4,065	1.151
Average				1.124

Using the peak discharge ratio obtained from the comparison mentioned above, the recurrent probable discharges at Khirmanjo calculated in Item a), Recurrent Probability of Discharge of the Pyanj River, have been converted to that at Chubek, as listed in Table R.4.2.3.

Table R.4.2.3 Peak Discharge of Simulation (m^3/s)

Probable Year	Khirmanjo	Chubek
1/100	5,215	5,862
1/50	4,839	5,439
1/30	4,561	5,126
1/20	4,338	4,875
1/10	3,951	4,440
1/5	3,547	3,987
1/2	2,937	3,301

Therefore, for the Design Discharge of 100-year return period at Chubek, 5,862 m^3/sec is proposed.

2) Design Water Level

The design water level is calculated as non-uniform flow based on the law of conservation of energy using the standard sequential calculation method. Discharge is given from the study on design discharge mentioned in the preceding Item 1). The topographic data required for the calculation is given by the Digital Elevation Map (DEM) taken from satellite images. Fig. R.4.2.9 shows the result of the calculation.

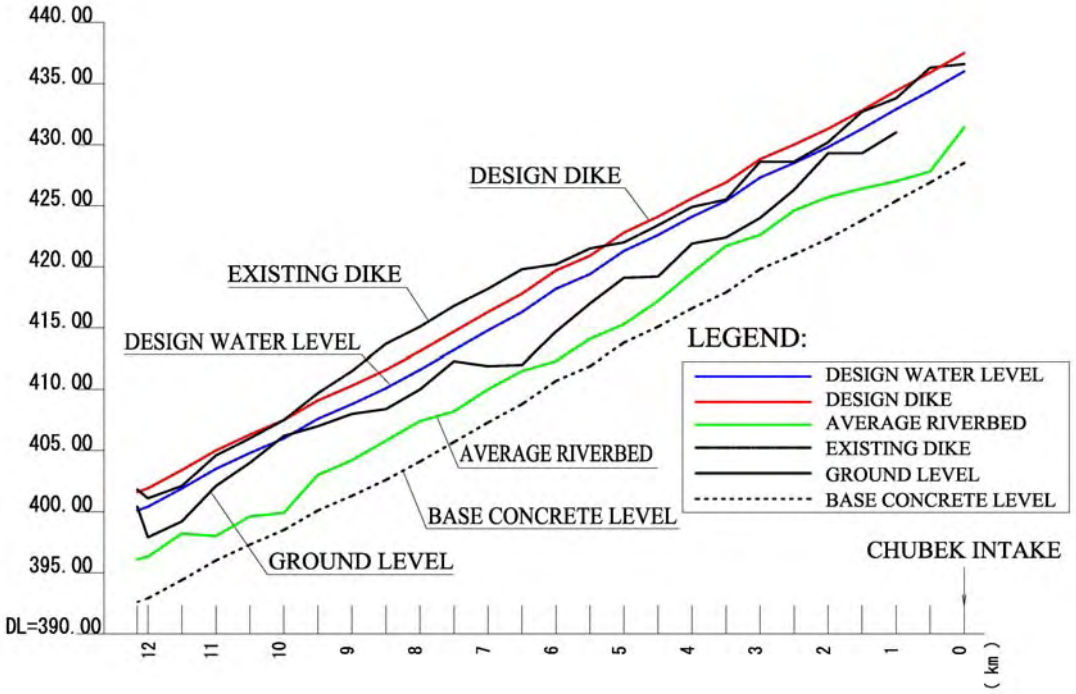


Fig. R.4.2.9 Longitudinal Cross-Section of Dike and Design Water Level

3) Freeboard

The Design Crest Level is to be determined with freeboard added to the design water level. Freeboard consists of various unknown factors, like wave height. Usually 0.7m is adopted for the design freeboard of dike according to SNIP. Along the dike in the Study Area, there are many spur-dikes already existing and proposed for study.

Spur-dikes block the river flow and reduce the river flow velocity, so that water level in the upstream side of a spur-dike has to be dammed--up with a certain height of water level.

Dammed-up water height is estimated by the formula $V^2/2g$, where V is the river flow velocity and g is gravity acceleration. Velocity is estimated using 4 m/sec, which is the

average velocity taken by 80% of the maximum velocity. The maximum velocity is taken from two-dimensional flow analysis in the Study. By substituting the average velocity into the formula, the dammed-up height is 0.8 meters in addition to the SNIP freeboard.

Therefore, the total freeboard proposed is 1.5 meters, which is applied to the whole extent of the dike.

4) Slope

Based on the site survey, the slope angle of the existing dike ranges from 1:1.5 to 1:1.8 to form a stable slope embanked with sand and gravel in general. Considering the requirement of allowance for bank erosion and loosening due to saturation of water, 1:2.0 is proposed for slope angle of the embanked dike including spur-dike.

Provision of a 3-m wide catwalk on the slope is proposed for the following reasons:

- To provide a work space for machinery used to repair slope protection or foot protection works.
- To increase the width of dike for the dike body to resist erosion or filtration.

5) Slope Protection

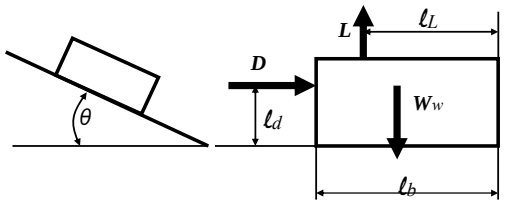
Conventionally there are some means for slope protection in river engineering such as gabion, wet-stone-masonry, concrete block, riprap, etc. In the study area, it has been observed that gabions, concrete blocks and riprap are utilized. Based on the comparison of unit cost, riprap is the cheapest, followed by gabion, wet-stone-masonry, and concrete block. Considering the convenience of repair work on portions damaged by forces such as erosion, and based on experience and actual site practices, slope protection with riprap, gabions and concrete blocks are proposed.

The dimensions of the proposed methods are as discussed below.

a) Concrete Blocks

Size of concrete block has been determined in such that the block will not be ridden-up by river flow, as calculated below.

$$W_W \times \cos\theta \times \ell_b / 2 \geq L \times \ell_L + D \times \ell_d$$



Note: Sliding is not considered as design condition because the blocks are connected to each other behaving as a mass.

W_W: Weight of concrete block
ℓ_b : Length of the block in up-downstream direction
L: Uplift induced by river flow acting on the block
ℓ_L : Length from downstream end to action point L
D: Thrust force induced by river flow acting on the block
ℓ_d : Length from bottom to action point D

θ: Angle of slope to horizon

$$L = \frac{\rho_W}{2} C_L A_L V_d^2 \qquad D = \frac{\rho_W}{2} C_D A_D V_d^2$$

ρ_w : Density of water
$C_{L,D}$: Experimental coefficient for uplift or thrust force respectively
$A_{L,D}$: Area for uplift or thrust force respectively
V_d: Flow velocity

Considering that the dimensions of 1m x 2m x 1m or 1m x 2m x 0.5m are applied by MMWR in its present practices at the site, 1m x 2m is taken for the planar dimension and thickness is calculated as the optimum. The results of the calculation of thickness are as shown below.

Thickness	0.5 m	0.3 m	0.2 m
Result	OK	OK	NG

Note: OK means the block will not be ridden up; NG means the block will be ridden up

Therefore, for the size of a concrete block placed as slope protection works, 1m x 2m x 0.3m is proposed.

b) Gabions

Gabions are composed of iron-wire net and boulders so that the diameter of iron-wire and boulders should be determined. The diameter of iron-wire is proposed to be 3 mm, while boulder size is to be determined under the following conditions:

- There is no soil pressure and water pressure underneath.
- Movement of packed boulders induced by the river flow causes a critical condition, which cause deformation of the wire frame.

Using the empirical formula, the required boulder size for gabions was determined to be more than 0.19m in average diameter.

To prevent soil from being washed out from the embankment through the spaces of stones in the gabion, filter material should be placed underneath the gabion.

c) Riprap

Riprap is composed of crashed rocks or boulders in general. Particle size should be designed considering the following conditions:

- There is no soil and water pressure underneath.
- Movement of particle is induced when scouring force of the river flow exceeds resistance of the particle.

Using the empirical formula, the required particle size for riprap was determined to be more than 0.45m in average diameter.

To prevent soil from being washed out through the spaces on the embankment, filter material should be placed underneath the riprap.

6) Foot Protection Works

The whole length of foot protection is to be placed at a certain depth to account for further riverbed erosion at the foot. The depth of foot protection is determined based on the deepest depth of the riverbed. Considering site conditions and river flow velocity obtained from the hydraulic analysis, and practicality of utilization in the study area since the Soviet era, concrete blocks with rectangular shape are proposed as material for foot protection works.

a) Design Depth

The design depth of foot protection is determined with the depth from the deepest spot to the mean riverbed (hereinafter referred to as ΔZ). Usually ΔZ is unknown. In Japan, if the mean riverbed and the height from the deepest spot to the top of the holm are known, the design depth is calculated as the equivalent value to ΔZ using the empirical formula for river engineering.

ΔZ = 0.8*Hs (Refer to Fig. R.4.2.10)

ΔZ: Depth from the deepest spot to the mean riverbed
Hs: Height from the deepest spot to the top of the holm

In the Study, the values for mean riverbed along the dike were determined from the satellite data, DEM, and Hs measured at the site. Therefore, ΔZ was estimated by the formula mentioned above, resulting in the design depth of 6.0 meters from the mean riverbed, which was applied to the foot protection works of dike without spur-dikes. For the foot protection of dikes protected by spur-dikes, 1.5 meters is given as the design depth.

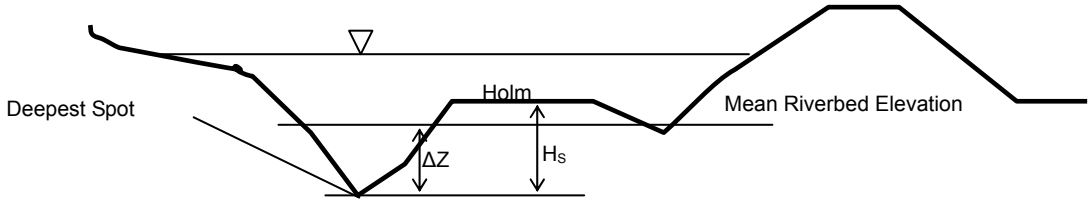
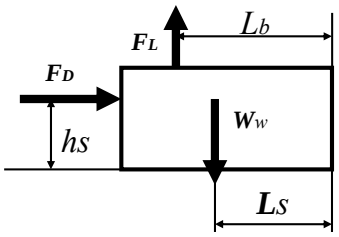


Fig. R.4.2.10 Definition of ΔZ and Hs

b) Design Dimensions of Concrete Block

The size of the concrete block should satisfy conditions shown as follows:

$F_D < \mu(W_w - F_L)$, $F_D * hs < Ww * Ls - F_L * L_b$



F_D: Thrust caused by the flow
μ : Coefficient of friction, 0.65
W_w: Weight of the block
F_L: Uplift caused by the flow
hs: Height from the bottom to the action point of the thrust caused by the flow
Ls: Length from the edge to the center of gravity
L_b: Length from the bottom to the action point of the uplift caused by the flow

Based on the result of calculation with the design flow velocity of 5 m/sec taken from the two-dimensional flow analysis in the Study, concrete blocks with dimensions of 1m x 2m x 1m are required for stable placement, as already used in the site. The longer side of the concrete block should be placed in parallel with the river flow direction.

7) Spur-dike

The Study Team had conducted numerical model analysis of hydraulics around the spur-dikes to determine the dimension of spur-dike in the Study Area. The numerical analysis was based on the two-dimensional flow analysis model, but accuracy and similarity to the actual condition were limited. Hence, the decision on dimension should take into account both numerical analysis and actual practices.

On the other hand, many lessons were learned from MMWR's practices on the actual construction of spur-dike in the Study Area. Therefore, the Study Team conducted site

surveys to study the condition of existing spur-dikes. The subjects of the site survey were as follows:

- Interval of spur-dikes
- Length of spur-dikes
- Type of spur-dikes
- Direction of spur-dikes

The existing dikes constructed after the 2005 flood have many of the empirical works. Therefore, the final decision on dimensions of spur-dikes was made by scrutinizing both the results of numerical analysis and the site survey of actual practices. The results of the scrutiny are as discussed below.

a) Interval of Spur-dikes

A site survey of the existing spur-dikes has been carried out to determine effectiveness. One of the elements to secure effectiveness is the ratio of length to the interval between spur-dikes. Some sections of the existing dike are heavily eroded, while some are well protected by spur-dikes.

The result of the site survey on damaged and undamaged sections is shown in Fig. R.4.2.11. In the figure, the red points show the damaged sections and the black triangle points show the undamaged sections. The vertical axis is the distance to the damaged section from the immediate upstream spur-dike for the red points, or the interval of spur-dikes for the black triangle points.

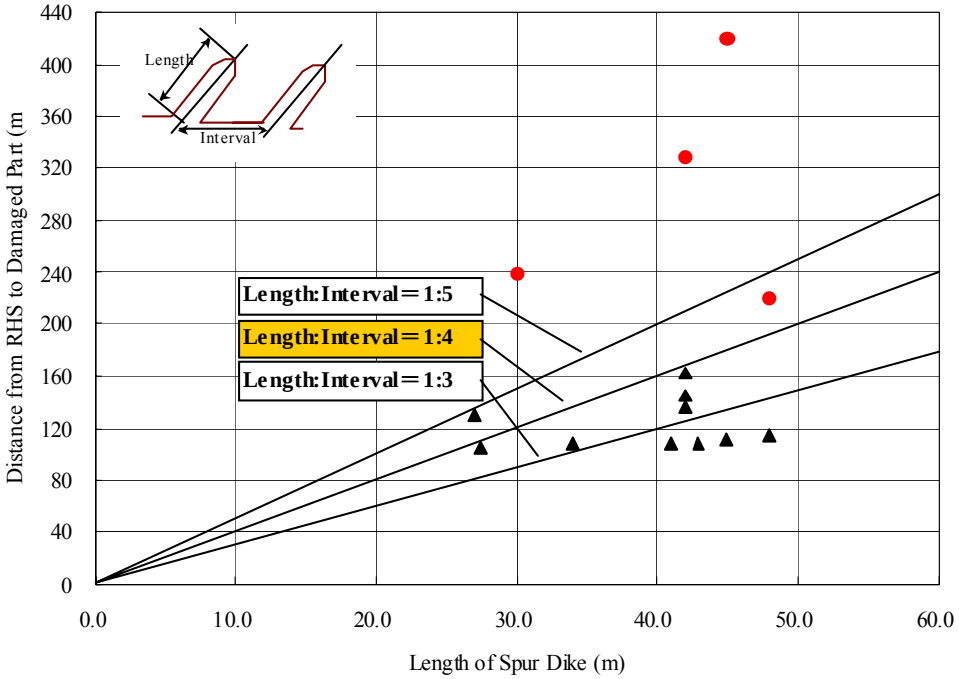


Fig. R.4.2.11 Result of Site Survey on Spur-dike Effectiveness

The above figure shows that damaged sections are located when the distance from the immediate upstream spur-dike exceeds more than 4 times the spur-dike length, and dike slopes have no damage and well protected in case the interval between spur-dikes is less than 4 times the spur-dike length.

The numerical analysis also supported this phenomenon. In addition, cost analysis results show that the interval of less than 4 is more expensive than the more than 5.

By integrating the results of the study and the survey mentioned above, the ratio of interval to length of spur-dike has been determined and is proposed to be 4.

b) Length of Spur-dike

One of the purposes of a spur-dike is to protect the flood protection dike from bank erosion with buffering tolerance and colliding flow against the dike. The main flow of Pyanj River lately has been running along the existing flood protection dike, and colliding against the dike in some sections causing bank erosion. Therefore, the longer spur-dike is preferable than the shorter one because the longer spur-dike can keep the main flow farther away from the existing dike.

However, the longer spur-dike exposes itself to more severe conditions of erosion because its top goes toward the strong current in the middle of the main flow. Consequently, the construction of a longer spur-dike is more costly than the shorter one because the longer spur-dike requires heavier protection against erosion.

The numerical analysis does not much contribute to the study on spur-dike length. Therefore, the dimensions should be determined from actual practices. Table R.4.2.4 shows the results of site survey on spur-dike effectiveness.

Table R.4.2.4 Result of Site Survey of Existing Spur-dike Constructed in 2006

Length of Spur-dike	Damage at Toe Section	Damage in Dike Section	Formation of Sediment between Spur-dikes	Depth of Scouring at Toe Portions
All Spur-dikes	8 Spur-dikes among 14; 60%	No Damage	12 among 14 spur-dikes formed sediment in front of flood protection dikes. Condition of remaining 2 is unknown because they were still submerged at the time of survey.	2.0m ~ 2.6m (2 samples)
Length: longer than 40m, shorter than 50m	4 among 7; 60%	No Damage	Length of sediment deposit: 45~100m; Width: 12~34m	Submerged
Length: 40~30m	1 among 4; 25%	No Damage	Length of sediment deposit: 50~65m; Width: 12~25m	2.6m
Length: less than 30m	2 among 2; 100% (These portions have strong flow collides.)	No Damage	Length of sediment deposit: 24~40m; Width: around 10m.	2.0m

The results suggest that spur-dikes with length of around 40 meters have been working well for the protection of dikes.

On the other hand, cost analysis results show that a longer spur-dike is more expensive in case interval-length ratio is fixed. Considering economic and functional effects, the length of spur-dike is proposed to be 40 meters.

c) Type of Spur-dike

There are two types of spur-dike adopted in the site; one is made of soil embankment and the other is made of concrete blocks. The former type was introduced in 2006. The latter was constructed before then. Site survey on the concrete block type has been carried out and the results are as shown in Table R.4.2.5.

Table R.4.2.5 Result of Site Survey of All Existing Spur-dikes

Type	Section	Damage	Effect of Spur-dike	Depth of Scouring at Toe Portions
Concrete Block Type	Flood Protection Dike (4 spur-dikes)	Toe sections of all spur-dikes have sliding-down concrete blocks.	Not much sediment developed at all spur-dikes.	2.4m - 3.0m (2 samples)
	Intake Guide Dike (8 spur-dikes)	Stable	No sediment was observed in 4 among the 8, but scale of sediment on the others was small.	2.0m - 5.2m (8 samples)
	Spillway Guide Dike (12 spur-dikes)	Downstream section of C20 has strong flow collide against the dike, so that toe portions of the spur-dikes are damaged.	Not much sediment developed because of short length and small angle of spur-dikes, i.e., less than 20m in length and less than 30 degrees in angle. One of them with 40m in length has a small scale of sediment.	1.4m - 4.0 (7 samples)
Embankment Type	Flood Protection Dike (14 spur-dikes)	8 among 14 have damages at toe portions.	Almost all spaces between spur-dikes have sediment deposits, which protect the dike slope against bank erosion very well	2 -2.6m

It was found that the embankment type is functioning well with sediment at the spaces between the spur-dikes protecting the main dike compared to the concrete block type. However, the embankment type should be carefully designed, employing the method introduced by the Study Team in Item e) below to solve the problem of damage at the toe portion.

d) Direction of Spur-dike

Hydraulic analysis has been carried out to find the optimum arrangement of spur-dikes. Fig. R.4.2.12 shows a part of the result of the analysis.

In Fig. R.4.2.12, the blue color indicates that scouring or the riverbed has gone down from the original level, and the darker in color, the deeper in erosion. The red color indicates either sedimentation or the riverbed has gone up from the original level, and the darker in color, the thicker in sedimentation. The angle of the spur-dike model was taken from the vertical line to the spur-dike alignment.

Comparing the left side figure to the right, the former has a darker blue color which means that the former has deeper scouring than the latter.

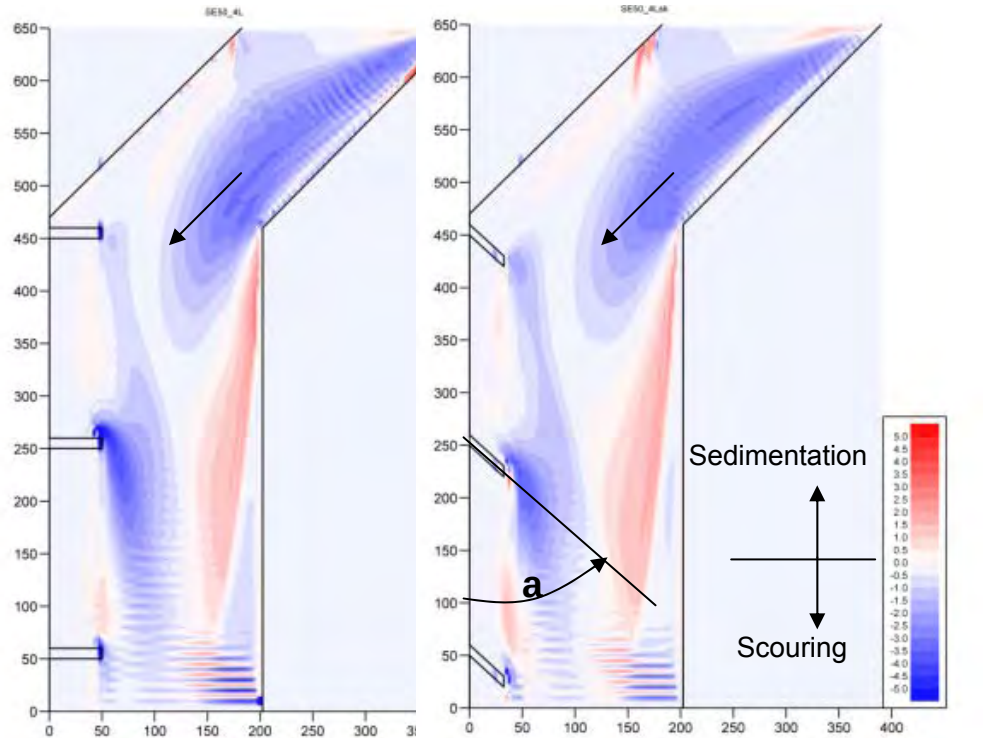


Fig. R.4.2.12 Result of Analysis on Spur-dike in Case of Collide Flow (a = 90° and 50°)

The results of several angles of spur-dike model show that the less angle model gives a shallower scouring depth at the top of the spur-dike than the right angle model. In case spur-dike length is 40 m, the required length of foot protection was calculated based on the scouring depths obtained from the result of analysis. (Refer to Table R.4.3.6.)

Table R.4.2.6 Required Foot Protection Length Based on the Angle of Spur-dike

Angle (a; degree)	Scouring Depth (m)	Foot Protection Length (m)	Perpendicular Length of Spur-dike (m)
90	8.1	14	40.0
60	6.9	12	34.6
50	6.5	11	30.6
45	6.3	11	28.3

With respect to foot protection length, the cases of 50° and 45° have the least length in the above table, while the case of 90° has the shortest perpendicular length. The condition where the length gets shorter according to the less degree of angle means that torrential flow is nearer to the dike.

Table R.4.2.7 show the results of the site survey on the existing spur-dikes of the embankment type.

Table R.4.2.7 Result of Site Survey on the Angle-Setting of Spur-dikes

Dike No.	Angle of Spur-dike (degree)	Damage in Toe Portion
R1	59.8	None
R2	50.1	Damage
R3	49.4	Damage
R4	50.1	Damage
R5	40.7	Damage
R6	55.0	Damage
R7	75.0	None
R8	50.0	Damage
R9	50.0	None
R10	50.2	None
R11	40.5	Damage
R12	40.4	None
R13	40.5	None
R14	60.5	Damage
Average	50.9	

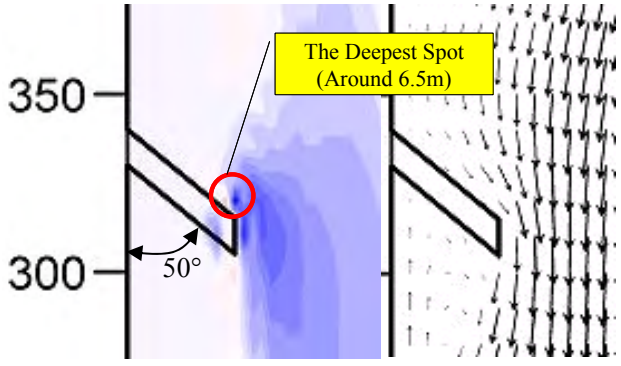
Some of the spur-dikes received damage on their toe portions, but there is no evidence showing that the angle setting had caused the damage. It was observed that all of the spur-dikes listed in the above table have functioned well to protect the main dike.

Considering the results of the study and analysis, there is no reason at present to improve the existing practice with respect to the spur-dike angle of alignment except that the angle is proposed to be 50 degrees.

e) Toe Protection

Usually, the toe portion of spur-dikes is subjected to severe river flow collision. Experiences and practices suggest that 3 or 6 meters is the deepest scoured depth in the riverbed at severely collided portions.

Hydraulic analysis has been carried out in this study to figure out the design depth for toe portion protection works using the two-dimensional hydraulic analysis method with mesh. To analyze the actual site condition, the model was simulated to the river flow with a holm, which makes the flow go diagonally toward the riverbank. The depth induced by erosion was calculated by the flow velocity and critical velocity of bed load transportation. Fig. R.4.2.13 shows the result of analysis.



(Erosion Depth) (Flow Velocity/Direction)

Fig. R.4.2.13 Result of Hydraulic Analysis for Deepest Scouring Depth (Close-up of part of Fig. R.4.2.12)

There are two kinds of foot protection countermeasures; one is to place a wall installed vertically reaching the deepest scoured depth, the other is to place connecting concrete blocks stretching horizontally to a certain extent to cover the deepest scoured depth by inclining after the riverbed is scoured. Considering the difficulty to excavate to so much depth, proposed is the connecting concrete blocks method shown in the conceptual drawing in Fig. R.4.2.14.

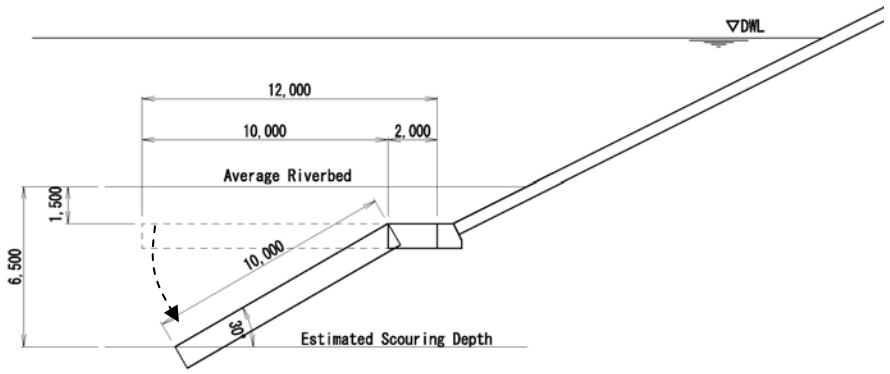


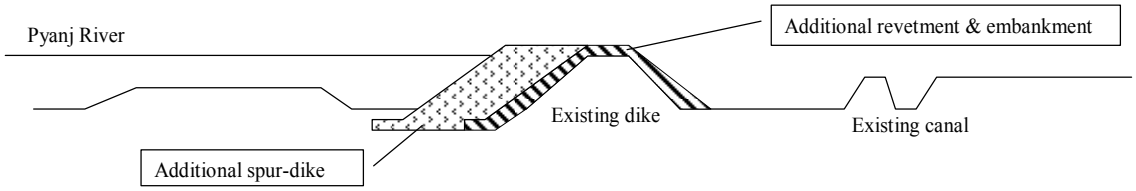
Fig. R.4.2.14 Proposed Method of Connecting Concrete Blocks

For the inclining concrete blocks to cover the deepest scoured portion of 6.5m, the total length of 10 meters of a series of connected concrete blocks is required.

4.2.3 Study on Alternatives

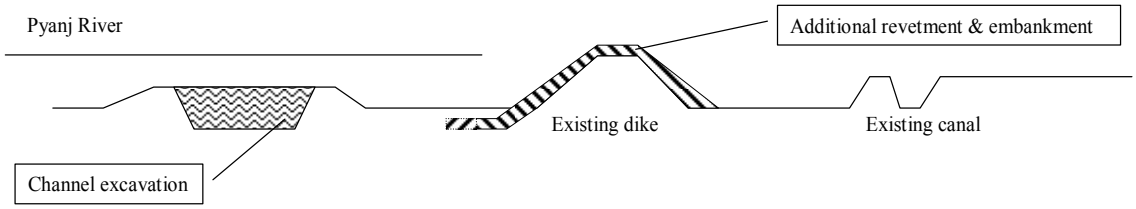
A study on alternative dike protection measures has been carried out for with- and without-spur-dike cases. The plan without spur-dike was categorized into three; one is with the excavation of channel to divert the flow away from the bank; one is with heavy reinforcement of foot protection instead of protection of spur-dike; and the other is the setting-back of dike including groundsill. Comparative designs were made for the main dike and Fig. R.4.2.15 shows conceptual illustrations of the alternative schemes.

Plan A: Dike Protection with Spur-dike



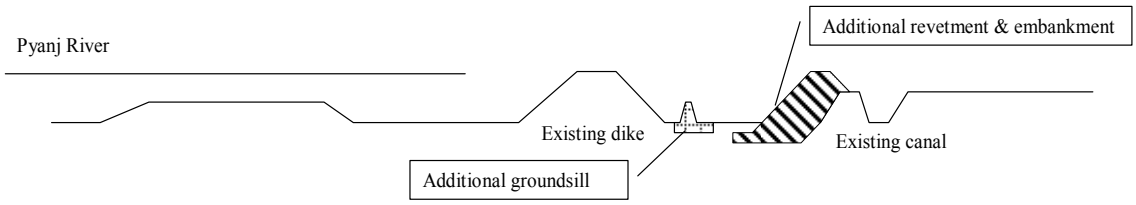
The existing dike is protected with additional revetment and embankment. The additional spur-dikes will make the dike protection works lighter or cheaper.

Plan B: Dike Protection Without Spur-dike but With Channel Excavation



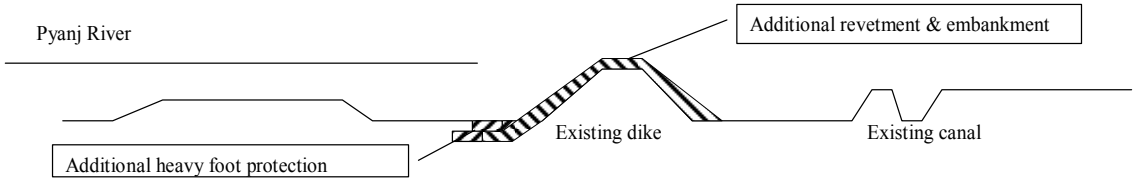
The existing dike is protected with additional revetment and embankment. The additional channel excavation of holms is to divert the river flow away from the dike section.

Plan C: Dike Protection by Setback with Groundsill



Setback of dike with protection works to protect the land along the existing canal from flood. The small additional groundsills are to keep the borderline. Construction works can be done without cofferdam and diversion works.

Plan D: Dike Protection Without Spur-dikes and With Heavy Foot Protection



Without spur-dikes, the existing dike should have a foot protection heavier than in Case A.

Fig. R.4.2.15 Conceptual Alternative Dike Protection Schemes

Table R.4.2.8 show the results of the comparative study on the above alternative plans.

Table R.4.2.8 Results of Comparative Study on Alternatives

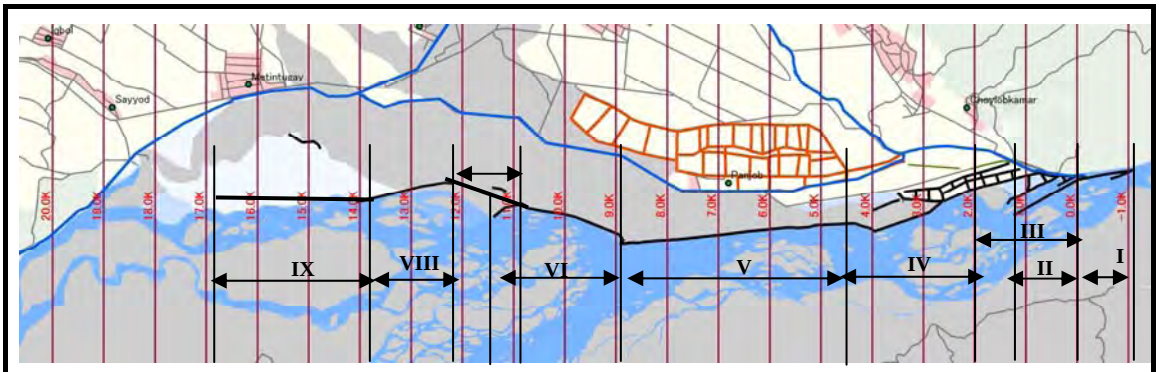
Item	Contents	Plan A	Plan B	Plan C	Plan D
		With Spur-dike	Without Spur-dike; With Channel Excavation	Setback of Dike incl. Groundsill	Without Spur-dike; With Heavy Foot Protection
Main Dike	Spur-dike (location)	39	0	0	0
	Slope Protection	CB-type: 10.8km; Riprap: 5.6km	Same as A	Same as A	Same as A
	Foot Protection (concrete blocks)	10.8km (B=2m)	7.1km (B=11m long); 3.7km (B=2m)	10.8km (B=11m long),	7.1km (B=11m, 2 layers); 3.7km (B=2m)
Intake Guide Dike	Spur-dike (location)	7	Same as A	Same as A	Same as A
	Slope Protection	CB-type: 1.0km			
	Foot Protection (concrete blocks)	FP: 1.0km (B=2m)			
Spillway Guide Dike (The case B has extension of the spillway guide dike to divert the river flow)	Spur-dike (location)	10	14	Same as A	Same as A
	Slope Protection	CB-type: 1.6km	CB-type 2.1km		
	Foot Protection (concrete blocks)	1.6km (B=2m l)	2.1km (B=2m)		
Others	Riverbed Excavation	0	4km long, 0.3km wide, 3.0m deep	0	0
	Groundsill			10.0km long, 41.2m wide	
Construction Cost		131.7 Mil. Tjs.	164.2 Mil. Tjs.	235.5 Mil. Tjs.	137.5 Mil. Tjs.
Evaluation		This Plan adopts the prevailing practices at the actual site and requires the least cost among the alternatives.	Sediment will accumulate on the excavated channels in the future; hence, maintenance cost will be required.	This Plan requires the biggest cost among the alternatives.	This Plan requires the second least cost, but does not adopt the prevailing practices at the site.
Priority		**1**	**3**	**4**	**2**

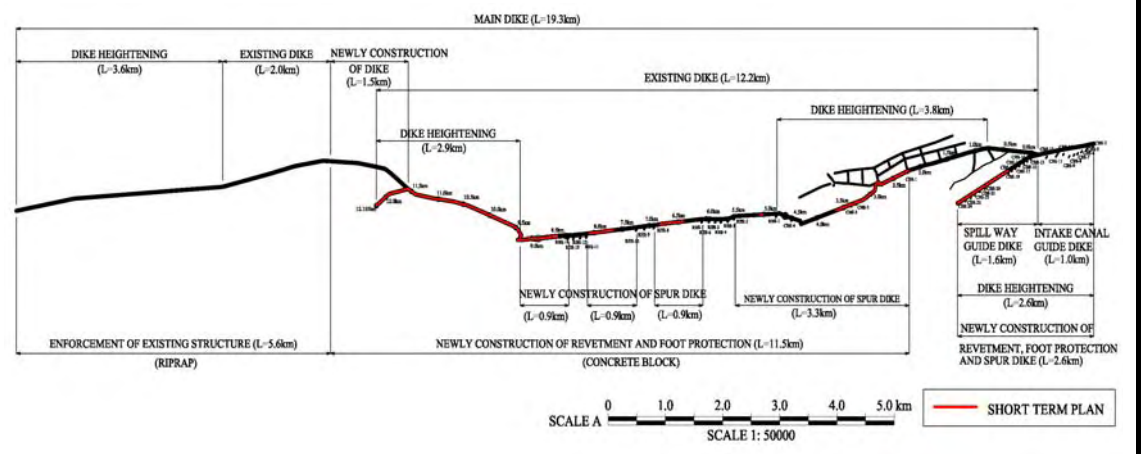
CB: Concrete Blocks; B: Length of Foot Protection

The results of the study on alternatives suggest that **Plan A** is the most economical and practical measure. Therefore, Plan A, which involves rehabilitation of the existing dike and improvement works with spur-dike, is proposed as the structure of the Master Plan.

4.2.4 Summary of the Proposed Master Plan of Structural Measures

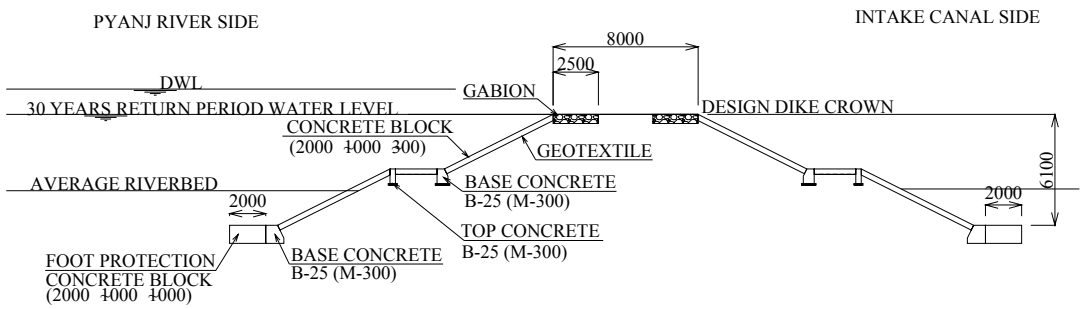
Fig. R.4.2.16 presents the summary of the proposed master plan of structural measures, together with the objective sections and sorts of works.





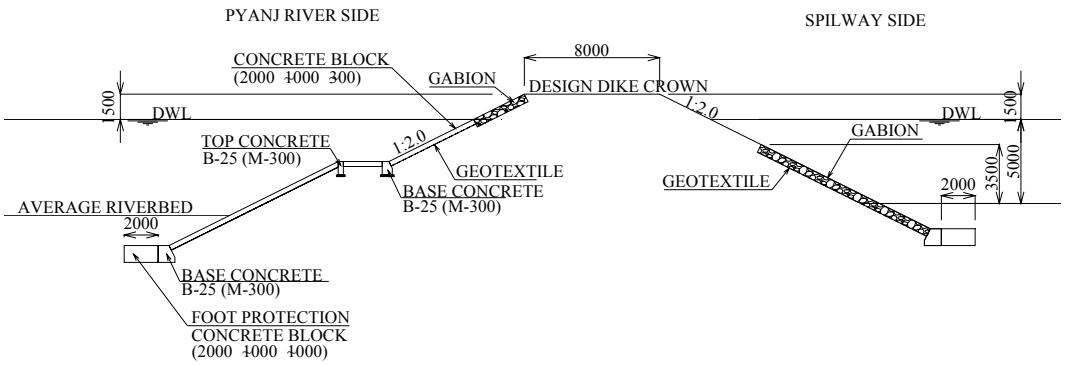
: Short Term Plan (7.1km); : Medium-Long Term Plan (20.9 km including Short Term Plan length)

Section	Typical Cross-Section	
	Section	Distance of Project: (km) ST: Short Term Plan MLT: Medium/Long Term Plan
I	Station Points : -1.0 to 0.0k (Intake Guide Dike)	Distance of Project (km): ST: 0; MLT: 1.0



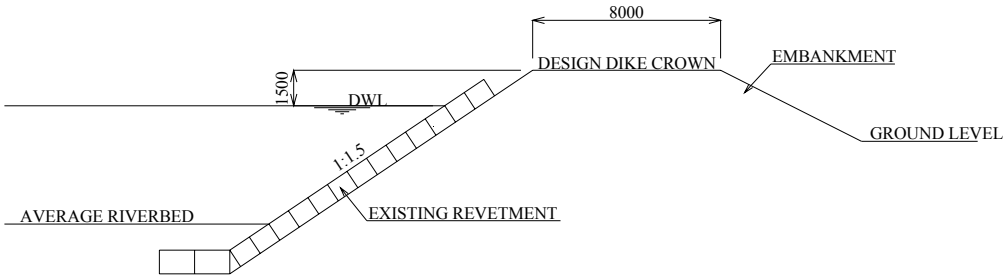
Remarks
Slope/foot protection of concrete blocks & gabion, with Spur-dikes is required

II	Station Points: 0.0 to 1.2k (Spillway Guide Dike)	Distance of Project (km) ST: 1.0; MLT: 1.6



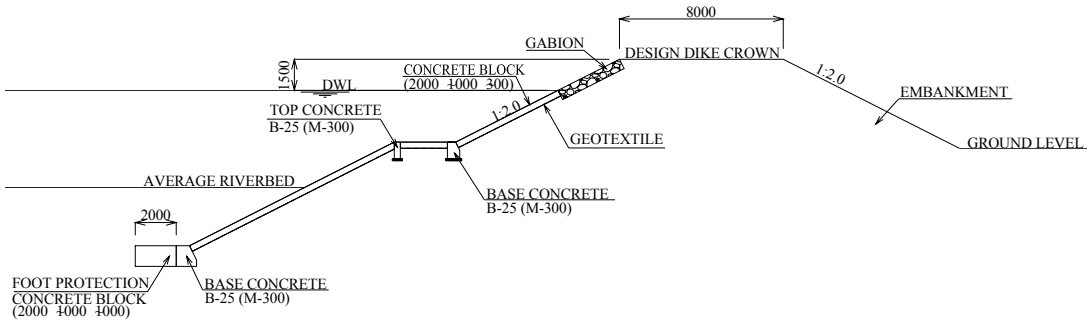
Remarks
Heightening of crest &slope/foot protection of concrete blocks & gabion, with spur-dike is required

III	Station Points : 0.0 to 2.0k (Main Dike)	Distance of Project (km): ST: 0, MLT:1.2



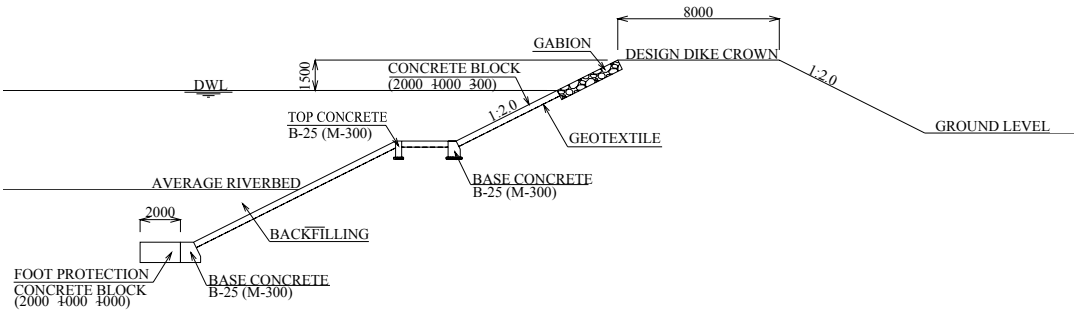
Remarks
Only heightening of the crest is required because this section is well protected by the SGD so that additional reinforcement is not required.

IV	Station Points : 2.0 to 4.5k (Main Dike)	Distance of Project (km): ST: 1.4, MLT: 2.6



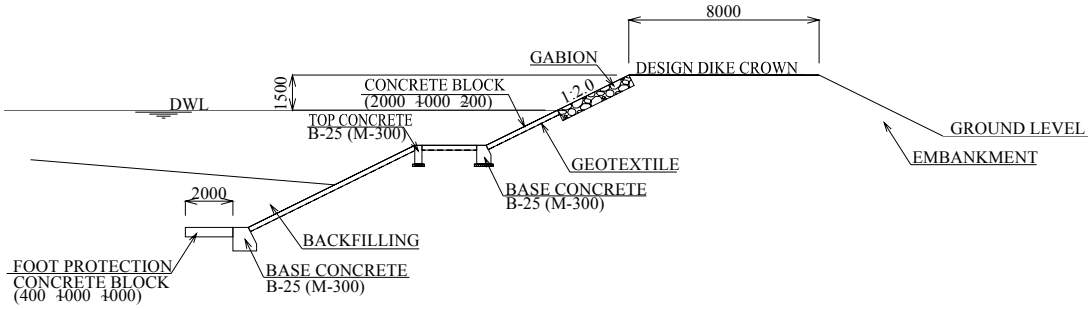
Remarks
Heightening of crest &slope/foot protection of concrete blocks & gabion, with spur-dikes is required

V	Station Points : 4.5 to 8.9k (Main Dike)	Distance of Project (km): ST: 1.8, MLT: 4.5



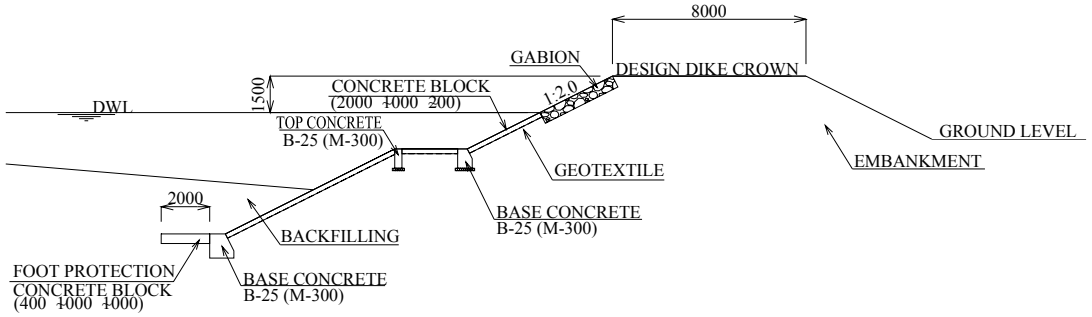
Remarks
Revetment of concrete blocks & gabion, with spur-dikes is required

VI	Station Points : 8.9 to 11.4k (Main Dike)	Distance of Project (km): ST: 2.9, MLT:2.9



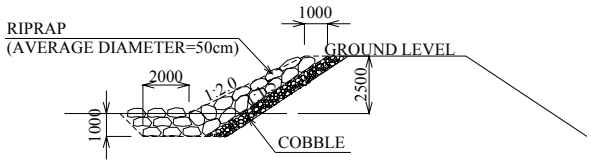
Remarks
Heightening of crest & revetment of concrete blocks and gabion is required.

VII	Station Points : 10.9 to 12.1k (Main Dike)	Distance of Project (km): ST: 0, MLT: 1.5



Remarks
Embankment with revetment of concrete blocks & gabion is required.

VIII	Station Points : 12.1 to 14.0k (Main Dike)	Distance of Project (km) ST: 0, MLT: 2.0



Remarks
According to the hydraulic analysis, design discharge does not flow over the existing dike in this area so that only revetment with riprap is required.

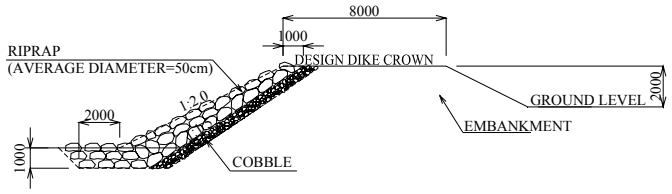
IX	Station Points : 14.0 to 17.0k (Main Dike)	Distance of Project (km): ST: 0, MLT: 3.6
		
Remarks		
Embankment with riprap is required.		

Fig. R.4.2.16 Classification of Works in Sections of the Short/Medium-Long Term Plans

Fig.R 4.2.17 and Fig.R 4.2.18 shows the plan and the typical cross section of spur dike proposed for the Master Plan.

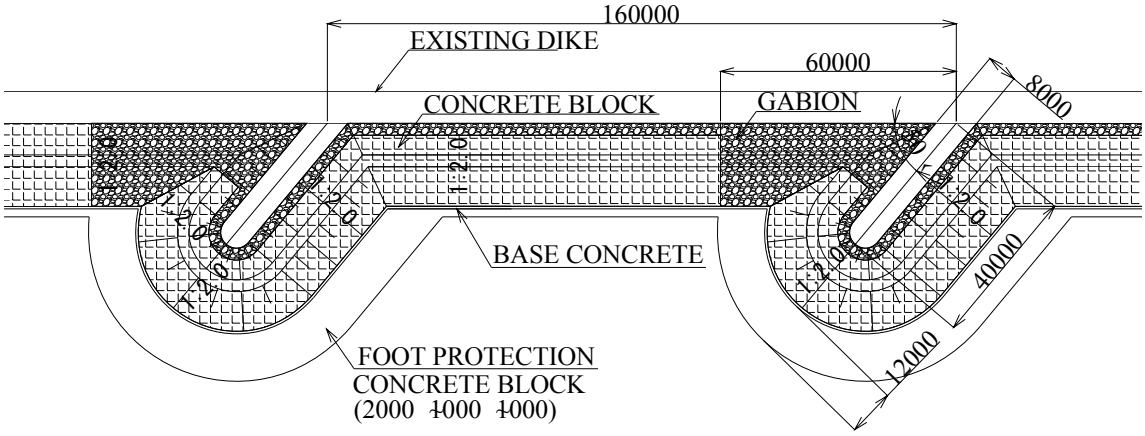


Fig. R.4.2.17 Plan of Spur Dike

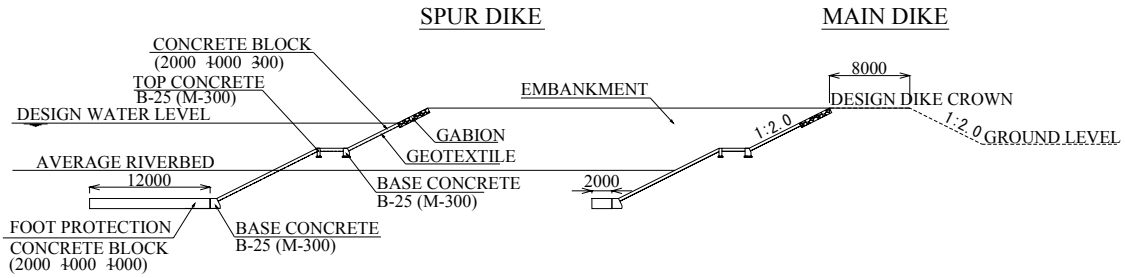


Fig. R.4.2.18 Typical Cross Sections of Spur Dike

4.3 STUDY ON NON-STRUCTURAL MEASURES

This section presents the contents of the study on the proposed non-structural measures for the Master Plan discussed in Subsection 3.3.2, as follows:

- Improvement of communal disaster management system

- Enhancement of capacity of flood fighting

4.3.1 Enhancement of Capacity for Communal Disaster Management in Hamadoni District

The challenges to the communal disaster management system consisting of the following items have been discussed in Subsection 3.3.2:

- Information Management
- Preparedness
- Guidance on Evacuation

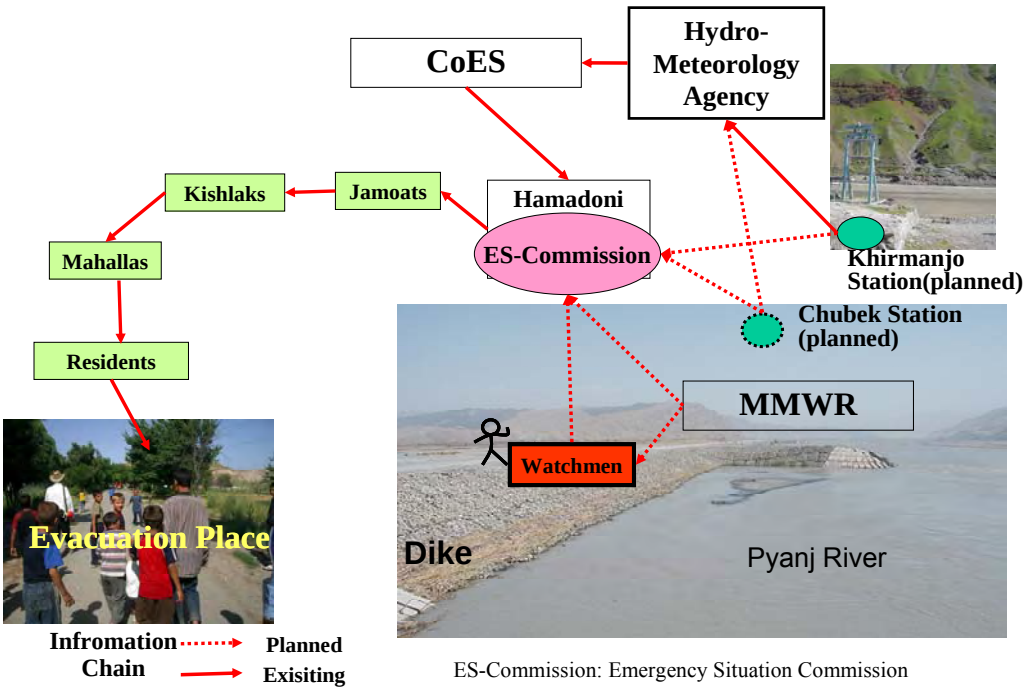
In this subsection, the Study Team proposes the necessary countermeasures according to the challenges mentioned above, as follows:

1) Information Management and Communication

The Hamadoni District Emergency Situation Commission has the responsibility to integrate disaster information and communication in the Hamadoni District, but the commission has to know the information on floods at Khirmanjo and the current situation of the river and dikes in the district. In this regard, the Study Team proposes the information management system and required facility plan, as presented below.

a) Information Management and Communication System

Presently, information on floods are initiated by the Hydrometeorology Agency and transmitted to Hamadoni District through CoES via wireless radio. It is necessary to maintain the present system but it is also required that additional information at the river site as well as the condition of the dike be transmitted from the site to Hamadoni District as the current situation report of MMWR, the administrator of the dike. Fig. R.4.3.1 illustrates the system.



ES-Commission: Emergency Situation Commission

Fig. R.4.3.1 Proposed Hamadoni District Information Transmission Network

Based on the concept of the information management system illustrated above, the proposed information collection system is as summarized in Table R.4.3.1.

Table R.4.3.1 System of Flood Information Collection and Communication

Activity	Jurisdiction	Duties	Remarks
Water Level Gauging	Hydro-Meteorological Agency	Water level gauging at Khirmanjo Station and data transmission	The station should be restored.
	Hydro-Meteorological Agency and MMWR	Water level observation at Chubek and data transmission to Hamadoni ES-Commission	Water level staff gauge should be installed.
Dike and River Monitoring	MMWR	Monitoring of current situation of dikes and data transmission to CoES and MMWR	Watchmen should be provided at the site.
Data Compiling, Analyzing and Decision-making	Hamadoni District ES-Commission	Implementation in cooperation with CoES and MMWR	
Information Transmitting	Hamadoni District ES-Commission	Transmission of disaster information to the residents	

b) Information Collection Facility Plan

It takes more than one day for flood flow to reach the inland area from the dike broken portion, according to the records shown in Fig. R.1.5.2, but it takes only a few hours for the evacuees to reach the evacuation places from their residences. Therefore, the evacuees have enough time for evacuation if destruction of the dike is immediately detected or expected by the watchmen, who should always participate in the activities at the site during the flood season. In this regard, it is enough for the data collection system to be provided with water level gauges for monitoring the dike condition.

Therefore, the Study Team proposes, as the master plan for the data collection system, as follows:

- The present system of information transmission from Khirmanjo should be maintained with restoration/rehabilitation of water gauging equipment.
- A new information transmission route from Khirmanjo to Hamadoni District should be provided.
- A new information transmission route from the riverside to Hamadoni District should be provided with additional installation of staff gauge.
- The watchmen should report the water level readings of the staff gauge and the current situation of the dike to Hamadoni District and the headquarters of MMWR.

Table R.4.3.2 show the necessary equipment for information collection.

Table R.4.3.2 List of Necessary Equipment for Information Collection

Location	Equipment	Remarks
Khirmanjo Observation Station	- Sonic Wave Sensor for Water Level - Data Transmitting Device (VH Radio)	Call-Response System
Chubek, Hamadoni	- Staff Gauge	-

2) Preparedness

The challenges to preparedness are the reorganization of the Emergency Situation Commission of Hamadoni District to function effectively with the participation of MMWR, the development of hazard and risk maps, and the formulation of communication networks, as mentioned in Subsection 3.2.3.

a) Improvement of Organization

The concept of organizational improvement has been mentioned in the preceding Item 1), which presents that the participation of MMWR in the Emergency Situation Commission of Hamadoni District would result in more accurate information on river and current dike condition so that the capacity of the commission to make proper judgment on evacuation will increase.

Fig. R.4.3.2 shows the proposed organization chart of the Emergency Situation Commission including MMWR.

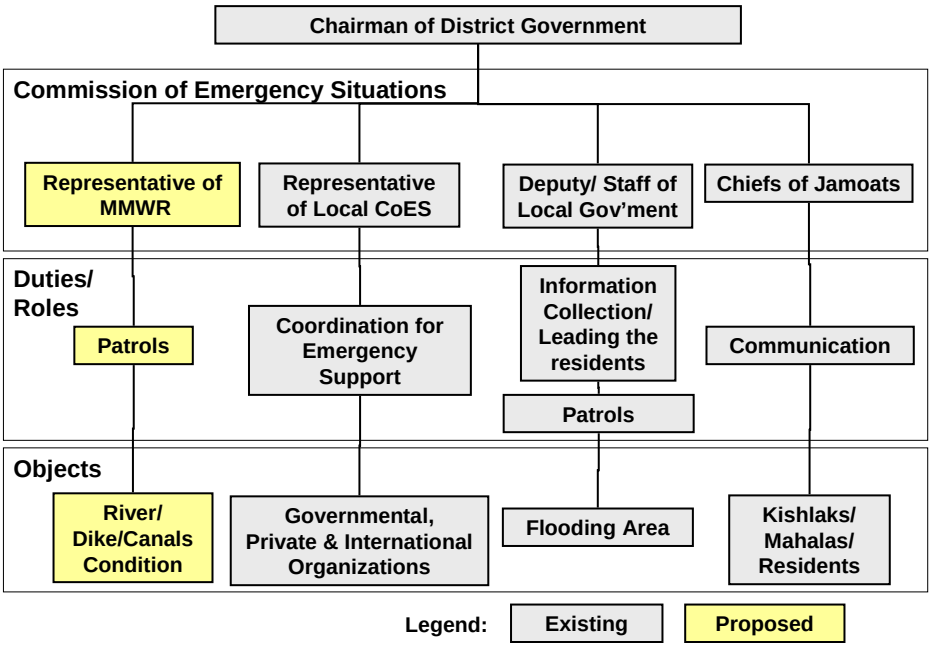


Fig. R.4.3.2 Proposed Organization of Hamadoni District Emergency Situations Commission

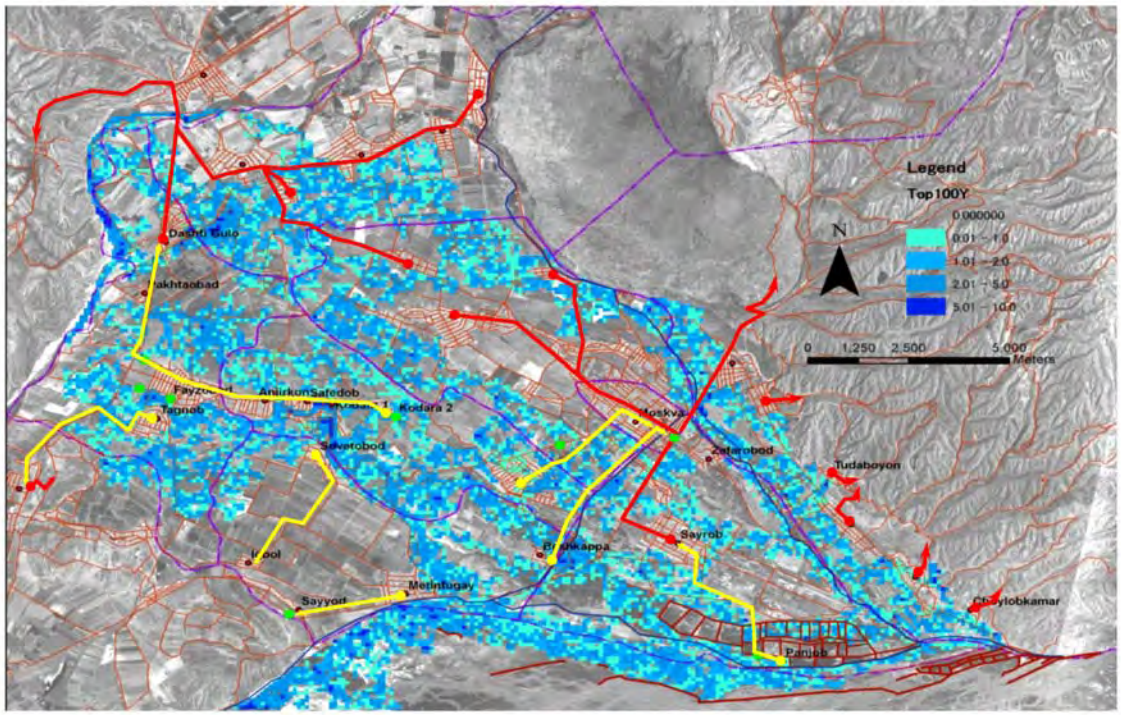
b) Hazard-Risk Maps

The Study Team had prepared five kinds of hazard-risk map and one flood record map. The contents of these maps are as summarized in Table R.4.3.3.

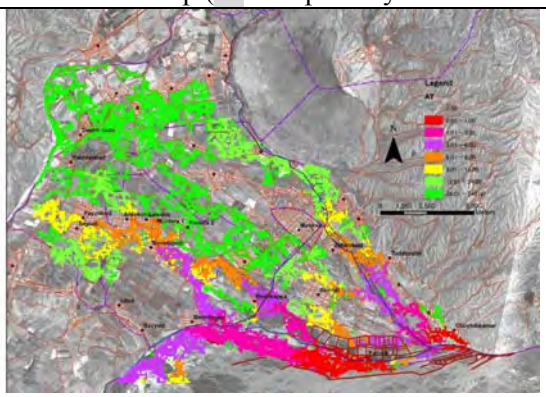
Table R.4.3.3 List of Hazard-Risk and Flood Maps

Kinds of Risk Map	Contents	Application
Flood Hazard Map	Inundation areas with evacuation places and routes	For the residents to know where to go for evacuation, and how they will go there.
Flood Arrival Time Map	The time when the flood will arrive from the dike to the places after the dike is broken.	For the residents to know how much time they have for evacuation or for taking other actions.
Flood Velocity Map	Velocity of flood flow	For the residents to know how much danger on lives is brought by the flood through the attached explanation on velocity-danger relation.
Flood Depth Map	Depth of flood	Together with the velocity map, for the residents to know how much danger is brought by the flood, and the influence to lives and the properties.
Flood Risk Rank Map	Rank of flood risk	The ranks are determined taking account of flow velocity and water depth so that the residents will know how much danger is expected by evacuating on foot in the floodwaters.
Flood Record Map	Records of the flood in 2005 (refer to Fig. R.1.5.2)	The above maps are prepared based on hydraulic analysis. This Flood Record Map is made based on the actual record of the flood in 2005 so that the actual record can be utilized as reference for the evacuation.

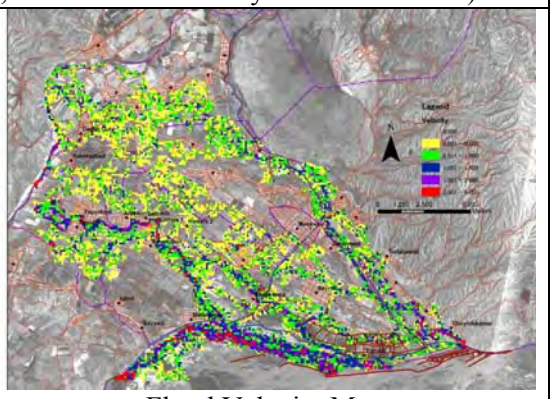
The prepared hazard-risk maps are as shown below. Copies of these maps should be kept at each local government office and utilized for the evacuation in case of floods. In addition, an evacuation exercise should be held before the flood season every year, and the maps should be improved adding the opinions of residents or the necessary information.



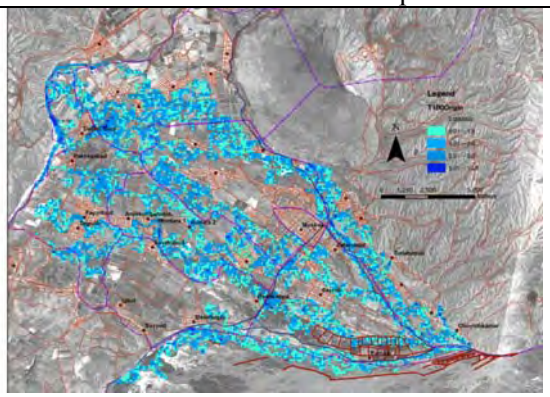
Hazard Map (:The primary evacuation route, : The secondary evacuation route)



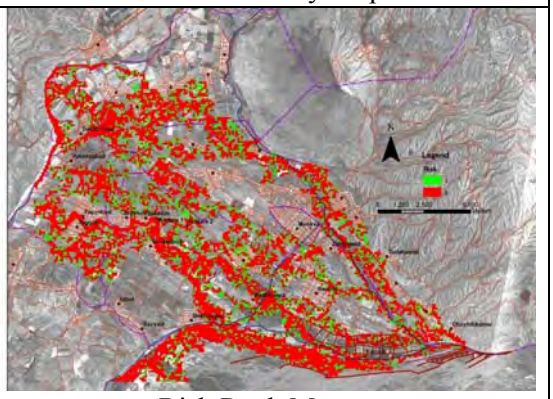
Flood Arrival Time Map



Flood Velocity Map



Flood Depth Map



Risk Rank Map

Fig. R.4.3.3 Hazard-Risk Maps of Hamadoni District (1/100 return period of flood)

3) Evacuation Guidance

The final decision and measure to save the lives of people during floods is evacuation. Therefore, a certain procedure should be taken to inform the residents in a reliable way

without undue delay the decision of the agency concerned in evacuation. The procedure should consist of information collection, judgment, transmission of instruction and implementation of evacuation. Since information collection has already been discussed in the preceding Item 2), the proposed procedures after that are as presented below.

a) Criteria of Warning

The Hydro-Meteorological Agency has been recording river water levels since 1967. These have been converted into flow discharges and shown in line graphics with maximum and minimum annual discharges, and average of maximum annual floods, as shown in Fig. R.4.3.4.

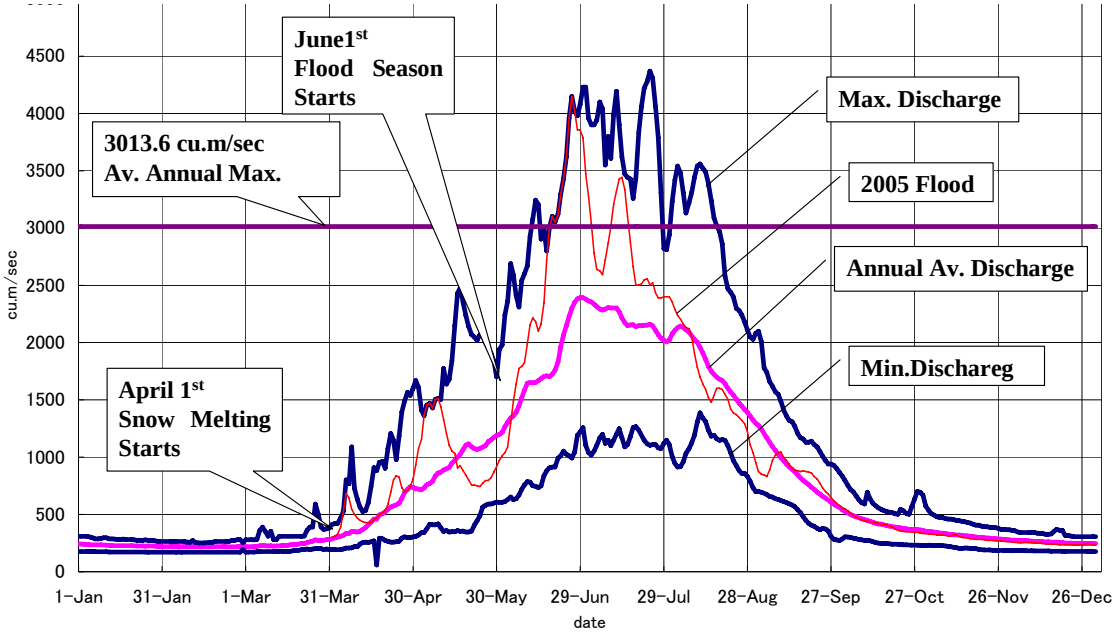


Fig. R.4.3.4 Flood Discharges with Maximum, Minimum and Average Flows at Khirmanjo

There is a significant difference between before and after April 1st of every year. Before that day, discharge levels remain below 400 m^3/s, but after that day, discharge levels rise to maximum, average and minimum. Therefore, the snow–melt period is considered to start at around April 1st, and the announcement of Snow-Melt Start Day is to encourage the public to be aware that river water level starts to increase and should pay attention to floods in the season.

The above graph shows another significant day, which is June 1st. Since the discharge level starts rising to peak discharge after that day, June is considered as the beginning of the flood season and the scheduling of announcement of Flood Season Start on June 1st is to encourage the public in flood prone areas to be ready for floods in the year.

In addition to the above, it is empirically known that the flow of more than the average annual maximum discharge contributes much to bank erosion, so that 3000 m^3/s is proposed to be one of the indicators for the warning to start careful monitoring of dike erosion.

A warning criteria and required actions for floods in Hamadoni District is provided based on the above-mentioned records and proposed as shown in the following Table R 4.3.4.

Table R.4.3.4 Warning Composition for Floods in Hamadoni District

Warning Level	Date or Criteria	Action
Announcement of Snow-Melt Start	April 1st	Get ready on river water rising
Announcement of Flood Season Start	June 1st	Get ready to pay attention to weather information; Start monitoring dikes
Flood Warning Level I	3000 m^3/sec at Khirmanjo	Get ready for flood defense
Flood Warning Level II	Based on CSR; Dike erosion starts	Start flood defense activities; Get ready to evacuate
Flood Warning Level III	Based on CSR; Break of Dike with Chubek's water level is higher than the Critical Water Level.	Evacuate

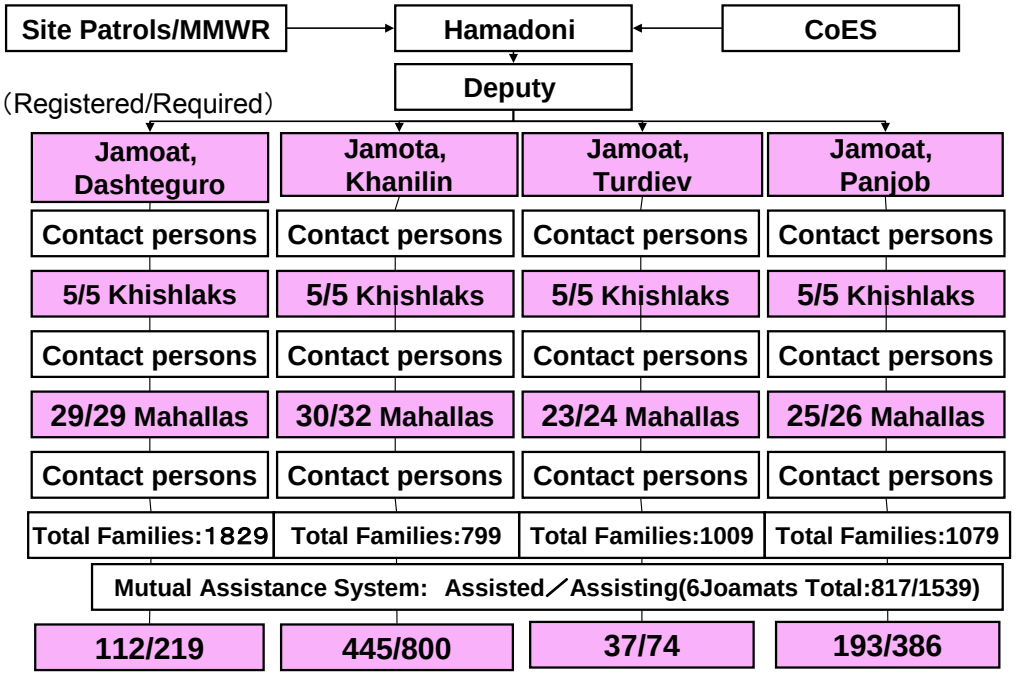
CSR: Current Situation Report

b) Dissemination of Warning

In case of Level I and II, the warning should be transmitted to the Jamoat chiefs in the daily meeting of Commission of Emergency Situations. They should inform the warning to the residents through chiefs of Kishraks and Mahallas. In case of Level III, the warning should be transmitted through the Evacuation Information Network.

The Study Team had provided the Evacuation Information Network consisting of the communication chain from the Commission of Emergency Situations to the Mahallas with the names of contact persons, as well as the mutual assistance system for disabled persons with names of assisting and assisted persons.

The Hamadoni District should improve the Evacuation Information Network and the Mutual Assistance System and have them updated with the latest information in cooperation with CoES. Fig. R 4.3.5 shows the Evacuation Information Network and Mutual Assistance System.



Dominator: Required numbers, Numerator; Registered numbers provided during the Study

Fig. R.4.3.5 Hamadoni District Evacuation Information Network and Mutual Assistance System

The Evacuation Information Network and Mutual Assistance System are still being prepared so that Hamadoni District office should complete the systems in cooperation with CoES Hamadoni District. After the completion, the systems should be always improved and maintained in the latest status.

The electronic files of the systems are handed over to CoES and Hamadoni District office by the Study Team.

In addition, the methodology and the equipment are required to ensure the dissemination of warning, as listed in Table R.4.3.5 and Table R 4.3.6 respectively.

Table R.4.3.5 Proposed Method of Communication in Communities

Category		No.	Communication Method		Remarks
			Present	Proposed	
District		1			
	Between District & CoES		VH radio	VH Radios	
	Between District & Jamoats		Regular meetings	- Regular meetings; - VHF Radios	
	Between District & Patrols			VHF radios	
Jamoats		8			Among 8, 4 are in flood prone areas
	Between Jamoat & Kishlak		Regular meetings	- Verbal communication networks - VHF Radios - Sirens	
Kishlaks		58			
	Between Kishlak & residents		Regular meetings	- Verbal communication networks - Sirens	

Table R.4.3.6 Equipment Proposed for Warning Communication

Item	Specification	Quantity	Remarks
VHF radio	Handy/Base/Car	31	Requires frequency permit for CoES use
Siren	Handy/manual operation	111	

c) Implementation of Evacuation

The evacuation plan and evacuation guidance for local governments and residents are as given in Table R.4.3.7.

Table R.4.3.7 Evacuation Plan and Guidance for Local Governments and Residents

For Local Governments		
Items	Requirements	Remarks
Commission/ Jamoat/ Kishlak	A list containing the names of responsible persons for emergency situation should be prepared and regularly updated. The CES* should hold evacuation drills in May every year. The CES should determine which Jamoats and Kishlaks are given priority to evacuate according to the Current Situation Report and the Hazard Map and Risk Maps.	*CES: Commission of Emergency Situation in Hamadoni District
Communication Network	The representative of CoES should keep the communication tools as the properties of CoES. The representative should deliver them to the District, Jamoats and Kishlaks according to communication network. The communication network should connect every house to Kishlaks, every Kishlak to Jamoats, and every Jamoat to District by name of responsible persons.	The name of persons concerned in the communication networks should be kept in a list at CES.
Patrol	Way of patrol should be stipulated in the Patrol Guide	
Hazard Map	Hazard maps including evacuation areas and routes should be kept in District, Jamoat, and Kishlak offices.	
For Residents		
Items	Residents (Potential Evacuees)	Local Officials
Food, water and cooking fuel	Each household should repare portable foods, potable water and cooking fuel in June good for at least 3 days.	Provide preserved foods, potable water and cooking fuel for long- term evacuation.
Evacuation places	Confirm the location and routes indicated in the hazard maps.	Deliver hazard maps to the residents in advance of the flood season.
Evacuation routes	Follow recommended evacuation routes. Do not take shortcuts; they may be blocked.	Install signboards of evacuation routes and evacuation areas.
Transportation	- Keep a full tank of gas in your car if evacuation seems likely. Gas stations may be closed during emergencies and unable to pump gas during power outages. Plan to use one car per family to reduce congestion and delay. - Make transportation arrangements with friends or your local government if you do not own a car. - Be alert for washed-out roads and bridges. Do not drive into flooded areas.	- Update the transportation plan in May every year. - Provide gas for vehicles in emergency situations. - Confirm the safe routes for evacuation and inform evacuees during emergency situations.
Information	Listen to a battery-powered radio and follow local evacuation instructions.	Check every communication channel and tools in advance of the flood season.
Family	Gather your family and go if you are instructed to evacuate immediately.	
Neighbors	Arrange in advance to assist minorities, the elderly and the handicapped in evacuation.	Hold regular meetings to encourage the residents to make preparations in advance of the flood season.
Dangerous Situation	Stay away from dangerous situations like downed power lines.	Watch the dangerous situation and inform it to the residents and responsible authorities
Sharing of Information	Attend meetings of local governments regularly.	Hold regular meetings to collect and disseminate information on emergency situations.
Exercise of Evacuation	Carry out exercise of evacuation in advance of the flood season every year.	Hold regular exercises of evacuation every year in the level of District, Jamoat and Kishlak respectively.

4.3.2 Enhancement of Capacity for Flood Fighting in Hamadoni District

The main activities of flood fighting in Hamadoni District are to be carried out under the responsibility of MMWR, as follows:

- The patrol teams are to monitor the current situation of floods and dikes and report the results of monitoring to the Emergency Situation Commission and MMWR headquarters.
- The Emergency Situation Commission and MMWR headquarters are to take countermeasures according to their capacity and responsibility.

The proposed plan to enhance the capacity for flood fighting in Hamadoni District is to achieve the challenges discussed in Item 2) of Subsection 3.3.2. The plan consists of enhancement of the monitoring system for the current situation of floods and dikes, and buildup of the system of urgent restoration to be carried out by MMWR as the leading agency in cooperation with CoES using the capacity of the military unit stationed in Hamadoni District. Since the former function is closely related to disaster management and already discussed in Subsection 4.3.1, only the latter is discussed below.

Fig. R.4.3.6 presents a conceptual figure of the proposed system of flood fighting and communal disaster management in Hamadoni District.

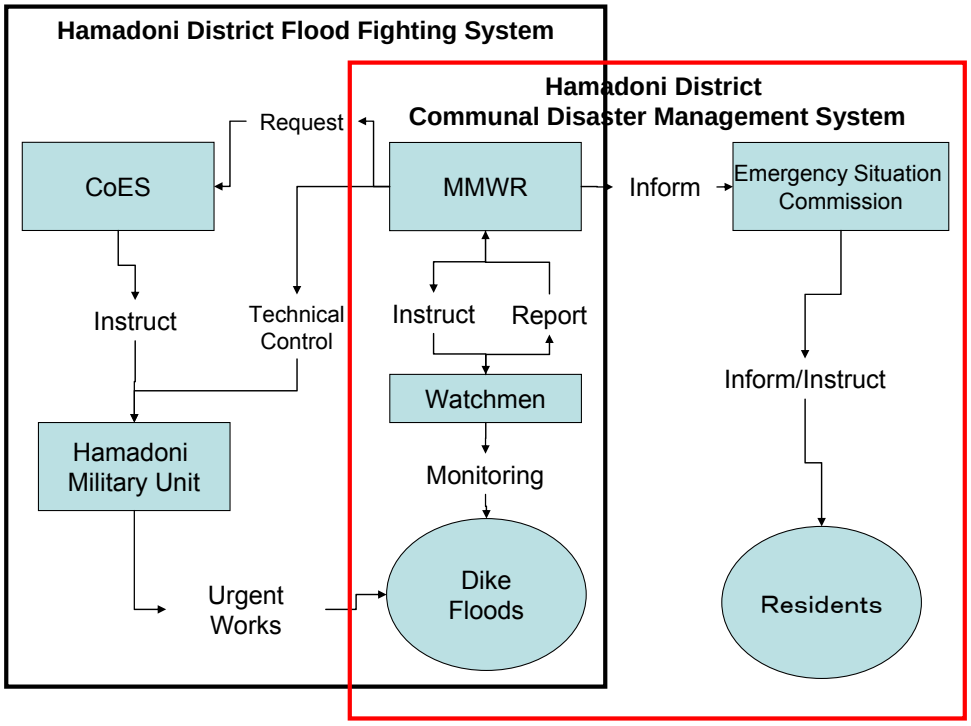


Fig. R.4.3.6 Proposed System of Flood Fighting and Communal Disaster Management in Hamadoni District

The machinery and equipment required to execute the urgent works for the restoration of dikes are as listed in Table R.4.3.8.

Table R.4.3.8 Machinery Required for the Urgent Restoration of Damaged Areas

Item Code	Name of Equipment	Necessary Quantity	Uses
1	Backhoe, hydraulic Crawler Mounted 1.0m^3 including Slope Molding Attachment	1	Excavation for foot protection, removal of damages
2	Truck Crane, Hydraulic Telescopic Boom, 5t	1	Hauling of materials and equipment
3	Crawler Tractor (Bulldozer), 15t or 16t	1	Embankment with compaction and excavation
4	Crawler Crane, 35t	1	Placing of concrete blocks and other countermeasures
5	Dump Truck, 10t	2	Transportation
6	Portable Concrete Mixer (0.8 m^3)	2	Mixing concrete for slope protection
7	Submerged Pump, 8"	1	Dewatering
8	Generator Set, 150kW	1	Electricity for mixer
9	Generator Set, 50kW	1	Electricity for pump and lighting
10	Knitting Machine for Gabion baskets (Wire diameter up to 3.90 mm, can do 4-8 cross connecting)	1	Production of gabion baskets
11	Patrol Car, 4WD, with Siren, Winch and Searchlight, Radio Equipment	2	Patrolling for observing site situations

4.4 SUPPORTING PLAN OF NATURAL DISASTER PREVENTION

4.4.1 Enhancement of Capacity for Rescue Center of CoES

Problems of the Rescue Center are mentioned in the previous item 3.3.2 3). The most urgent problem to be solved is a lack of equipment required for rescue activities. The required equipment is shown as listed in Table R.4.4.1.

Table R.4.4.1 List of Necessary Equipment for the Rescue Work of Sentrospas

No.	Name of Equipment	Unit	Quantity
1	Winch, wire10t	set	1
2	Illuminating complex	set	4
3	Lifting mechanical jack	set	2
4	Altitude RKUM	set	1
5	Vest jack (diving)	set	6
6	Dry type of diving jacket	set	4
7	Waterproof Jacket	set	30
8	Depth-gauge	set	6
9	Rubberboat	set	4
10	Aqualung	set	2
11	Alpinist rope main one, 9-11 mm	meter	500
12	Auxiliary alpinist rope, 6 mm	meter	600
13	Release device	set	20
14	Lifting device	set	20
15	Air lifejacket	set	20
16	Gloves (leggings) type	pair	100
17	Warm mitten	pair	100
18	Enclosure band	set	5
19	Individual first aid set	set	50
20	Tent	set	4
21	Alpinist rucksack (80-10 l)	set	40
22	Gas Mask	set	40
23	Respiratory System	set	10
24	Hydraulic accidental-saving instrument	set	1
Others	Special cutting pliers, Combining scissors, Universal chopper, Hand pump, Spool-Extender, Power cylinder, Pump station, Set of necessary spare parts	Lump Sum	

4.4.2 Enhancement of Hydro-Meteorological Observation and Communication System

The urgently required facility for the hydro-meteorological observation system is proposed in the previous item 4.3.1. The only framework is proposed for the enhancement of the hydro-meteorological observation system according to the reason shown in the previous item 3.3.2 4). The proposed framework is described as follows;

1. The framework for facility of the hydrological observation system is proposed as shown in Fig R 4.4.1.
2. The framework for facility of the meteorological observation system is proposed as shown in Fig R. 4.4.2.

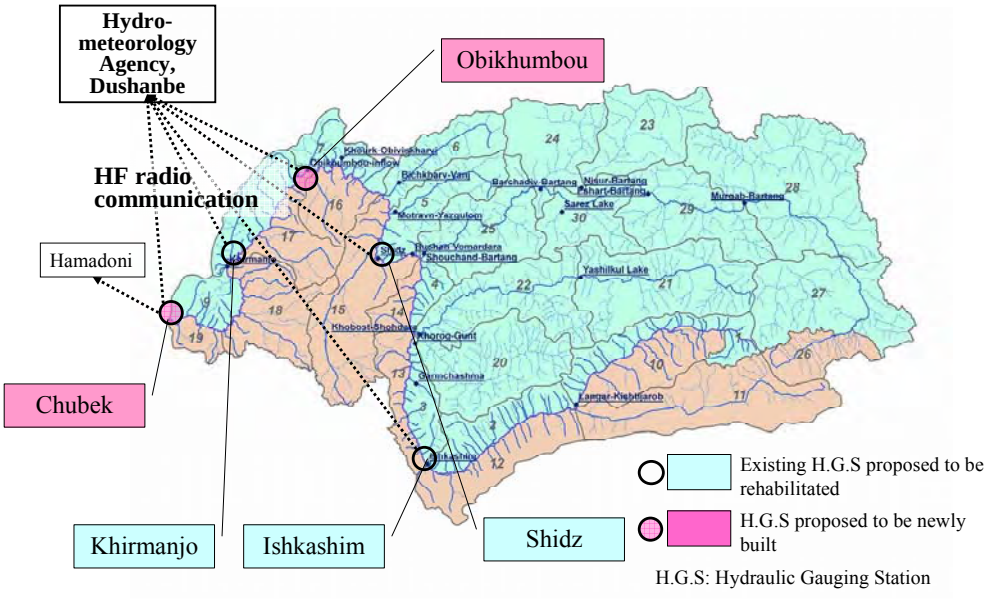


Fig. R.4.4.1 Location of Hydrological Observation Stations to be Rehabilitated and Newly Built

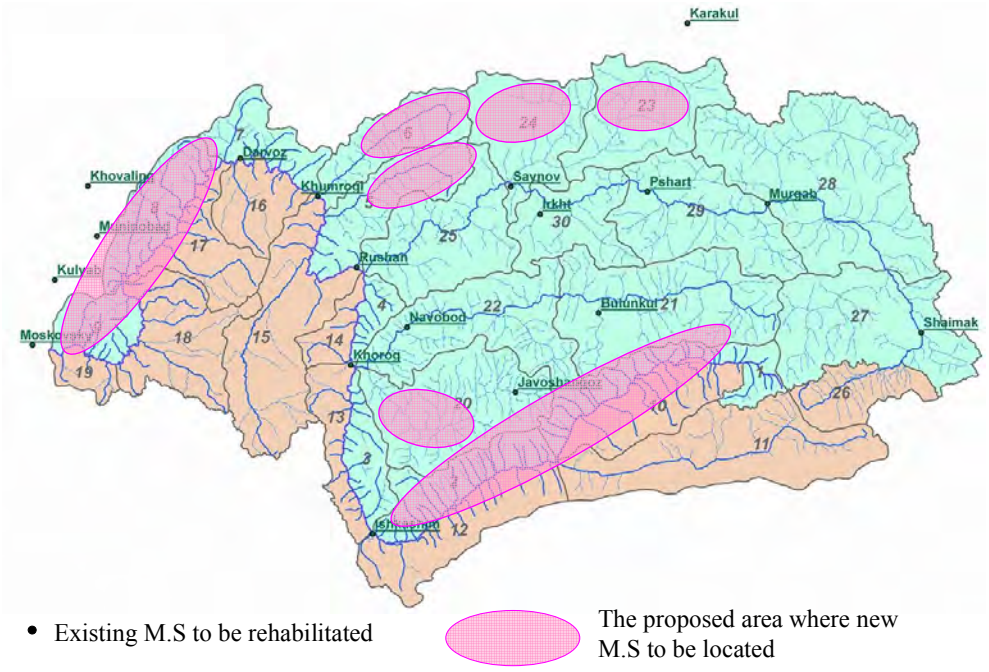


Fig. R.4.4.2 Location of Meteorological Stations (M.Ss) to be Rehabilitated and Newly Built

4.4.3 Enhancement of Organizational Capacity for Disaster Management of CoES

The countermeasure to the challenges to improve the organization for the disaster management mentioned in previous item 3.3.2. 5) and the contents of the improved capacity of the organization of CoES are described as follows;

1. Capacity of preparedness of CoES to formulate the guideline for the local government to implement the communal disaster management and to support and supervise its activity.
2. Capacity of planning/research of disaster management to carry out the preliminary site-investigation and evaluation of disaster events, to formulate the national disaster management plan, to promote the implementation of the national disaster management, and to evaluate the implemented disaster management projects.
3. Capacity of public relation to deepen the citizens' understanding of the activities of the disaster management of CoES, to disseminate the preparedness in nationwide, and to encourage the nations to participate the disaster management activities disclosing the disaster information
4. Capacity of the organization to be improved through reactivation of the existing sections by re-realizing their own tasks and adding new tasks.

The sections to be enhanced in the CoES organization for disaster management are shown in Fig R 4.4.3.

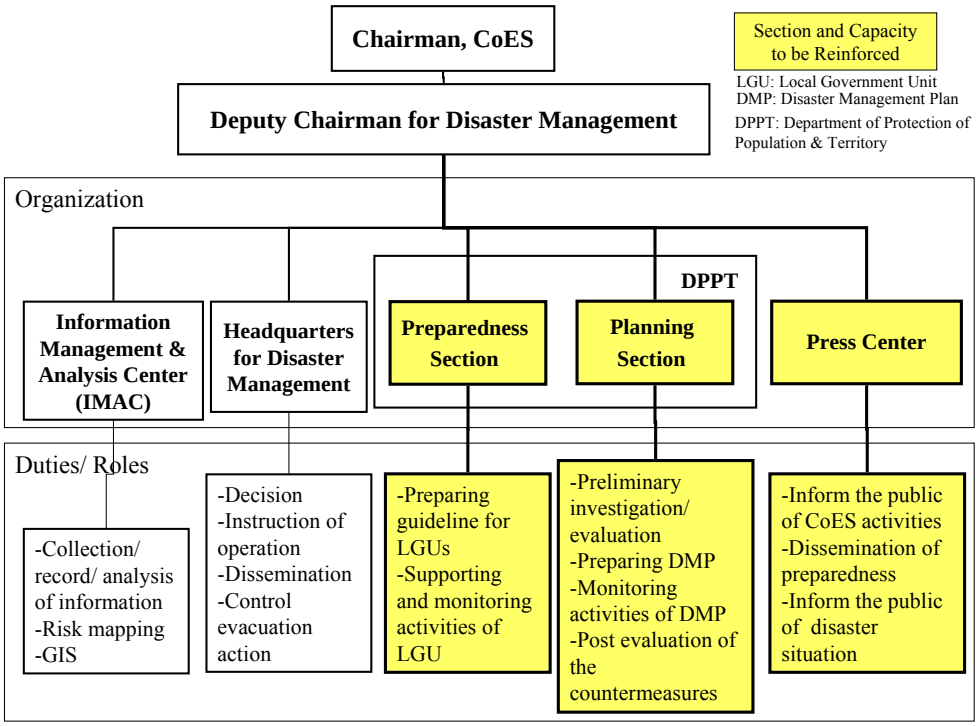


Fig. R.4.4.3 Proposed Organizational Structure of CoES for the Disaster Management

4.4.4 Enhancement of Capacity for Disaster Engineering and Management of CoES

Disaster Engineering is the engineering that deals with natural disaster prevention using integrated knowledge over the various aspects of expertise. Furthermore, the build-up and development of capacity are required for the CoES's officials to develop and implement target programs aiming at disaster prevention and recovery and to maintain the updated knowledge on disaster engineering with level equivalent to the expertise of the members of the Advisory Commission for Natural Disaster Management (ACNDM), which is proposed in Subsection 4.3.7 below.

Along with the proposal for a new organizational structure, the capacity of sections and personnel involved in the activities of disaster management is required to increase or built-up in order to achieve their duties. In this regard, it is proposed that CoES should maintain a program of enhancement and development of disaster engineering.

Implementation of the program requires the support of experts and organizations with knowledge and experience in disaster engineering activities. The program is proposed on the premise of provision of such experts and organizations, as shown in Table R4.4.2.

Table R.4.4.2 Capacity Development Program of Disaster Engineering

Items	Contents
A. .Duration of the Program	5 years
B. Composition of the Program	
1. Preparation Stage – Recognition of the current situation by the lecturers, Capacity building of disaster management of CoES, Preparation of the textbook	(2 years) Required experts: Disaster engineers, Geologist, Hydrologist, Seismologist - Site investigation and collection of information to understand the situations. - Preparation of textbooks - Conduct of seminars on the situations/site investigation/ evaluation
2. Lecturing Stage – Lecturing for the counterparts and Cultivate the lectures for local governments	(2 years) Required experts: Disaster engineers, Geologist, Hydrologist - On-the-job training for the counterparts on site investigation and evaluation - Conduct of seminars/training to nurture the CoES experts/ the local trainers to disseminate the disaster engineering/management
3. Evaluation Stage – Dissemination by persons who take the lecture stage to the local governments	(1 year) Required experts (persons who take the lecturing stage): disaster engineers - Conduct of on-the-job-training, seminars, training by the CoES experts/the local trainers to the personnel of the local government
C. Output	- Risk maps of natural disasters (floods, landslides, debris flows, mud flows and earthquakes) - Textbooks for disaster engineering - Textbooks for communal disaster management
D. Input from the Supporting Organizations	- Experts - Computers & accessories with necessary software - Equipments for survey, measurement and monitoring - Interpreters - Vehicles Cost: 4 million USD
E. Input from CoES	- Counterpart personnel/trainees - Office spaces - Office equipment

4.4.5 Establishment of Advisory Commission on Natural Disaster Management

Considering the challenges of coordination mentioned in the previous items 3.3.2.7), it is proposed to establish the Advisory Commission on Natural Disaster Management (ACNDM) in order to advise the Chairman of the CoES on the implementation of natural disaster management in Tajikistan.

The purposes of ACNDM are as follows:

1) To advise CoES on the following issues from the viewpoint of the respective specialties according to the mandates of the organization concerned:

   - Development of the national disaster management plan and the guidelines for the local governments and the organization concerned.

- Activities of CoES on the implementation of disaster management in the national level as well as in the local level.
- Monitoring, analysis and evaluation of the natural disaster phenomena and countermeasures.

2) To provide CoES with the information and data on the natural disaster phenomena.

The advisory commission is proposed to be chaired by CoES and composed of the organizations concerned according to their mandate, as shown in Table R.4.4.3.

Table R.4.4.3 Proposed Members of Advisory Commission for National Disaster Management for CoES

Category	Mandate	Organization
Research Institutes	Meteorology and Hydrology	Hydrometeorology Agency
	Geology	State Department of Geology
	Seismology	State Institute of Seismology
	Land Use and Topography	State Agency of Land Management, Geodesy and Cartography
Implementation Organizations	Flood Prevention in Hamadoni District	Ministry of Melioration and Water Resources
	Disaster Recovery in Agriculture; Water Rights Control	Ministry of Agriculture and Nature Protection
	Disaster Recovery in Transportation and Communication	Ministry of Transportation and Communication
	Disaster Recovery in Industrial Production	Ministry of Industries and Trade
	Disaster Recovery in Health	Ministry of Health
	Disaster Education	Ministry of Education
	Disaster Recovery in Hydropower Generation	Ministry of Energy

4.4.6 Establishment of Pyanj River Coordination Committee

In order to achieve the challenges of international coordination on the Pyanj River, the Study Team proposes to establish the Pyanj River Coordination Committee to give the occasion for mutual communication. One of the most important issues for such coordination is the border issue between Tajikistan and Afghanistan but the commission is proposed to focus on the technical matters, which are hydro-meteorological observation and analysis, environment, watershed management, water quantity and quality control, and river management for disaster management. The organizations concerned with the technical matters should be involved. Fig. R.4.4.4 shows the organization chart for the proposed Pyanj River Coordination Committee.

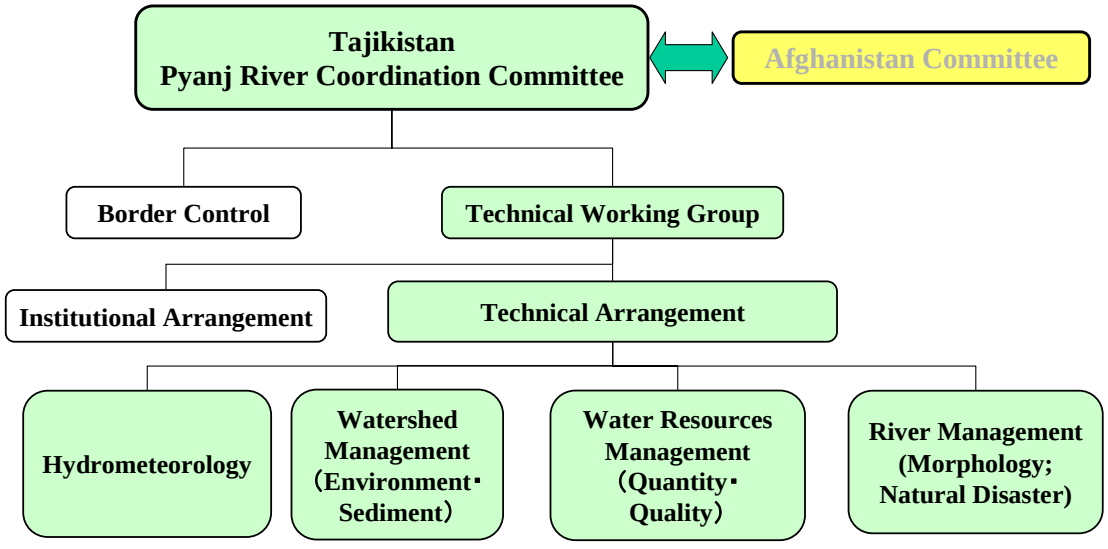


Fig. R.4.4.4 Organizational Chart of Proposed Pyanj River Coordination Committee

4.5 QUANTITY AND ECONOMIC EVALUATION FOR THE PROPOSED MASTER PLAN

4.5.1 Quantity

Quantities of the Short Term and Medium-Long Term plans are as summarized in Table R.4.5.1.

Table R.4.5.1 Summary of Quantities of Short Term Plan and Medium-Long Term Plan

Structural Measures				
Construction Works			Quantity	
			MLP including STP portion	STP
Main Dike	Total Length		18.3 km	6.1 km
	Dike	Dike - New construction	1.5 km	-
		Heightening	10.3 km	4.3 km
	Spur-dike (L=40m)		6.0km (39 locations)	3.1 km (21 locations)
	Revetment	Concrete Blocks	11.5 km	6.1 km
		Riprap	5.6 km	-
	Foot Protection (B=2m)		11.5 km	6.1 km
Intake Canal Guide Dike	Total Length		1.0 km	-
	Dike (Heightening)		1.0 km	-
	Spur-dike		1.0 km(7 locations)	
	Revetment (Concrete Blocks)		1.0 km	
	Foot Protection (B=2m)		1.0 km	
Spillway Guide Dike	Total Length		1.6 km	1.0 km
	Dike (Heightening)		1.6 km	1.0 km
	Spur-dike (L=40m)		1.6 km(10 locations)	1.0 km (7 locations)
	Revetment (Concrete Blocks)		1.6 km	1.0 km
	Foot Protection (B=2m)		1.6 km	1.0 km
Non-Structural Measures (Immediate Action Plan)				
Items		Specifications	No. of Units	No. of Units
Communication Tool for Communal Disaster Management		VHF Radios/Handy Silents		1 set
Water Level Gauge and HF Radios for Communal Disaster Management		Water level gauge/HF Radio		1set
		Staff gauge		1 set
Equipment for Flood Fighting Activity		Construction Equipment	1 set	

MLP: Medium-Long Term Plan, STP: Short Term Plan

4.5.2 Economic Evaluation

In this item is described that the procedure, outcomes of the processing, and the result of the economic evaluation of the Master Plan.

1) Method of Estimation of Project Benefits

In general, a project is evaluated taking engineering, economic and/or financial aspects into consideration. The engineering aspects are studied as part of the study on technical reliability from the viewpoint of construction, operation and maintenance.

The economic evaluation procedures for flood mitigation projects are as follows:

- Evaluate each damage item.
- Estimate unit value per unit area (amount/ha).

- Estimate most likely damages of the adopted flood.
- Estimate annual average flood damage by means of probability analysis.
- Estimate the benefit due to the project under the "With-" and "Without-Project" situations.
- Compare benefit with the cost.
- Evaluate the project's feasibility by means of some indices such as economic internal rate of return (EIRR), net present value (NPV), and Benefit-Cost Ratio (B/C).

2) Estimation of Flood Damage

The Study Team had conducted a flood damage survey on the area affected by the 2005 flood in Hamadoni District. The damages have been categorized into four items, as follows:

a) Damage to houses and households.

b) Damage to agricultural products of household plots or kitchen gardens, which are usually less than 0.15 ha including house lots.

c) Damage to agricultural products of the Dehkan farms, which have been established as collective farms reorganized from Sovkhoz and Kholvoz after Tajikistan became independent from the Soviet Union. The damage in this category is divided into two kinds based on the cause of damage, as follows:

- Damages caused by direct hit to the fields.
- Damages caused by interruption of irrigation water supply.

d) Damage to infrastructure and additional cost required for first-aid and evacuation.

Results of the flood damage survey are as summarized in Table R.4.5.2.

Table R.4.5.2 Unit Flood Damage

(TJS/ha)

Description	Damages to Houses and Household Movables incl. Agricultural Tools			Damages to Products in House-hold Plot	Damages to Cotton			Damages to Vine-yard	Damages to Agricultural Products Other Than Cotton and Grape in Vine-Yard	Damages to Social Infra-structure Together with Additional Cost for First-Aid and Evacuation
	Totally Destroy-ed Houses	Partially Destroy-ed Houses	Inundat-ed Houses		Damages to Cotton Due to Direct Hit by Flood in **Hamadoni**	Damages to Cotton in **Hamadoni** Caused by Lack of Irrigation Water	Damages to Cotton in **Farkhor** Caused by Lack of Irrigation Water			
Unit Amount of Damages	802,147	490,443	303,420	1,171	4,070	2,042	662	2,400	1,171	64.35%

In the case of damage to social infrastructure and the additional cost for first-aid and evacuation indicated in the table above, both damages and savings on public structures and the cost of back-up goods, supplies and services for evacuation activities are included as percentage of the total direct damage caused by the 2005 flood.

The rate of 64.35% during the 2005 flood is quite high. For the economic evaluation, the rate of damage to social infrastructure including public structures is assumed to be 10% based on the value for similar projects in developing countries from the conservative point of view.

3) Identification of Economic Benefit

Economic flood control benefit is defined as damage reduction brought by the Project. To define the flood control benefit, a probability analysis has been made to clarify the annual average flood damage due to the designed flood scale.

At first, the inundation areas by the probable flood scale in each return period were estimated and the results are as summarized in Table R.4.5.3:

Table R.4.5.3 Summary of Inundated Area by Probable Flood Scale

(ha)

Returtn Period	Irrigated Agricultural Area									Built-Up Area		
		Cotton Field				Vine-yard	Field for Other Vegetables			Inundatede Area		
	Total	Sub-Total	Wash-ed Out Area	Inundat-ed Area	Influenc-ed Cotton Field for Irrigation Water	Wash-ed Out Area	Sub-Total	Wash-ed Out Area	Inundat-ed Area	Total	Floor Area of Houses in Total	House-hold Kitchen Garden (HH Plot)
5-year	2,559.22	1,589.11	158.70	1,430.41	1,458.33	48.39	921.72	123.46	798.26	52.60	3.00	49.60
10-year	2,733.25	1,703.16	171.95	1,531.21	1,364.76	50.37	979.73	132.90	846.83	54.57	3.11	51.46
20-year	7,639.00	4,595.23	246.90	4,348.33	1,479.99	135.88	2,907.89	233.80	2,674.09	118.18	6.74	111.44
30-year	7,702.47	4,635.13	249.11	4,386.02	1,665.06	136.35	2,930.99	235.35	2,695.64	120.15	6.85	113.30
50-year	7,863.99	4,736.60	252.77	4,483.83	2,060.30	137.47	2,989.92	238.15	2,751.77	121.50	6.93	114.57
100-year	8,093.18	4,873.83	255.64	4,618.19	1,973.94	148.87	3,070.48	241.79	2,828.69	123.01	7.02	115.99

Using the area inundated by the probable flood scale in each return period indicated in the table above and the unit amount of damage in each damageable item indicated in Table R.4.5.2, the probable flood damages were calculated and the results are as shown in Table R.4.5.4.

Table R.4.5.4 Summary of Probable Flood Damage in Each Return Period

(1,000 TJS)

Description	Damages to Houses and Household Movables incl. Agricultural Tools			Damages to Crops in Household Plot	Damages to Cotton			Damages to Vineyard	Damages to Agri-cultural Products Other Than Cotton and Grape in Vine-yard	Damages to Social Infra-structure	Grand Total
	Totally Destroy-ed Houses	Partially Destroy-ed Houses	Inundat-ed Houses		Damages to Cotton Due to Direct Hit by Flood in **Hamadoni**	Damages to Cotton in **Hamadoni** Caused by Lack of Irrigation Water	Damages to Cotton in **Farkhor** Caused by Lack of Irrigation Water				
5-Year Flood	578	338	483		6,467	2,978	13,737				
Amount of Counted Damages:			483	58	Total of the above:		23,183	116	1,079	2,492	27,411
10-Year Flood	600	351	501		6,932	2,787	13,737				
Amount of Counted Damages:			501	60	Total of the above:		23,456	121	1,147	2,528	27,813
20-Year Flood	1,299	759	1,084		18,702	3,023	13,737				
Amount of Counted Damages:			2,168	130	Total of the above:		35,461	326	3,405	4,149	45,640
30-Year Flood	1,321	772	1,102		18,864	3,400	13,737				
Amount of Counted Damages:			2,221	133	Total of the above:		36,002	327	3,432	4,211	46,326
50-Year Flood	1,336	781	1,115		19,277	4,208	13,737				
Amount of Counted Damages:			2,257	134	Total of the above:		37,222	330	3,501	4,344	47,788
100-Year Flood	1,352	790	1,128		19,836	4,031	13,737				
Amount of Counted Damages:			2,297	136	Total of the above:		37,604	357	3,595	4,399	48,388

4) Identified Economic Cost

The following tables (Table R.4.5.5, Table R.4.5.6) give a summary of the estimation process from financial cost to economic cost. The former shows the components of project cost, and the latter shows the annual disbursement schedule of the Project Cost. These Project Costs are to be allocated annually, as shown in Table R.4.5.6 and Table R.4.5.7.

Table R.4.5.5 Summary of Estimation Process of Economic Cost of Project

(1,000 TJS)

Description	Total Cost in Short Term			Total Cost in Medium/ Long Term			Grand Total of All the Terms		
	LC	FC	Total	LC	FC	Total	LC	FC	Total
Cost for Civil Works	54,373	8,959	63,332	66,059	12,652	78,711	120,433	21,611	142,043
Engineering Fee (Cost for Consulting Services)	1,183	5,916	7,099	1,462	6,364	7,827	2,645	12,281	14,926
Administration Cost	580	0	580	525	0	525	1,106	0	1,106
Physical Contingency	1,061	237	1,298	1,402	350	1,752	2,463	587	3,050
Value Added Tax (VAT)	13,282	0	13,282	17,888	0	17,888	31,170	0	31,170
Sub-Total (Net Financial Project Cost)	70,479	15,112	85,591	87,337	19,366	106,703	157,816	34,478	192,294
Price Contingency	9,362	157	9,519	18,173	211	18,384	27,535	368	27,903
Financial Cost in Total (Incl. Price Contingency)	79,841	15,269	95,110	105,510	19,578	125,087	185,351	34,846	220,197
Economic Cost in Total	89,203	15,425	104,628	84,432	19,046	103,478	173,635	34,471	208,106

LC: Local Currency; FC: Foreign Currency

Table R.4.5.6 Annual Disbursement Schedule of Project Cost (Short Term Works)

(1,000 TJS)

Description	Grand Total	Short Term Works					
		2009	2010	2011	2012	2013	Total
Financial Cost							
Excluding Price Contingency	192,294	3,294	2,826	23,843	23,843	31,785	85,591
Including Price Contingency	220,197	3,490	2,987	26,332	26,560	35,741	95,110
Economic Cost (excl.Price Contingency)	172,834	3,088	2,637	19,091	19,091	25,449	69,356

Table R.4.5.7 Annual Disbursement Schedule of Project Cost (Medium-Long Term Works, excluding Short Term Works)

(1,000 TJS)

Description	Medium/Long Term Works						
	2014	2015	2016	2017	2018	2019	Total
Financial Cost							
Excluding Price Contingency	1,903	20,960	20,960	20,960	20,960	20,960	106,703
Including Price Contingency	1,977	24,008	24,288	24,594	24,928	25,293	125,087
Economic Cost (excl.Price Contingency)	1,755	19,374	19,816	20,300	20,828	21,406	103,478

5) Economic Evaluation

Economic evaluation for the Project was made by using a cash stream. The results are as summarized in Table R.4.5.8.

Table R.4.5.8 Results of Economic Evaluation of the Project
(Medium-Long Term Works, including Short Term Works)

Description	Short Term Works	Medium/ Long Term Works
NPV	40,199	11,072
EIRR	18.41%	11.59%
B/C Ratio	2.01	1.14

The condition of economic feasibility with regard to EIRR has been definitely determined, but the general requirement widely employed by international funding institutions for projects of similar nature is that EIRR should be 8-10%. In addition, B/C should be over 1.

Therefore, the works proposed in the Master Plan are feasible on the economic aspect. The short term works, especially, have relatively high economic effects, which suggest that the implementation and completion of the short term works taken from the total project works that include the medium-long term works would draw much benefit.

4.5.3 Environment Impact Assessment

1) Requirement of EIA

Institutional arrangements for environmental impact assessment in Tajikistan are provided under some laws, as described in the Section 1.4. According to these laws, strategic plans like the Master Plan are exempted from the application of EIA. There are 19 kinds of projects whose structural measures could be subjected to the EIA requirement. However, the structural measures of the river dike project proposed under the Master Plan are not included in the 19 kinds of projects stipulated by the law.

In addition, the non-structural measures in the Master Plan are also exempted from the application of the law. Therefore, the projects proposed by the Master Plan are not required to undergo EIA in Tajikistan.

However, the Study Team has been required to collect the information related to impacts on environment and society, prepare the draft scoping in consultation with the Government of Tajikistan and hold stakeholders' meetings. Considering those conditions, the Study Team had conducted a simple environmental impact assessment on the structural measures proposed by the Master Plan in accordance with the requirement on structural measures under the law. The details of the assessment and the result of that as well as the result of stakeholder meeting are summarized in the sector seven (7) of the supporting report.

2) Result of Simple EIA

a) Outline

The structural measures proposed by the Master Plan are only the works to restore and improve the existing dike in Hamadoni District which will induce little impact to the environment. The results of the hydraulic analysis conducted by the Study Team suggest that the flow condition of the Pyanj River does not change as long as the location of the existing dike does not change. In addition, it is estimated that the construction works would induce minimal adverse impacts to environment and society because there are very few houses and infrastructures in the project site and the surrounding areas.

Therefore, the result of the simple EIA indicates that the structural measures proposed by the Master Plan will induce only minimal adverse impacts to the project site and the local community in particular.

However, although the adverse impacts on the degree of flood risk of Afghanistan side are considered negligible because of keeping the existing dike alignment unchanged in the Master Plan, the implementation of the structural measures proposed in the Master Plan should be carried out after the detailed study on the possibility of the adverse impacts on Afghanistan side by the structural measures.

b) Alternatives

The four alternatives compared in Subsection 4.2.3 are provided based on the plan to restore and improve the existing dike so that they have little adverse impact to the environment. Therefore, the result of the environmental impact assessment does not affect the results of the study on alternatives.

c) Stakeholders' Meetings

The Study Team twice supported CoES in holding the stakeholders' meetings during the Study period. The first meeting was on how to proceed with the Study and the second was on the Master Plan with purposes of information disclosure and reflection of residents' comments to the planning of countermeasures. From the results of the meetings, it was confirmed that the Master Plan is accepted by the governmental organizations and communities concerned.

CHAPTER 5. PRIORITIZED PROJECT AND RECOMMENDATION

5.1 PRIORITIZED PROJECT

The residents and cotton field in Hamadoni District have been protected by dike constructed since 1950s from flooding of the Pyanj River. That is to say, residents' lives and cotton production have not gone along without the dike for more than half a century. In addition, the river course of the Pyanj River has been coming closer to Hamadoni District than the previous location. Therefore, the importance of dike is growing more than ever.

On the other hand, dike has potential to be destroyed by erosion as the 2005 flood had proved. One of the possible countermeasures to protect the dike from such erosions is to urgently restore it by first-aid actions, or flood fighting activities.

In addition, the communities have to arrange preparedness against flooding in case of dike broken. Governmental organizations and officials are required for enhancement and development of their capacities of engineering and management to arrange preparedness against flooding disaster effectively. Improvement of such capacities should work for the other natural disasters.

Rescue works are also urgent requirement for human lives once flooding disaster happened but also other natural disasters.

Among the components of the proposed Master Plan and Supporting Plan, the JICA Study Team recommends giving priority to the following components or projects, considering the effects on economic development and the urgent necessity of measures against flooding and other natural disasters:

1. Structural Measures against Flooding:

    The Project for Urgent Dike Restoration Works in Hamadoni District

2. Non-Structural Measures against Flooding:

    Enhancement of Communal Disaster Management in Hamadoni District; and

    Enhancement of Capacity for Flood Fighting in Hamadoni District

3. Countermeasure for Natural Disasters:

    Enhancement of Capacity for Disaster Management of CoES

    Enhancement of Capacity for Rescue Center of CoES

These recommendations are as explained below.

5.1.1 Structural Measures against Flooding

The Project for Urgent Dike Restoration Works in Hamadoni District is urgently required, and the utilization of funds to be provided from international financial institutions has been confirmed by the Study Team to be advantageous for the following reasons:

- The existing dike was eroded by flood flow in 2007. The erosion will continuously develop in the succeeding years and bring more serious damages to Hamadoni District.
- Project implementation would ensure the provision and enhancement of safety against flooding in Hamadoni District.
- The project has enough economic viability for international funding.

5.1.2 Non-Structural Measures against Flooding

1) Project for Enhancement of Capacity for Communal Disaster Management in Hamadoni District

The *Project for Enhancement of Capacity for Communal Disaster Management in Hamadoni District* consists of several components, as summarized in Table R.5.1.1.

Table R.5.1.1 Components of the Project of Enhancement of Capacity for Communal Disaster Management in Hamadoni District

Components	Project or Activity	Contents
Information Management	Buildup of Information Management	- Activation of Emergency Situation Commission. - Participation of MMWR in the Emergency Situation Commission and the monitoring of floods and dikes.
	Facility Plan of Information Collection System	- Restoration of Khirmanjo Gauging Station. - Buildup of Staff Gauge in Chubek.
Preparedness	Enhancement of Organization	Participation of MMWR in the Emergency Situation Commission
	Utilization and Maintenance of Hazard-Risk Maps	Utilization and improvement of the hazard-risk maps provided by the Study Team.
Guidance of Evacuation	Utilization of Criteria of Warning Level	Utilization and improvement of the warning criteria provided by the Study Team.
	Enhancement of Dissemination of Warning	Utilization of the Information Network and Mutual Assistance System provided by the Study Team, and its maintenance and improvement by the Emergency Situation Commission and CoES
	Improvement of Evacuation Method	Maintenance of evacuation drill, mutual assistance system and evacuation guidance by the Emergency Situation Commission and CoES

2) Project of Enhancement of Capacity for Flood Fighting in Hamadoni District

The *Project for Enhancement of Capacity for Flood Fighting in Hamadoni District* is composed of the flood fighting system presented by Fig.R.4.3.6 and the provision of the machinery and equipment presented by Table R.4.3.8.

5.1.3 Countermeasures for Natural Disasters

1) Project of Enhancement of Capacity for Disaster Management of CoES

The *Project of Enhancement of Capacity for Disaster Management of CoES* consists of several components aiming to heighten the capacity of the CoES organization and its officials. A summary of the Plan is given in Table R.5.1.2.

Table R.5.1.2 Summary of the Project of Enhancement of Capacity for Disaster Management of CoES

Components	Projects or Activities	Contents
Enhancement of Organizational Capacity for Disaster Management of CoES	- Enhancement of preparedness capacity - Enhancement of planning capacity - Enhancement of public relations capacity	- Enhancement of the leading capacity of local government offices - Enhancement of the capacity to research and evaluate natural disasters -Enhancement of public understanding of the National Disaster Management
Enhancement of Capacity for Disaster Engineering and Management of CoES	Enhancement of Engineering Capacity of officials to boost the organizational capacity	5year-Program
Establishment of Advisory Commission on Natural Disaster Management	Enhancement of capacity for disaster management and coordination.	-CoES receives advices on the disaster management from the Commission. -CoES also receives the information from the member organizations of the Commission on the natural disasters.

2) Project of Enhancement of Capacity for Rescue Center of CoES

The *Project of Enhancement of Capacity for Rescue Center of CoES* is recommended to enhance the rescue capacity of the Rescue Center of CoES, because its personnel are well trained and their skills on rescue work are very high but rescue gears and materials are lacking. Therefore, provision of the required gears and materials would ensure the efficiency of rescue work. The required gears and materials are as shown in Table R 4.4.1.

5.2 RECOMMENDATIONS

The JICA Study Team recommends the following based on the results of the Study and its knowledge on disaster management.

5.2.1 Structural Measures against Floods in Hamadoni District

1) Implementation of Detailed Design for the Project of Restoration Works of the Pyanj River Dike in Hamadoni District

The Study Team recommends *The Project for Urgent Dike Restoration Works in Hamadoni District* as the prioritized project. In the Study, only the basic design was prepared using satellite data on the assumption that the authorities concerned has recognized this project as the project to be implemented with funds provided from international financial institutions.

In this connection, the Study Team makes some additional recommendations on project implementation, as follows:

(1) A detailed design to increase the accuracy of structural dimensions given by the basic design should be carried out in accordance with the basic design introduced in the Master Plan.

(2) A topographic survey on the scale of 1/2000 should be conducted to provide detailed information for the preparation of detail designs.

(3) Coordination and agreement with Afghanistan regarding the problems on preparatory works such as the diversion works should be concluded before the start of project works to keep enough work periods.

(4) The contracting procedure should be done keeping transparency according to international rules.

(5) The project contractors should submit construction plans and construction records to the project owners as required to ensure quality and quantity control.

2) Monitoring and Maintenance of River Structures

The Study Team recommends the following with respect to the monitoring and maintenance of river structures:

(1) MMWR, as the administrator of river structures, should provide a monitoring team to monitor the situations of flood and dikes, and inform or instruct the organization concerned to take the necessary countermeasures, as follows:

- Hamadoni District Emergency Situation Commission: The Commission should decide on the necessary countermeasure such as evacuation consultation with CoES and MMWR after receiving the current situation report from the monitoring team in the site.
- MMWR: The MMWR should maintain the river structures properly and provide the monitoring team or watchmen to report the current situation or condition of the flood and the dike to MMWR.

(2) MMWR should maintain the river structures properly, referring to the Maintenance Manual that has been provided by the Study Team.

5.2.2 Non-Structural Measures against Flood in Hamadoni District

1) Implementation of Communal Disaster Management

For the communal disaster management in Hamadoni District, the Study Team recommends as follows:

(1) One of the most critical challenges to the communal disaster management in Hamadoni District is the collection of information on the current situation of the flood and the dikes. Hence, the Study Team had recommended the provision of a monitoring team in the preceding Subsection 6.2.1. In addition to that, the Study Team also recommends that MMWR should participate in the Emergency Situation Commission in Hamadoni District to provide advices on the risks of flooding.

(2) Another important challenge is the utilization and improvement of the hazard-risk maps provided by the Study Team. The Commission should decide on the necessary countermeasures based on the current situation report, the hazard-risk maps and consultation with CoES and MMWR. Therefore, the maps should be regularly updated with the latest information from the residents and the organizations concerned.

(3) Establishment of Evacuation Information Network is also important task for the communal disaster management of Hamadoni District. As mentioned in the previous item 4.3.1, the Commission of Emergency Situations of Hamadoni District should utilize the evacuation information networks and mutual assistance system provided by the Study Team,

2) Implementation of Flood Fighting Activity

For the flood fighting activity, the Study Team recommends that MMWR, as the administrator of river structures, should carry out monitoring and maintenance, as well as immediate restoration works against serious damages on dikes, in cooperation with CoES according to the capacity on restoration works in the Hamadoni area such as the capacity of the military unit of CoES.

5.2.3 Necessity of Watershed Management Plan

The Study Team had proposed the framework of the Integrated Pyanj River Management Plan in CHAPTER 3 and it recognizes the necessity of watershed management but only proposes its framework plan. Therefore, the Study Team recommends the continuation of the basic study on forestation, vegetation and soil characteristics in the watershed, as mentioned in Subsection 3.1.1.

5.2.4 Natural Disaster Management

1) Establishment of Advisory Commission on Natural Disaster Management

CoES has been taking a very important role in national disaster management in Tajikistan. Since there are various kinds of natural phenomena, CoES is required to coordinate the wide range of expertise of the other organizations involved. In this regard, the Study Team recommends the establishment of the Advisory Commission on Natural Disaster Management, as mentioned in Subsection 3.3.2

2) Enhancement of Capacity for Observation, Analysis and Forecasting of Natural Phenomena

The Study Team proposes the plan for enhancement of capacity in several fields as the framework plan of Pyanj River Management. Among them, the Study Team recommends the enhancement of the most basic field and urgent challenge; namely, the enhancement of capacity for observation, analysis and forecasting of natural phenomena.

The organizations involved in this field are as follows:

(1) Hydrometeorology Agency

(2) Institute of Geology

(3) Institute of Seismology

The Study Team also recommends that the government and international cooperation organizations involved should focus on the enhancement of their capacities, as follows:

(1) Promotion of restoration of the existing observation facilities and of required new facilities;

(2) Promotion of compilation and analysis of existing data and information accumulated in their records;

(3) Enhancement of capacity on the forecasting of natural disasters; and

(4) Fostering and training of researchers and observers.