The Republic of Tajikistan
Ministry of Energy and Industry

DATA COLLECTION SURVEY ON THE INSTALLMENT OF SMALL HYDROPOWER STATIONS FOR THE COMMUNITIES OF KHATLON OBLAST IN THE REPUBLIC OF TAJIKISTAN

FINAL REPORT

September 2012

Japan International Cooperation Agency

NEWJEC Inc.

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CR (1)
12-005

Data Collection Survey on the Installment of Small Hydropower Stations for the Communities of Khatlon Oblast in the Republic of Tajikistan

FINAL REPORT

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Abbreviations

ADB	Asian Development Bank
EIA	Environmental Impact Assessment
GDP	Gross Domestic Product
GNI	Gross National Income
GPS	Global Positioning System
GRT	Government of Republic of Tajikistan
HPS	Hydro Power Station
IDB	Islamic Development Bank
IEA	International Energy Agency
IMF	International Monetary Fund
IUCN	International Union for Conservation of Nature and Natural Resources
JICA	Japan International Cooperation Agency
MEDT	Ministry of Economic Development and Trade
MEI	Ministry of Energy and Industry
MLRWR	Ministry of Land Reclamation and Water Resource
MHP	Mini Hydro Power
NDS	National Development Strategy
OJSHC	Open Joint Stock Holding Company
PPA	Power Purchase Agreement
SEE	State Ecological Expertise
TPES	Total Primary Energy Supply
UNDP	United Nations Development Programme
USGS	United States Geological Survey
WB	World Bank

SUMMARY

SUMMARY

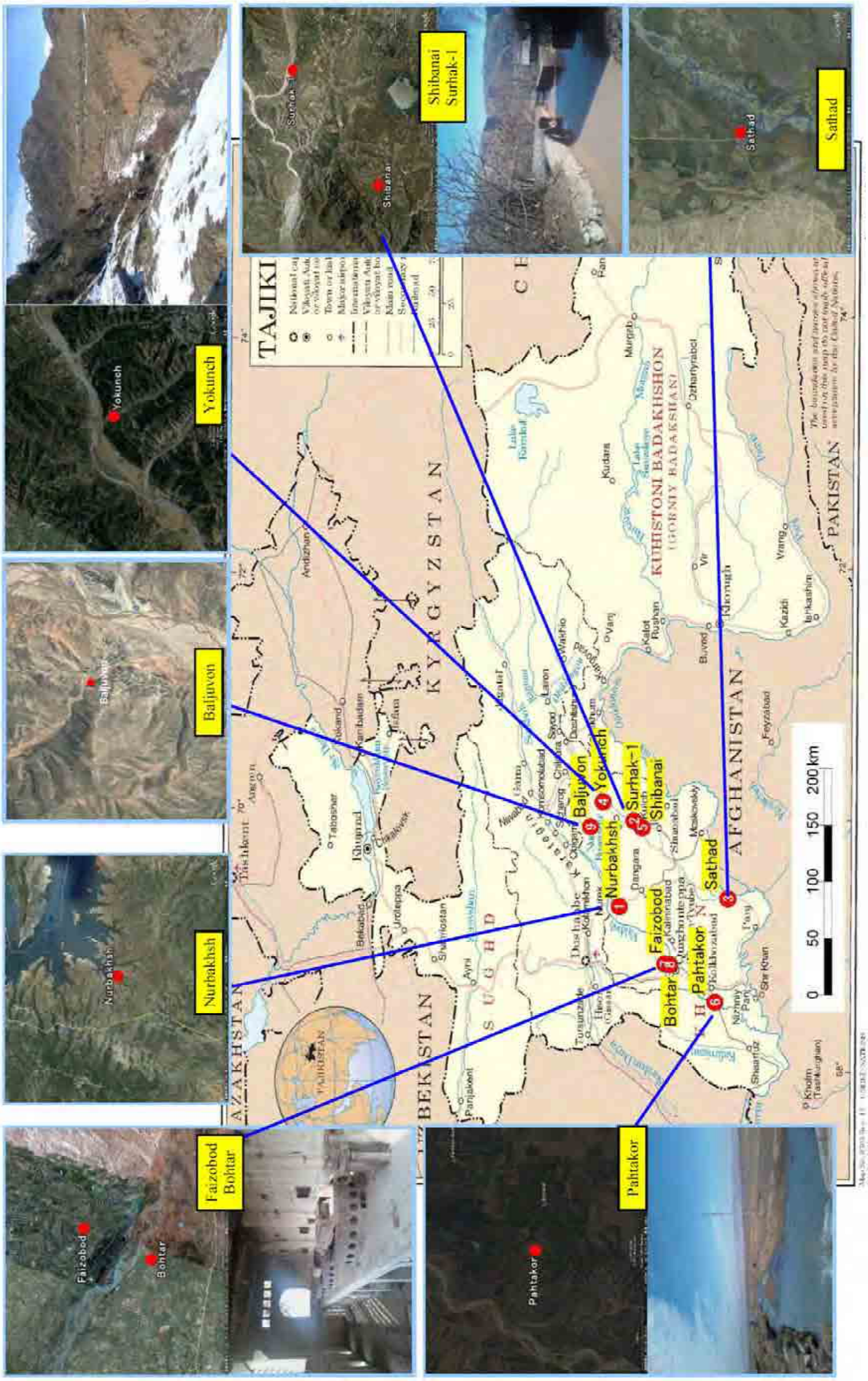
1. Objectives of the Study

This Study shall be implemented on small hydropower generation project in Tajikistan. In this Study, necessary information for examination of effective cooperation method and implementation of JICA cooperation project formation in the future, will be collected and analyzed for acknowledgment of the latest trend of the power sector in Tajikistan based on confirmation of the demand for a small hydropower generation project in Khatlon that has the higher poverty index among the provinces.

1) Need for implementation of the project will be confirmed in consideration of issues of the power sector and other related sectors, situations of power supply and demand in Tajikistan, social and environmental situation in Khatlon, and activities of other donors in Tajikistan.

2) Based on the above, feasibility of projects in the candidate sites will be studied for effective assistance to establish priorities, realize the prior project, and arrange the project components including prospective issues and considerations.

The location map of the sites is shown in Fig.1.1



Source : Map : United Nation HP (http://www.un.org.)
Photo: JICA report "Research 2011"

Fig.1.1 Location Map of the Potential Sites

2. Power Development Plan (1st Screening)

Promising sites out of the nine (9) candidates were selected based on the results of the 2nd site survey.

2.1 Consideration of Power Discharge

(1) Collection on Hydrological Data

Hydrological data of nine hydropower potential sites will be collected. Potential sites are classified into two types, sites using natural rivers (Yokunch and Baljuvon) and artificial canals (Nurbakhsh, Surhak-1, Sathad, Shibanai, Pakhtakor, Faizobod and Bohtar). Hydrological data is essential factor for power generation plan such as power discharge, annual power generation, plant factor and so on. Therefore it is important to ensure the reliability of the data by using various documents.

Meanwhile, it is difficult to collect reliable hydrological data in Tajikistan due to lack of observation stations, aging facilities and inadequacy of operation record of intake weirs. As discharge data of artificial canals is particularly unavailable, discharge is estimated by site surveys, relevant data and interviews at the 1st screening stage.

(2) Decision of Power Discharge

Decision of power discharge at the 1st screening stage is based on discharge during winter season (minimum discharge) when power shortage occurs. If there is no water during winter, discharge during summer is used.

Power discharge of each site is decided as follows;

- Interviews with persons in charge of water resource department of local governments (water use (irrigation, drinking water and domestic use), gate operation and annual fluctuation of discharge)
- Interviews with local residents (discharge in winter and flood water level)
- Engineering Judgment by site survey of river and canal situation such as width, depth and velocity
- In the case of natural river, more than 10% of minimum discharge is reserved for maintenance flow discharge

2.2 Power Generation Plan

The power output is estimated by using power discharge and head. The power discharge is estimated as described in Chapter 2.1 and the head is done based on the measurement at site. The head means the effective head and the power output is estimated with the following formula.

$$\textit{Power Output (P)} = \textit{Maximum Power Discharge(Q)} \times \textit{Head (m)} \times 10 \times 0.8$$

The estimated power output is summarized in Table 2.1.

Table 2.1 Salient Features of Each Site based on Results of Site Survey

Item			1	2	3	4	5	6	7	8	8' (Option)	9
			Nurbakhsh	Surhak-1	Sathad	Yokunch	Shibanai	Pahtakor	Faizobod	Bohtar	Bohtar	Peshtova-2
Rayon (District)			Dangara	Muminabad	Farhor	Khovaling	Temurmalik	Jilikul	Jomi	Bohtar	Bohtar	Baljuvon
Jamoat (Village)			Okhsu	Marhok	Baridom	Yokunch	Shibanai	Kuibeshe	Faizobod	Ges	Ges	Peshtova
River	Type of Water Source		Water Use Canal	Natural River	Irrigation Canal	Natural River	Irrigation Canal	Irrigation Canal	Irrigation Canal	Irrigation Canal	Irrigation Canal	Natural River
River	River/Canal		Dangara Canal	Chashma Canal	Sulho Canal	Yokunch River	Shibanai Canal	Kaiganobod Canal	Shorobod Canal	Canal from Golovnoy Dam (PK25)	Canal from Golovnoy Dam (PK25)	River
River	Main River		Vakhsh	Yakhsu	Pyanj	Yakhsu	Kizilsu	Vahksh	Vakhsh	Vakhsh	Vakhsh	Kizilsu
River	Discharge (m^3/s)	Winter	10.5	1.0	1.5	2.5	0.6	2.5	3.0	N/A	N/A	N/A
River	Discharge (m^3/s)	Winter	1.0	0.8	0.0	*4.0	0.5	1.0	1.0	0.0	10.0	N/A
River	Discharge (m^3/s)	Summer	60.0	2.5	7.0	4.0	1.5	7.0	16.0	N/A	N/A	N/A
River	Discharge (m^3/s)	Summer	1.5	0.5	1.0	*3.0	0.06 - 0.08	1.0	6.0 - 10.0	10.0	10.0	N/A
Power Plan	Power output (kW)		5,285	170	120	500	42	150	180	1,201	1,201	320
Power Plan	Power output (kW)		400	26	28	432	16	24	24	0	240	220*
Power Plan	Effective Head (m)		50.3	15.0	8.0	20.0	7.0	6.0	6.0	4.0	4.0	N/A
Power Plan	Effective Head (m)		50.0	4.0	3.5	20.0	4.0	3.0	3.0	3.0	3.0	N/A
Power Plan	Power Discharge (m^3/s)		12.6	1.2	1.8	3.0	0.7	3.0	3.6	36.0	36.0	N/A
Power Plan	Power Discharge (m^3/s)		1.0	0.8	1.0	2.7	0.5	1.0	1.0	0.0	10.0	N/A
Distance to Demand Area (km)			2.6	0.7	0.1	5.0	0.1	0.1	0.1	0.1	0.1	-
Beneficial Target	Population (people)		2,000	1,400	500	2,500	1,600	20,000	1,000	1,200	1,200	-
Beneficial Target	Household		400	200	51	400	178	4,000	100	120	120	-
Beneficial Target	Hospital / Clinic (place)		0/1	0/1	1/0	0/1	0/1	1/1	0/1	1/0	1/0	-
Beneficial Target	Educational organization (place)		1	1	1	2	1	1	1	1	1	-
Structure Planning	Intake weir		–	–	–	–	–	–	–	–	–	N/A
Structure Planning	Intake weir		Not Necessary	Not Necessary	Not Necessary	New Construction (85m)	New Construction (400m)	New Construction (4.5m)	New Construction (7m)	Not Necessary	Not Necessary	N/A
Structure Planning	Intake			New construction	–	Repair of existing intake	–	–	–	–	–	N/A
Structure Planning	Intake		New Construction	Not Necessary	New Construction	New Construction	New Construction	New Construction	New Construction	Included in Powerhouse	Included in Powerhouse	N/A
Structure Planning	Conduit		–	Repair of existing conduit 500m	–	Repair of existing conduit 1200m	–	–	–	–	–	N/A
Structure Planning	Conduit		Not Necessary	Concrete Canal (550m)	Not Necessary	New Construction (800m)	Not Necessary	Not Necessary	Not Necessary	Included in Powerhouse	Included in Powerhouse	N/A
Structure Planning	Headtank		–	New construction	New construction	New construction	New construction	New construction	New construction	–	–	N/A
Structure Planning	Headtank		New Construction	New Construction	New Construction	New Construction	New Construction	New Construction	New Construction	Not Necessary	Not Necessary	N/A
Structure Planning	Spillway		–	New construction	–	–	–	–	–	–	–	N/A
Structure Planning	Spillway		Not Necessary	New Construction	Not Necessary	New Construction	Not Necessary	Not Necessary	Not Necessary	Not Necessary	Not Necessary	N/A
Structure Planning	Penstock		–	New construction	New construction	New construction	New construction	New construction	New construction	–	–	N/A
Structure Planning	Penstock		New Construction (485m)	New Construction	New Construction	New Construction	New Construction	New Construction	New Construction	Not Necessary	Not Necessary	N/A
Structure Planning	Powerhouse		Existing underground facility owned by Ministry of Land Reclamation and Water Resources can be utilized.	New construction	New construction	New construction	New construction	New construction	New construction Generator, turbine×2 units)	Repair of small hydroelectric powerhouse constructed before	Repair of small hydroelectric powerhouse constructed before	N/A
Structure Planning	Powerhouse		New Construction	New Construction	New Construction	New Construction	New Construction	New Construction	New Construction	New Construction	New Construction	N/A
Structure Planning	Outlet		–	–	–	–	–	–	–	–	–	N/A
Structure Planning	Outlet		New Construction	New Construction	New Construction	New Construction	New Construction	New Construction	New Construction	New Construction	New Construction	N/A
Structure Planning	Other Works		Slope Protection at Penstock	Access Road to Powerhouse		Access Road and Bridge	Slope Protection at Channel		River Bank Protection Work	Demolition of Existing P/H	Demolition of Existing P/H	N/A
Structure Planning	Other Works		Foundation Improvement Works	Slope Protection		Slope Protection				River Protection Works	River Protection Works	
Access	Distance from District Center (km)	Intake	10.0	8.4	11.8	23.2	6.0	2.3	9.1	28.8	28.8	N/A
Access	Distance from District Center (km)	P/H	11.2	-	-	-	-	-	-	-	-	
Access	Length of Unpaved Road (km)	Intake	0.4	3.6	1.0	21.0	3.0	0.2	1.5	0.1	0.1	N/A
Access	Length of Unpaved Road (km)	P/H	0.5	-	-	-	-	-	-	-	-	
Barriers					Close to Afghanistan Border and the Site is in the Military Zone	Landslide Potential Area	Landslide and Flood Potential Area	No water in winter season		No water in winter season		No access from Dec. to May

Yellow Character means the revised plan based on the Study.

Source : Research, Application Form, Plan 2009-2020

2.3 Environmental and Social Considerations

Document survey, site survey, and interview for residents were conducted on the natural and social environment of candidate sites based on the following criteria. The risk of each candidate sites is shown in Table 2.2.

- National parks, protected areas
- Habitats of threatened species
- Natural disaster (volcano, landslide, strong earthquake zone, etc.)
- Resettlement, land acquisition, etc.
- Ethnic minorities and indigenous peoples
- Accessibility (flood)
- Electrification
- Needs of residents

Following impacts brought by small hydro power development at each candidate sites are predicted based on the situation of natural and social environment (Table 2.3).

Table 2.2 Risk of Candidate Sites

Project		Rayon (District)	Jamoat (Village)	Protected area	Threatened species (source: red list of Tajikistan)	Threatened species (souece:hearing at the site)	Volcano / landslide / earthquake zone	Ressetlement	Indigenous people	Accessibility (Flood)	Electrification
1	Nurbakhsh	Dangara	Okhsu	-	-	-	-	-	-	-	○
2	Surhak-1	Muminabad	Marhok	Childuhtaron species management area (10km from the site)	Markhor	Brown bear	Landslide	-	-	-	○
3	Sathad	Farhor	Baridom	Karatau species management area (5km from the site)	Goitred gazelle	-	-	-	-	-	○
4	Yokunch	Khovaling	Yokunch	Childuhtaron species management area (5km from the site)	Markhor	Brown bear, Bukhara red deer	Landslide	-	-	Difficulty in access during heavy snow and rain season	○ (Village has been electrified since April, 2012.)
5	Shibanai	Temurmalik	Shibanai	-	-	-	-	-	-	-	○
6	Pahtakor	Jilikul	Kuibeshe	Tigrovaya Balka strict nature reserve (1km from the site)	Bukhara red deer	-	-	-	-	-	○
7	Faizobod	Jomi	Faizobod	-	-	-	-	-	-	-	○
8	Bohtar	Bohtar	Ges	-	-	-	-	-	-	-	○
9	Baljuvon	Baljuvon	Peshtova	-	Brown bear	-	N/A	N/A	N/A	No access by mobile between December to May	○

Table 2.3 Environmental Impact Prediction

Item		1 Nurbakhsh	2 Surhak-1	3 Sathad	4 Yokunch	5 Shibanai	6 Pahtakor	7 Faizobod	8 Bohtar	9 Baljuvon
Rayon (District)		Dangara	Muminabad	Farhor	Khovaling	Temurmalik	Jilikul	Jomi	Bohtar	Baljuvon
Jamoat (Village)		Okhsu	Marhok	Baridom	Yokunch	Shibanai	Kuibeshe	Faizobod	Ges	Peshtova
natural environment	During construction	○	△	○	×	○	○	○	○	-
	remarks		• Noise and vibration of transport and construction. • Impact on vegetation such as wet land and natural grassland.		• Noise and vibration of transport and construction. • Impact on the vegetation for construction of access road.					-
	During operation	○	○	○	×	○	○	○	○	-
	remarks				• Impact on aquatic organisms because of dam up and reduction of water.					
social environment	During construction	△	○	×	○	×	○	×	×	-
	remarks	Brick factory near the site.		Residence is adjacent to the site.		Residence is adjacent to the site.		Residence is adjacent to the site.	Residence is adjacent to the site.	-
	During operation	◎	◎	◎	◎	◎	◎	◎	◎	-
Total Evaluation		◎	◎	○	△	○	◎	○	○	-

◎: positive impact
○: neutral impact
△: a little negative impact
×: negative impact

2.4 Criteria to Select Promising Sites

According to information from MEI, on thirty nine (39) candidate sites for small hydropower development in Khatlon Province, MEI has no documents to exemplify the selection results and the criteria to prioritize is also uncertain. Barki Tojik studied these small hydropower potential sites. It is considered the criteria that 1) large amount of water is secured throughout the year, 2) electricity of objective areas is not provided yet or shortage, and 3) accessibility to site is good.

JICA Study Team recommends the following criteria as high priority ones:

Effect of Benefit	having greater effects of benefit by electricity supply
Development Plan	not less than 100kW in power output and 5m in head
Power Facility Plan	having no potential hazards in landslide, volcano, earthquake, etc, at site for construction of power plant
Water Flow Condition	having stable discharge throughout the year
Accessibility	easy access to site, and located within 10km from demand areas
Environmental and Social Considerations	location without protected areas or natural parks where development activities are prohibited, and no resettlement

2.5 Result of Preliminary Evaluation

First of all, discussing the effect of benefit, all of the villages around sites are facing the shortage of electricity in winter season when electricity is provided only in a few hours, therefore the villagers are expecting the small hydropower development.

In light of development plan, namely expected power output (P), the three (3) sites, such as the Nurbakhsh site (P: 400kW), Yokunch site (P: 500kW), and Bohtar site (P: 240kW, in case of Qmax is 10.0m^3/sec on the basis of summer water flow), are able to have those capacities of more than 100kW.

The other five (5) sites are expected to have the capacities of less than 50kW only.

Baljuvon site could not be visited in 2nd site survey due to high water level of the Kizilsu River. The access road is the river course on the right side and an approach to the access road is close by a bridge on the Kizilsu River, and the bridge is located about 1km from the district center of Baljuvon District. From the viewpoint of accessibility, it is regarded that the priority is low.

Since a mountain road of 21km long, which is the only access to Yokunch site from the district center, is unpaved and in bad conditions, the improvement works of the road are required. In addition, the area from the intake weir to the powerhouse is situated in a landslide potential area, this situation implies that the project is in higher risk. Accordingly, it is regarded that the priority of Yokunch site among three (3) sites of more than 100kW is lower.
Since some amount of water to be used in Nurbakhsh power plant is utilized for drinking water, it is expected that water discharge of at least 1.0m^3/sec can be used for power generation through the year. In the future, the possibility of additional intake water should be discussed. Accordingly, it is regarded that the development risks of Nurbakhsh site are low.

The development risks in Bohtar site are low, except securing power discharge. There has been no water in the canal on in winter season, so far. Further studies to identify how much water can be ensured for power generation in winter are required.

Based on the above mentioned criteria, the superior Nurbakhsh and Bohtar sites among all of the nine (9) candidate sites for development are compared in Table 2.4. The preliminary results were explained to vise chairman of Khatlon Province at Khatlon provincial government on 24th of April, 2012 and MEI and Barki Tojik at Dushanbe in April, 2012. The evaluation results prepared by the Study Team were appreciated.

Table 2.4 Evaluation Results of Nurbakhsh and and Bohtar Sites

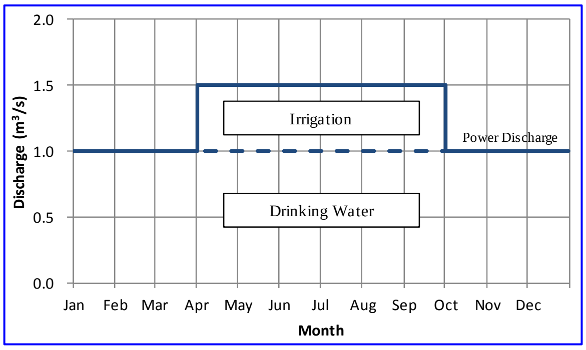
Criteria / Site		Nurbakhsh	Bohtar
Effect of Benefit	Having greater effects of benefit by electricity supply (Number of Beneficial household and public facilities such as hospital, etc.))	Beneficial household: 400 Clinic: 1 School: 1	Beneficial household: 120 Clinic: 1 School: 1
Development Plan	Not less than 100kW in power output	400kW	240kW
	Not less than 5m in head	50.0m	3.0m
	Location within 10km from main demand area	2.6km	0.1km
Power Facility Plan	Having no potential hazards in landslide, volcano, earthquake, etc	Possible landslide potential in the penstock route	None
Water Flow Condition	Having stable discharge throughout the year	Summer Season: 1.5 m^3/s Winter Season: 1.0 m^3/s Since the water is for irrigation and drinking water, the water can be secured in winter season.	Summer Season: 10.0 m^3/s Winter Season: 0.0 m^{ab}/s Since the water is for irrigation only, there are no water in the canal in winter season
	Utilizing water for power generation (Not to require coordination with water utilization for irrigation)	Water amount of 1.0m^3/sec for power generation is secured, on the other hand coordination with related organizations is required to ensure additional water amount.	Coordination with related organizations is required to ensure water amount in winter.
Accessibility	Easy access to site and to be able to transport heavy equipment	Good accessibility	Good accessibility
Environmental and Social Consideration	Location without protected area or natural park in which development activities are prohibited	Not applicable	Not applicable
	Not to involve resettlement	Not applicable	Not applicable
	No requirement for land acquisition or no difficulty in land acquisition	Not applicable	Land acquisition is necessary because the development site is privately owned
	No existing facilities or no difficulty in demolition of existing facilities	Two (2) existing pipes have been installed in the area between intake and outlet. These pipes are to be utilized after launching operation of the power plant, the ground reinforcement works, etc. are required.	The existing power plant was constructed in the former soviet union years, the demolishment works are expected to be easy.

3. Outline of Promising Site

3.1 Nurbakhsh Site (No.1)

(1) Power Generation Plan

The planned power generation of Nurbakhsh site utilizes the water for irrigation and domestic use which is conveyed from Nurek dam and the head between the distribution weir and the canal. The objective canal is supplying the irrigation and domestic use and its actual annual water utilization pattern is shown below.



Power Output	:	400 kW
Maximum Power Discharge	:	1.0 m^3/s
Effective Head	:	50.0 m
Beneficial Targets	:	Household: 400, Clinic: 1, School: 1

Maximum power discharge is planned as 1.0 m^3/s for winter season when power shortage occurs. The effective head is set at 50.0m based on the result of simple measurement at site.

Fig. 3.1 Annual Water Utilization Pattern at Nurbakhsh Site

(2) Power Facility Plan

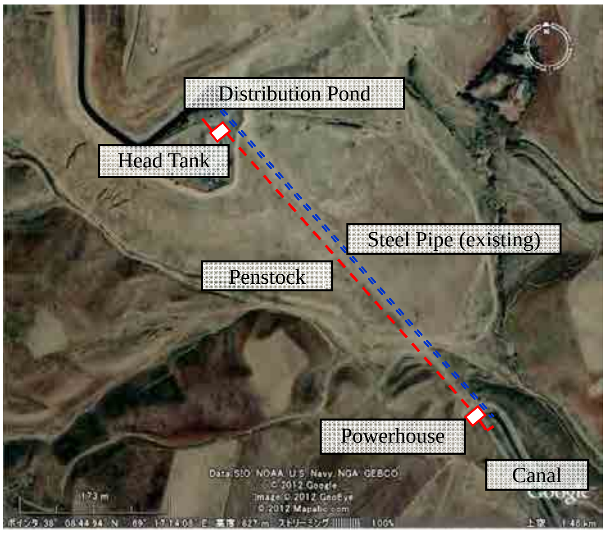


Fig. 3.2 Layout Plan of Plant Facilities

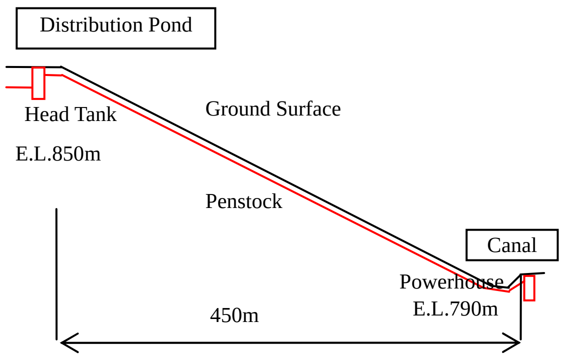


Fig. 3.3 Section of Plant Facilities

Intake	: Connect between the existing distribution pond and the head tank
Head Tank	: Install in the vicinity of the existing distribution pond
Penstock	: Install in the ground along with the existing buried pipes
Powerhouse	: Install in the vicinity of the existing outlet
Outlet	: Connection between the powerhouse and the existing canal

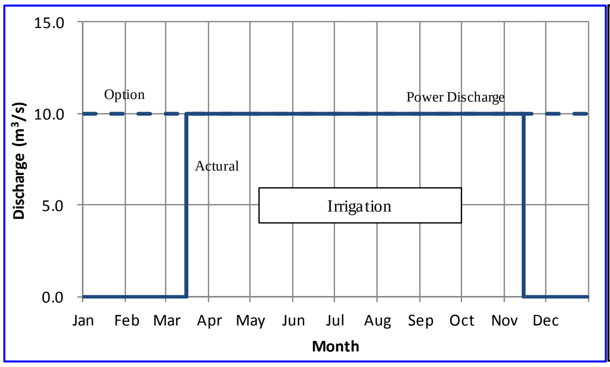
Substation and Transmission/ Distribution Facilities

As for the other works, the consolidation works of the ground and the slope protection works on the penstock route are expected.

3.2 Bohtar Site (No.8)

(1) Power Generation Plan

The planned power generation of Bohtar site utilizes the water for irrigation and domestic use which is conveyed and distributed from Golovnaya dam and the head between upstream and downstream of powerhouse. There is the existing power plant, constructed in the Soviet years, however it has not been operated now.



Power Output	:240 kW
Maximum Power Discharge	:10.0 m^3/s
Effective Head	:3.0 m
Beneficial Targets	:Household: 120, Clinic: 1, School: 1

Maximum power discharge is decided as 10.0m^3/s of summer's water intake. Meanwhile, based on the results of the interview survey, the same and more of the power discharge even in the winter season can be possible. The effective head is set at 3.0m based on the simple measurement result at site.

Fig. 3.4 Annual Water Utilization Pattern at Bohtar Site

(2) Power Facility Plan

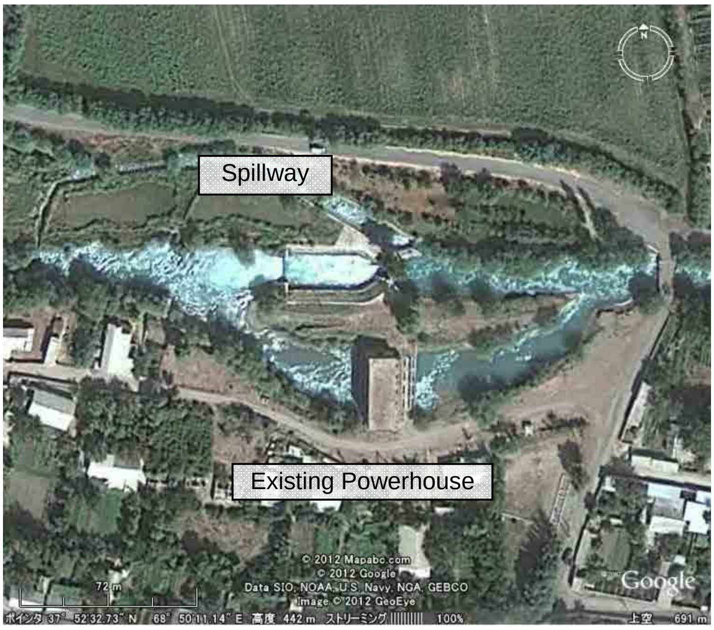


Fig.3.5 Location Map

Intake	:Install an intake gate integrated with the powerhouse building
Powerhouse	:Demolish the existing power plant then re-construct a new power plant
Outlet	:Install an outlet gate integrated with the powerhouse building
Substation and Transmission/ Distribution Facilities	

As for the other works, demolition of the existing plant, river bank protection works and modification of the spillway are expected.

4. Conclusion

In this Study, the third survey was planned to be implemented for a month in December 2012 to confirm potential site conditions in winter season and finalize the evaluation of them.

However, the scope of works of this Study was determined to be modified in the interim report meeting. As described in Chapter 3, Nurbakhsh and Bohtar are abstracted as the promising sites for further development. The Nurbakhsh site was selected as the most preferable sites for the JICA cooperation project formation in the future. The further study for the project formation of JICA granted scheme will be taken over to “PREPARATORY SURVEY FOR THE PROJECT OF MICRO-HYDROELECTRIC POWER GENERATION IN KHATLON PROVINCE IN THE REPUBLIC OF TAJIKISTAN”.

CHAPTER 1

PREFACE

CHAPTER 1 PREFACE

1.1 OBJECTIVES AND SCOPE OF THE STUDY

(1) Background of the Project

Republic of Tajikistan (hereinafter "Tajikistan") is the landlocked country located in the Pamir mountains in the Central Asia having a land area of 143 thousand km^2 and population of 7.1 million. Tajikistan achieved independence on account of collapse of the Soviet Union in December 1991, and after the civil war between the government and the antigovernment force occurred in 1992, it reached the final peace agreement in June 1997 through the intermediation of the United Nations. As the civil war ended, the government of Tajikistan established "National Development Strategy (NDS)" to set up a long-term goal, priority, and policy in social and economic development from 2006 to 2015 for recovery and development of devastated society and economy. Furthermore, "Poverty Reduction Strategy Papers" was drafted as the mid-term measures for NDS with the aim of fulfilling social and economic prosperity of the citizens based on the principles of market economy, and the third-term (2010 to 2012) is in operation at present. As a part of this "Poverty Reduction Strategy Papers", it goes for poverty reduction in the rural area of Khatlon province by improving of energy infrastructure as the countermeasure against emigration of labors to foreign countries because of low income and shortage of working opportunities.

Tajikistan has been keeping economic growth of 8.6% annually since 2000, and the electricity power demand has been increasing according to the population increase from 5.25 million in 1990 to 7.1 million in 2010. However, capacity of power generation is decreased compared with that in the time of independence from the Soviet Union, and Tajikistan has to depend on electricity imported from neighboring countries because of tight supply in the country.

In the age of former Soviet Union, the Central Asia Power System (CAPS) was planned and constructed for efficient distribution of electricity by system interconnection among the Central Asian countries such as Uzbekistan, Kazakhstan, Kyrgyzstan, and Turkmenistan including Tajikistan. After the collapse of the Soviet Union, however, it becomes difficult to keep the power demand supply balance among the countries and supply the power efficiently because of seasonal shortage and other troubles caused by own independent operation of each country. For example, in Tajikistan, 97.8% of total power generation is supplied by hydropower and the power demand increases especially in winter, but Tajikistan own control is difficult to acquire consensus of other countries because it may cause a flood in winter or water shortage for irrigation in summer.

Power shortage is a very serious problem in rural area because of population increase and economic upward movement as well as in metropolitan area. Especially in winter, electricity is supplied only for 4 to 6 hours a day on average, and it impedes economic activation in rural area. Therefore, the government of Tajikistan focuses on small hydropower generation as a method to secure electricity for rural area. Encouragement of installing small hydropower facilities is defined as one of the main goals in the NDS mentioned the above, and the Ministry of Energy and Industry (MEI) has been promoting installation of 189 small hydropower stations by 2020 according to the Presidential Decree No. 73 (Active promotion for installation of small hydropower facilities) announced in February 2009. In fact, however, less than one third of proposed sites has been developed on track only because of the fund shortage of the government or the National Power Utility Company of Tajikistan (Barki Tojik). Therefore, installation of small hydropower facilities is counted as one of the major activities of the energy sector in the

Donor Coordination Council, and importance of cooperation for this field is highly recognized by the donors.

Small hydropower is one of the superior alternatives to solve the problem of power shortage in rural area because of lower initial investment cost, shorter construction period, and less environmental impact compared with large-scale hydropower. Therefore, JICA plans to implement this Study to collect basic information and confirm about potential hydropower in Tajikistan in order to examine assistance for a small hydropower project by Grant-Aid. JICA assume that a Grant-Aid project to be reviewed in this Study will be implemented in Khatlon Province mostly organized by agricultural communities. In Khatlon poverty index is higher than that of other provinces, therefore JICA grant assistance is also provided significantly to other fields of health, economic infrastructure, agriculture, etc.

(2) Objectives of the Study

This Study shall be implemented on small hydropower generation project in Tajikistan. In this Study, necessary information for examination of effective cooperation method and implementation of JICA cooperation project formation in the future, will be collected and analyzed for acknowledgment of the latest trend of the power sector in Tajikistan based on confirmation of the demand for a small hydropower generation project in Khatlon that has the higher poverty index among the provinces.

1) Need for implementation of the project will be confirmed in consideration of issues of the power sector and other related sectors, situations of power supply and demand in Tajikistan, social and environmental situation in Khatlon, and activities of other donors in Tajikistan.

2) Based on the above, feasibility of projects in the candidate sites will be studied for effective assistance to establish priorities, realize the prior project, and arrange the project components including prospective issues and considerations.

1.2 ARRANGEMENT OF SMALL HYDROPOWER POTENTIAL SITES

The former report of “Research on Small Hydropower of the Republic of Tajikistan, 2011” (hereinafter “Research 2011”), shall be reviewed to understand the outline of potential sites selected by the local consultant before preparation of the basic policy of this Study.

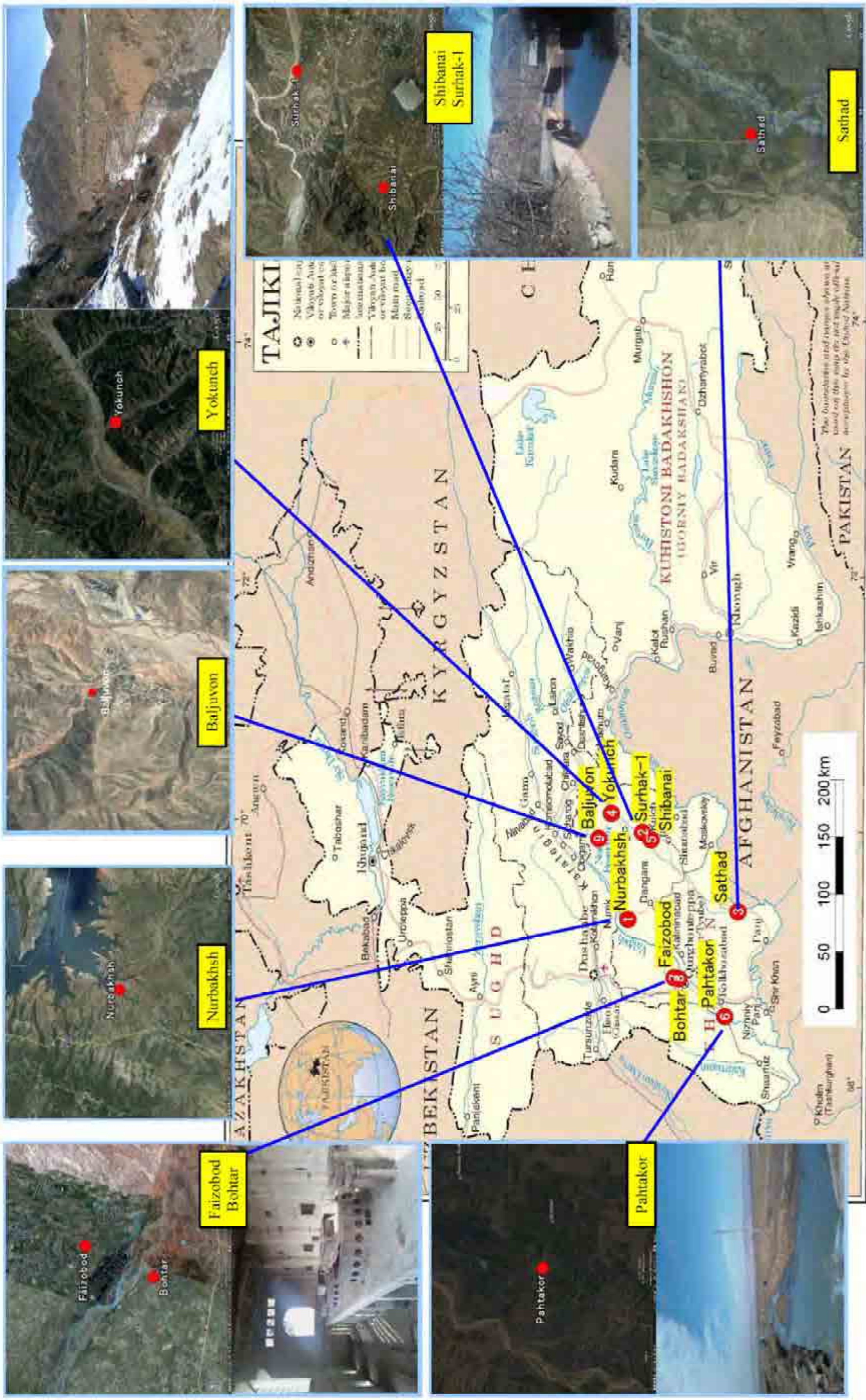
(1) Outline of the potential sites

Seven (7) sites, so called four (4) sites proposed in the application form of Tajikistan and three (3) sites in the vicinity of the four sites, have been selected for this Study among all nine (9) candidate sites as shown in Table 1.2-1. On the other hand, in “Research 2011”, thirty three (33) sites in Khatlon have been ranked according to evaluation criteria such as gross head, power output, etc. after scrutinizing the planned small hydropower generation project for forty nine (49) sites, and finally eight (8) sites has been selected as the candidate for the project. Baljuvon has not been selected in “Research 2011” although it is involved in the former seven (7) candidate sites (as one of three sites in the vicinity).

The location map of the sites is shown in Fig.1.2-1 and basic information of nine (9) sites is shown in Table 1.2-2. Characteristics of these potential sites are also shown in Table 1.2-3.

Table 1.2-1 Candidate Sites for the Study of a Small Hydropower Project

No.	Facility (Province)	Target site for this study	Application proposed by Tajikistan	Target site for local study	Reason for the Study
1	Dangara	◎	○	○	This site is included in the application form.
2	Muminabad	◎	○	○	This site is included in the application form.
3	Farhor	◎	-	○	This site should be studied because of the location in the vicinity province of the site included in the application form.
4	Khovaling	◎	○	○	This site is included in the application form.
5	Temurmalik	◎	-	○	This site should be studied because of the location in the vicinity province of the site included in the application form.
6	Jilkul	×	-	○	The study is not required because electricity issue can be solved after starting operation of the large power generation facility currently under construction.
7	Jomi	×	-	○	The study is not required because electricity issue can be solved after starting operation of the large power generation facility currently under construction.
8	Bohtar	◎	-	○	This site should be studied because of the location in the vicinity province of the site included in the application form.
9	Baljuvon	◎	○	-	This site is included in the application form. * not a target site for survey by the local consultant



Source : Map : United Nation HP (http://www.un.org.)
Photo: JICA report "Research 2011"

Fig. 1.2-1 Location Map of the Potential Sites

Table 1.2-2 Basic Information of the Potential Sites

Item			1	2	3	4	5	6	7	8	9
			Nurbakhsh	Surhak-1	Sathad	Yokunch	Shibanai	Pahtakor	Faizobod	Bohtar	Baljuvon
Province			Dangara	Muminabad	Farhor	Khovaling	Temurmalik	Jilikul	Jomi	Bohtar	Baljuvon
Location of hydropower station			Dangara irrigation channel	Surhak river right bank	Sathad discharge point of main channel	Yokunch river right bank	Yahsu river left bank of irrigation channel	Pahtakor discharge point of main channel	Shorobad main channel	Juibor irrigation channel	N/A
Power output (kW)			5,285	170	120	500	42	150	180	1,201	320
Elevation (m)			592	1224	437	1501	710	340	429	452	N/A
Gross head (m)			50.3	15	8	20	7	6	6	4	N/A
Max discharge (m/s^3)	Winter		10.5	1	1.5	2.5	0.6	2.5	3	N/A	N/A
	Summer		60	2.5	7	4	1.5	7	16	N/A	N/A
Water consumption (m^3/s)			12.6	1.2	1.8	3	0.7	3	3.6	36	N/A
Target	Population (people)		117,900	16,800	2,680	1,500	8,236	22,500	20,000	36,853	12000
	Hospital / Clinic (number)		60	12	1	2	9	6	10	12	1
	Educational Organization (number)		67	10	2	1	9	6	7	13	6
Facility Plan	Intake weir		–	–	–	–	–	–	–	–	N/A
	Intake		–	New construction	–	Repair of existing intake	–	–	–	–	N/A
	Conduit		–	Repair of existing conduit 500m	–	Repair of existing conduit 1200m	–	–	–	–	N/A
	Tank		–	New construction	New construction	New construction	New construction	New construction	New construction	–	N/A
	Spillway		–	New construction	–	–	–	–	–	–	N/A
	Penstock		–	New construction (Dia. 700mm, Length 50m)	New construction (Dia. 1000mm or less, Length 60m)	New construction (Dia. 1200mm or less, 40m(L), or Dia.700mm, 40m(L) × 2)	New construction (Dia. 500mm or less, Length 50m)	New construction (Dia. 1200mm or less, Length 60m)	New construction (Dia. 800mm or less, 200m(L) × 2)	–	N/A
	Hydropower station		Existing underground facility owned by Ministry of Land Reclamation and Water Resources can be utilized.	New construction	New construction	New construction	New construction	New construction	New construction (Generator, turbine × 2 units)	Repair of small hydropower station building constructed in the past	N/A
	Outlet		–	–	–	–	–	–	–	–	N/A

Source : JICA report "Research 2011", Application form of Tajikistan

Table 1.2-3 Characteristics of Potential Sites

Facility planning	➢ As for power output among nine (9) sites, the maximum is 5,285kW for Nurbakhsh and then 1,201kW for Bohtar, and less than 1,000 kW for other seven (7) sites. ➢ Six (6) sites (Nurbakhsh, Sathad, Shibanai, Pakhtakor, Faizobod, Bohtar) are hydropower stations utilizing irrigation facilities. Surhak-1, Yokunch is conduit type exclusively for power generation. Baljuvon is unknown. ➢ Five (5) sites (Sathad, Shibanai, Pakhtakor, Faizobod, Bohtar) are low head (less than 10m) hydropower stations. ➢ It has been proposed to use the existing facilities.
Hydrologic information	➢ As for flow rate ratio between summer and winter, the minimum is 18% for Nurbakhsh and the maximum is 63% for Yokunch. ➢ As for water consumption for power generation, 120% of discharge in winter is adopted. ➢ Water discharge is available stably for all sites. ➢ There is low possibility of conflict with other water usage.
Access and Environment	➢ Access to the sites is in good condition. ➢ There are no sites affected by the environmental impact risk

(2) A Few Potential Sites to be selected through Site Reconnaissance (in Summer).

The close communication among JICA Study Team, JICA and Tajikistan government is required for screening potential sites through frequent discussion. Work process to determine candidate sites by Grant-Aid after survey of potential sites is shown in Fig. 1.2-2.

A few potential sites will be selected in this Study if possible after the site reconnaissance is over (in summer). Then, the screening process for determining the candidate sites will be explained to the government of Tajikistan before the second or third survey is over, and to JICA in the interim report for consultation and exchange of opinions. Screening the candidates to a few sites will be effective to establish the survey policy for effective site survey (in winter), study the plan for candidate sites, and arrange the issues and considerations for Grant-Aid by concentrating on the implementation resources.

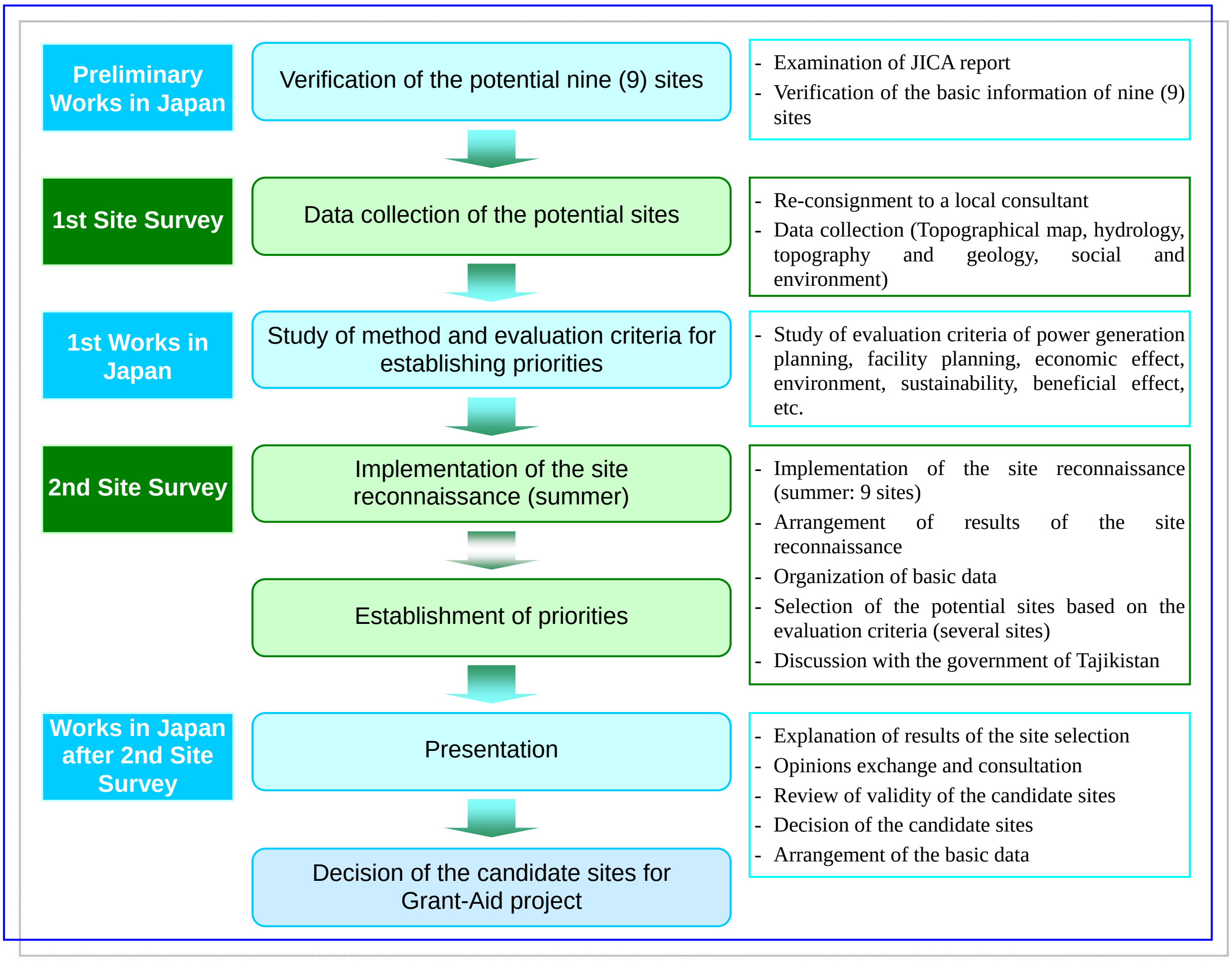


Fig. 1.2-2 Process of the Site Reconnaissance and Establishment of the Priorities

1.3 FLOWCHART OF THE STUDY IMPLEMENTATION

Candidates for small hydropower projects will be selected out of several potential sites in this Study to arrange the issues and considerations for Grant-Aid projects in the future. It is proposed that candidate sites are selected and the screening criteria are established by submission of the interim report to arrange the issues and considerations.

Flowchart of overall study is shown in Fig. 1.3-1.

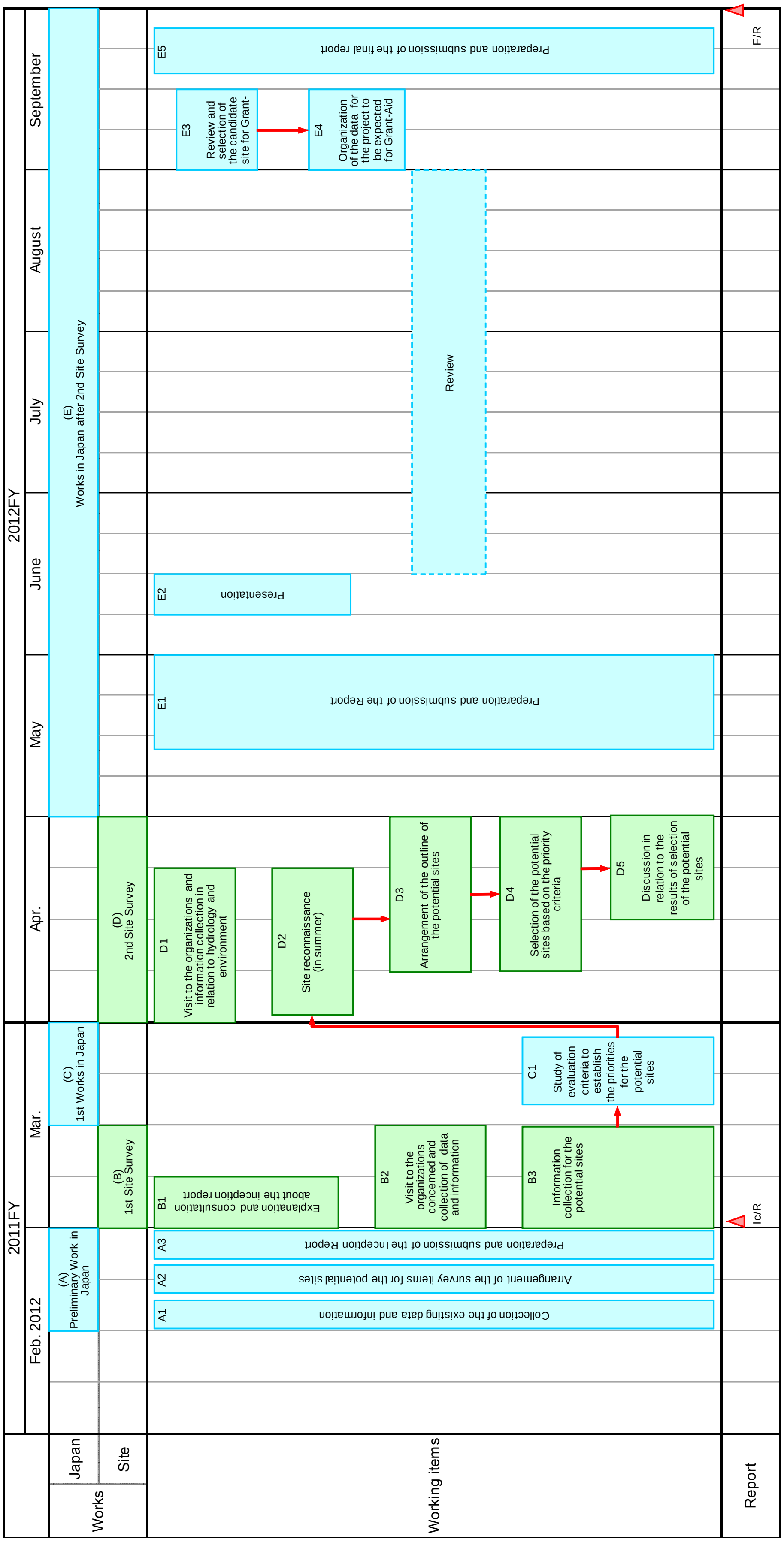


Fig. 1.3-1 Overall Study Flowchart

CHAPTER 2

OVERVIEW OF ENERGY SITUATION IN TAJIKISTAN

CHAPTER 2 OVERVIEW OF ENERGY SITUATION IN TAJIKISTAN

2.1 ECONOMIC ACTIVITIES AND ELECTRICITY

2.1.1 Social and Economic situation in Tajikistan [1]

(1) Current Situation

Republic of Tajikistan (hereinafter referred to as "Tajikistan") is a landlocked country in Central Asia surrounded by Afghanistan, Uzbekistan, Kyrgyzstan, and China. The total land area is 143,100 km^2, which corresponds to approximately 40% of Japan's land area. About 94% of the country is mountainous and half of mountains are highlands exceeding 3,000m in altitude. The population is 7.1 million, and Gross National Income (GNI) per capita is US$734 (International Monetary Fund (IMF), 2010). Tajikistan declared its independence in 1991 when Soviet Union collapsed. The economy growth tends to be slow in consequence of the civil war from 1992 to 1997 and frequent occurrence of natural disasters. Tajikistan is one of the poorest countries in the former Soviet Union as poverty group accounts for 83% of total population.

The capital city is Dushanbe and the ethnic groups consist of Tajik (79.9%), Uzbek (17.0%), Kyrgyz (1.3%), Russian (1.0%), and others (0.8%) (Statistical yearbook of Tajikistan). Official language is Tajik, which belongs to western Iranian language as well as Persian of Iran and Dari of Afghanistan, and standard language is northwestern dialects of Tajik which has been much influenced by Turkic languages such as Uzbek in its grammar and vocabularies. Russian is widely used as well.

Sunni Islam is the predominant religion among Tajik people. Ismailism, one of Shia Islam sects has many adherents in Pamir Mountains.

(2) Economy

Major industries are agriculture (cotton), production of aluminum, and hydropower generation. Gross Domestic Product (GDP) is US$ 5.64 billion (IMF, 2010), GDP per capita is US$ 733.86 (IMF, 2010), and the economy (Real GDP) growth rate is 6.5% (IMF, 2010) correspond to the price level increase. Unemployment rate is 2.3% (Statistics Agency, 2010).

As for international trade, export value is US$1.195 billion and import value is US$2.652 billion (Bureau of Customs, 2010). Main trade items are as follows (Statistical yearbook of Tajikistan):

1) Export Non-precious metal (mainly aluminum), textile and textile products (mainly cotton and cotton products), machinery/vehicles/equipment for transport, minerals, organic products, etc.
2) Import Minerals (mainly bauxite), machinery/vehicles/equipment for transport, chemical products, organic products, non-noble metals, processed foods, etc.

Main trade partners are as follows (Statistical yearbook of Tajikistan):

1) Export China, Turkey, Russia, Uzbekistan, Iran, Czech, Netherlands, etc.
2) Import Russia, Kazakhstan, China, Uzbekistan, Ukraine, UAE, Turkmenistan, Turkey, etc.

1 Website of Foreign Affairs of Japan: Republic of Tajikistan, http://www.mofa.go.jp/mofaj/area/tajikistan/data.html

2.1.2 Energy and Electricity[2]

(1) Overview of the Energy Situation in Tajikistan

Energy balance for Tajikistan in year 2009 (the last available year according to the data from International Energy Agency (IEA)) is presented in Table 2.1-1.

Table 2.1-1 Energy Balance for Tajikistan in Thousand Tons of Oil Equivalents on A Net Calorific Value Basis (2009)

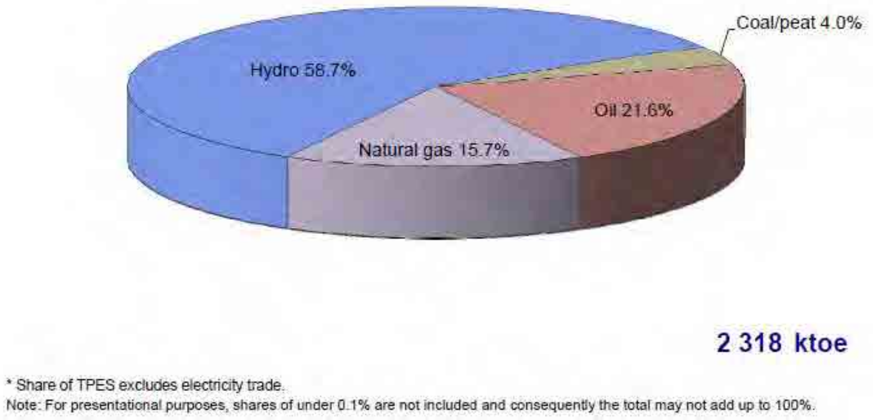
SUPPLY and CONSUMPTION	Coal and Peat	Crude Oil	Oil Products	Natural Gas	Nuclear	Hydro	Geothermal, Solar, etc.	Biofuels and Waste	Electricity	Heat	Total
Production	86	26	0	31	0	1359	0	0	0	0	1502
Imports	6	0	0	332	0	0	0	0	370	0	1210
Exports	0	-4	-20	0	0	0	0	0	-365	0	-389
International Marine Bunkers	0	0	0	0	0	0	0	0	0	0	0
International Aviation Bunkers	0	0	-4	0	0	0	0	0	0	0	-4
Stock Changes	0	0	0	0	0	0	0	0	0	0	0
TPES	92	22	478	363	0	1359	0	0	5	0	2318
Transfers	0	0	0	0	0	0	0	0	0	0	0
Statistical Differences	0	0	0	0	0	0	0	0	20	0	20
Electricity Plants	0	0	0	0	0	-1359	0	0	1359	0	0
CHP Plants	0	0	0	-214	0	0	0	0	28	86	-100
Heat Plants	0	0	0	0	0	0	0	0	0	0	0
Gas Works	0	0	0	0	0	0	0	0	0	0	0
Oil Refineries	0	-22	20	0	0	0	0	0	0	0	-2
Coal Transformation	0	0	0	0	0	0	0	0	0	0	0
Liquefaction Plants	0	0	0	0	0	0	0	0	0	0	0
Other Transformation	0	0	0	0	0	0	0	0	0	0	0
Energy Industry Own Use	0	0	0	0	0	0	0	0	-13	0	-13
Losses	0	0	0	0	0	0	0	0	-234	0	-234
TFC	92	0	497	149	0	0	0	0	1165	86	1989
Industry	0	0	0	0	0	0	0	0	529	0	529
Transport	0	0	83	11	0	0	0	0	2	0	96
Other	92	0	414	138	0	0	0	0	634	86	1363
Residential	0	0	0	0	0	0	0	0	254	0	254
Commercial and Public Services	0	0	0	0	0	0	0	0	25	0	25
Agriculture / Forestry	0	0	0	0	0	0	0	0	355	0	355
Fishing	0	0	0	0	0	0	0	0	0	0	0
Non-Specified	92	0	414	138	0	0	0	0	0	86	729
Non-Energy Use	0	0	1	0	0	0	0	0	0	0	1
- of which Petrochemical Feedstocks	0	0	0	0	0	0	0	0	0	0	0

Source: International Energy Agency (IEA)

2 United Nations Development Programme (UNDP) Tajikistan, Energy Efficiency Master Plan for Tajikistan, January 2011

1) Energy Supply

The share of Total Primary Energy Supply (TPES) in 2009 is presented in Fig.2.1-1.

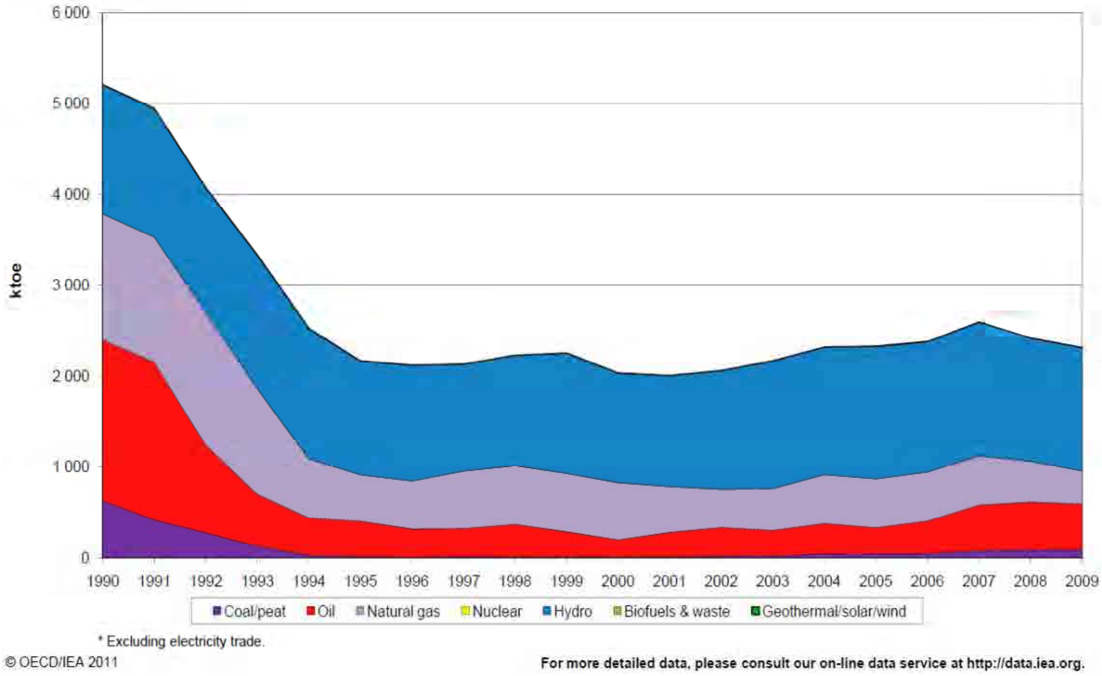


Source : IEA

Fig. 2.1-1 Share of Total Primary Energy Supply* in 2009

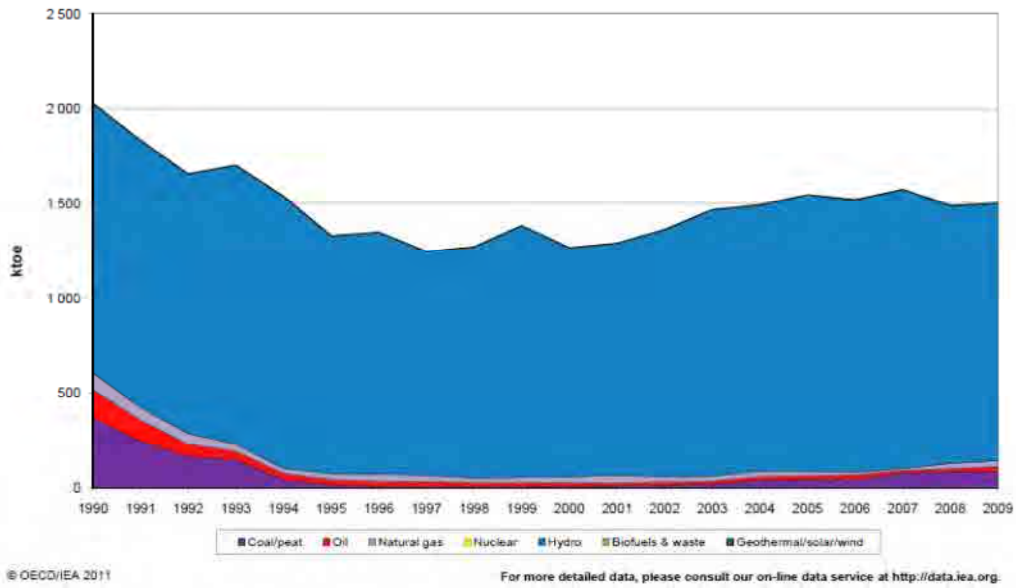
In Fig.2.1-2 and Fig.2.1-3, the historical changes of TRES and energy production in Tajikistan are depicted. The decrease of TPES is obvious, a consequence of a weakened economy after Soviet Union collapsed.

As seen from the country's energy balance, TPES is much higher than domestic energy production and there is a high level of dependency on imports – today, Tajikistan imports approximately 40% of its energy demand. This share is expected to rise, primarily as a consequence of increasing needs for petroleum products for transport.



Source : IEA

Fig. 2.1-2 Total Primary Energy Supply from 1990 until 2009



Source : IEA

Fig. 2.1-3 Energy Production from 1990 until 2009

It is evident that the majority of TPES derives from hydro power. The participation of coal is low, despite the proven reserves, which are much higher than the consumption. Until the 1990s, between 400 and 800 thousand tons of coal were mined annually in Tajikistan. In recent times, these figures have diminished to 15-20 thousand tons, less than 5-10% of the country's total energy demand. 40 coal deposits (Nazarailok, Shurab, Fan-Yagnob, etc.) have been explored and registered in the country. Coal deposits are sufficient in Tajikistan and amount to 4 billion tons; however, according to estimates, these deposits are insufficient for industrial and energy related use in the current conditions. Increased production and utilization possibilities of coal must be investigated and supported. Positive developments regarding the utilization of coal are already being made with the reconstruction of district heating plants in Dushanbe and other cities to switch from imported gas to domestic coal.

Domestic crude oil and natural gas participation in TPES is modest; research of these potentials has yet to be completed. Tajikistan possesses comparatively small amounts of these fossil fuel resources. In all, 18 oil and gas deposits (Kanibadam, Airitan, Niyazbek, Kichikbel, etc.) explored and registered in the country.

Evidently, Tajikistan is heavily dependent on hydro power, with about 98 % of the total electricity generated in Tajikistan originating from hydroelectric sources. Electricity and heat generation in Tajikistan are reported in Table 2.1-2. The key figure that shall be noted is electricity losses (16.7%). This is much higher than normal losses (approximately 6-8%); hence potential for efficiency improvements in this area are tremendous.

Electricity consumption in Tajikistan has not regained the level of 1992 although electricity demand has been slightly increased since 1997. Maximum load is 2,901MW (as of 2002, World Bank (WB)), annual energy production is 16,127 GWh, and final energy consumption in the country is 13,544 GWh in 2009. Power generation supply had covered the demand by 1999, but after that, the supply has been below the demand. The same situation can be seen in electricity trade. Electricity exports had exceeded imports by 1999, but after that, the export has been significantly decreased. In late years, Tajikistan is facing power shortage and cannot supply the electricity sufficiently for peak demand in winter. The aluminum plant accounts for approximately 30% of total electricity demand as only large industry in the country.

Table 2.1-2 Electricity and Heat Generation in Tajikistan in 2009

	Electricity	Heat		Electricity	Heat
	Unit: GWh	*Unit: TJ*		*Unit: GWh*	*Unit: TJ*
Production from:			**Domestic Supply**	**16184**	**3583**
- coal and peat	0	0	Statistical Differences	233	0
- oil	0	0	**Transformation****	**0**	**0**
- gas	327	3583	Electricity Plants	0	0
- biofuels	0	0	Heat Plants***	0	0
- waste	0	0	**Energy Industry Own Use******	**156**	**0**
- nuclear	0	0	Losses	2717	0
- hydro*	15800		**Final Consumption**	**13544**	**3583**
- geothermal	0	0	Industry	6146	0
- solar PV	0		Transport	23	0
- solar thermal	0	0	Residential	2952	0
- wind	0	0	Commercial and Public Services	290	0
- tide	0	0	Agriculture / Forestry	4133	0
- other sources	0	0	Fishing	0	0
Total Production	**16127**	**3583**	Other Non-Specified	0	3583
Imports	4304	0			
Exports	-4247	0			

Note : * Includes production from pumped storage plants.
** Transformation includes electricity used by heat pumps and electricity used by electric boilers.
*** Heat shown in this row represents waste heat bought from other industries that is generated from combustible fuels.
**** Energy industry own use also includes own use by plant and electricity used for pumped storage.

Source : IEA

2) Energy Demand

Final energy consumption in 2009 in Tajikistan equaled 1,989 ktoe (see Table 2.1-3), with electricity (1,165 ktoe) having the largest share of approximately 58.6% and followed by petroleum products with the share of 25%.

An analysis of consumption per sector reveals that there is a decidedly low consumption of fuels from the industry sector, a figure indicative of a weak economy. Even though it reached 26.6% in 2009, the indicator for this year might be misleading as it was the year of the peaking economic crises when consumption of petroleum products for transport purposes decreased significantly.

The fact that majority of consumed petroleum products cannot be attributed to any sector is indicating poor conditions in collecting and analyzing energy statistics. However, it is expected that this amount (414 ktoe) is predominantly used in the transport sector. With this presumption the share of transport sector (510 ktoe) in final energy consumption is equal to 25.6%. Regardless to statistical uncertainties, it is clear that the largest share, i.e. the half of total final energy is consumed in residential, agriculture and service sector. If it is assumed that non-specified energy consumption is attributed to residential and service sector, it can be stated that 1/3 of country's total energy consumption is used inside buildings.

Table 2.1-3 Energy Consumption per Fuel and Sector (Excerpt from Energy Balance 2009)

SUPPLY and CONSUMPTION	Coal and Peat	Crude Oil	Oil Products	Natural Gas	Nuclear	Hydro	Geothermal, Solar, etc.	Biofuels and Waste	Electricity	Heat	Total	Share of sector in TFC
TFC (Total Fuel Consumption)	**92**	**0**	**497**	**149**	**0**	**0**	**0**	**0**	**1165**	**86**	**1989**	
1. Industry sector	0	0	0	0	0	0	0	0	529	0	529	26.6%
2. Transport sector	0	0	83 (497*)	11	0	0	0	0	2	0	96 (510)	25.6%
3. Other sectors	92	0	414 (0*)	138	0	0	0	0	634	86	1363 (950)	47.8%
a) Residential	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*254*	*0*	*254*	*12.8%*
b) Commercial and Public Services	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*25*	*0*	*25*	*1.26%*
c) Agriculture / Forestry	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*355*	*0*	*355*	*17.8%*
d) Fishing	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0%*
e) Non-Specified	*92*	*0*	*414(0)*	*138*	*0*	*0*	*0*	*0*	*0*	*86*	*729 (315)*	*15.8%*

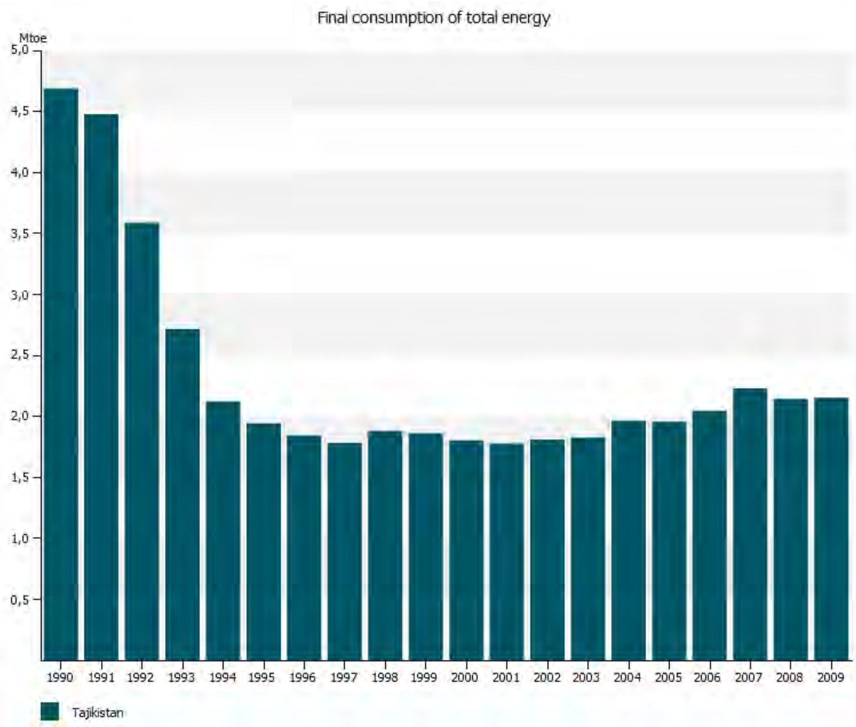
* The amount for other sectors is added in Transport sector and shown in bracket

Source : IEA

The historical changes of energy consumption in Tajikistan are depicted in Fig.2.1-4. The drastic fall in energy consumption, as expected, coincided with the beginning of civil war. By 1997, energy consumption fell to 38% of the amount consumed in 1990, causing severe consequences to the economy and living standard of Tajik people. Steady energy consumption growth can be noted from 1997 with the average annual growth rate of 1.60%. The growth was the most intensive and continuous since 2001, with the average growth rate of 2.43%. Growth rate for the period 2003-2007 was approximately 7%.

Looking back in the medium-term, Tajikistan has experienced steady economic growth since 1997. Economic growth reached 10.6% in 2004, but dropped below 8% in 2005-08, as the effects of higher oil prices and then the international financial crisis began to register - mainly in the form of lower prices for key export commodities and lower remittances from Tajiks working abroad, due to the global economic downturn. In 2009 GDP growth dropped to 3.4% as a result of the world recession1.

As the remittances from expatriate Tajikistanis is estimated to account for 30-50% of Tajikistan's GDP, the GDP growth in the past period is actually not directly and solely related to the increase of the domestic economic activity, especially industry production. This is one of the main reasons, apart from disrupted and unavailable energy supply, why energy consumption growth was significantly below the economic growth and it would be wrong to conclude that economic growth is decoupled with energy consumption growth due to improved energy efficiency.



Source : The UNDP Tajikistan: Energy Efficiency Master Plan for Tajikistan

Fig. 2.1-4 Total Final Energy Consumption in Tajikistan in Period 1990-2009

(2) Country's Energy Price

In 2007 the price of electricity in Tajikistan was only $0.005 USD/kWh. In March 2012 the price rose to approximately $0.023 USD/kWh. The price of electricity is formed in a similar manner to the price of natural gas. A tariff system has been proposed to the Monopoly Commission of the Ministry of Economic Development and Trade (MEDT). There is no high (daily) and low (nightly) tariff. The tariff system is clarified to 6 groups of consumers: Industry; Population; Governmental institutions; Water supply systems and Irrigation systems.

The price of electricity is unnaturally low compared to the prices of natural gas and liquid fossil fuels. Although such a relationship is uncommon, it is an outgrowth of a combination of factors, most notably the fact that most fuels are imported and much of the electricity used derives from domestic production. Over the medium and long term, electricity prices should be increased to provide funding for the maintenance of the power system and the construction of new production facilities. Reliance on electricity as the main source of energy should be maintained and even increased to provide for the possibility of selling surplus electricity to neighboring countries and simultaneously alleviate dependence on fossil fuel imports.

Official electricity and heat energy prices are denoted in Table 2.1-4 which provides the official prices of electrical energy and heat energy according to the applicable tariff system, and Table 2.1-5 outlines the energy prices of other fuels available in Tajikistan.

A country's energy bill represents the total costs of energy consumption in a country and the share of these costs in the GDP. This calculation exercise can show how much money could actually be saved by reducing energy consumption and energy imports.

The energy allocated for the general population is treated as a social welfare category and thus the prices set for this group of consumers are low relative to the real market price. The current parities between energy prices are not financially viable. Moreover, artificially maintaining the price of heat energy to figures lower than the price of the fuel used for its production is not sustainable in the long term.

Treating energy, and specifically electricity, as a social commodity is reasonable to some extent, but eventually it is likely to abate and decrease developmental possibilities for a host of vital sectors.

Table 2.1-4 Tariffs for Electrical and Heat Energy (Electric and Thermal Energy Amounts of Charge, March 2012)

(1USD = 4.83smni = 483diram)

#	Electrical energy	diram for 1 kWh	US$/kWh
1.	For industrial and non-industrial consumers	26.63	0.0551
2.	For the SUE “Tajik Aluminum Company” - From May 1 to September 30 - From October 1 to April 30	 6.25 10.25	 0.0129 0.0212
3.	For consumers budget sphere, communal industry, electrical transport and sport complexes	10.63	0.0220
4.	Water pumps for pumping irrigation pumping stations, repair and production bases of the Ministry of Land Reclamation and Water Resources - From April 1 to September 30 - From October 1 to March 31	 1.88 7.13	 0.0039 0.0148
5.	For the reclamation of vertical wells and meliorative pumping stations	1.88	0.0039
6.	For the public, including VAT	11.00	0.0228
7.	For the use of electricity in electric boilers and electrical systems, to provide hot water and heating of buildings - For non-budget sphere - For budgetary organizations and agencies	 65.88 19.5	 0.136 0.040
	Thermal energy	Somoni for 1 Gcal	US$/Gcal
1.	For institutions and government – funded budget	38.08	7.884
2.	For wholesale buyers supplying thermal energy to the population	4.98	1.031
3.	For other consumers	146.48	30.327

Note: excluding VAT, except for the population, SUE “Tajik Aluminum Company” and water pumps, pumping stations, lift irrigation, reclamation of vertical wells, meliorative pumping stations repair and production bases of Ministry of Land Reclamation and Water Resources

Table 2.1-5 Prices of the Fuels Available at the Market in Tajikistan

			US$/unit	EUR/unit	LCV	US$/kWh	EUR/kWh
Coal	155	TJS/t	35.65	24.80	9.7 MJ/kg	0.0132	0.0190
Gasoline	3.2	TJS/t	0.7360	0.5120	43.45 MJ/kg	0.0819	00.1177
Diesel	2.6	TJS/t	0.5980	0.4160	42.79 MJ/kg	0.0601	0.0864
HFO	1523	TJS/t	350.29	243.68	42.79 MJ/kg	0.0295	0.0424
Natural Gas							
for population	1327	TJS/1000nm^3	305.21	212.32	33.49 MJ/ nm^3	0.0328	0.0472
for all enterprises and institutions	1327.14	TJS/1000nm^3	305.24	212.34	33.49 MJ/ nm^3	0.0328	0.0472
for cogeneration plant and cement factory	1230.9	TJS/1000nm^3	283.11	196.94	33.49 MJ/ nm^3	0.0304	0.0437

Source : IEA Data 2008

2.1.3 Current Situation and Planning for Power Development [3]

(1) Central Asian Power System [4]

The CAPS was planned and constructed in the Soviet Union era. Five countries in the Central Asia succeeded this system after the Soviet Union collapsed. CAPS was planned in order to supply the power efficiently to the countries taking advantage of mal-distribution of primary energy resources and difference of peak time between summer (for irrigation) and winter (for power generation) provided that using water resources for irrigation is given the first priority. For this purpose, dams were constructed in Kyrgyzstan and Tajikistan to generate power by taking advantage of plenty of their water resources. On the other hand, thermal power plants were placed in Uzbekistan, Southern Kazakhstan, and Turkmenistan where sufficient fossil fuels are available such as natural gas, etc. Then, these facilities were connected by high-voltage transmission lines to be operated efficiently taking advantage of each characteristics. Moreover, this system enabled to supply fossil fuels from countries in lower area to countries in upper area in order to cover the power shortage in winter.

CAPS has been formed in the Soviet Union era. The infrastructures of five countries of Uzbekistan, Kazakhstan, Kyrgyzstan, Tajikistan, and Turkmenistan are connected by 500 kV (total length: 1,573km) and 220kV (total length: 1,352km) transmission lines. Overviews of this power system and transmission lines are shown in Fig.2.1-5 and Table 2.1-6. Numbers in Table 2.1-6 correspond to the numbers in Fig.2.1-5.

These transmission lines were connected without any consideration of the borders between the countries because it has been planned and constructed in the Soviet Union era. As a result, unreasonable facts are seen as power transmission, which passes through partially another country, is charged even for own country use. It is still taking time to reach mutual agreement.

500 kV transmission line has been constructing to connect Kambarata in Kyrgyzstan and Dushanbe in Tajikistan without passing through the territory of Uzbekistan. The line construction has been started between Khojend and Dushanbe under Chinese loan and construction between Kambarata and Khojend is under preparation. Moreover, a contract of supplying power from Tajikistan to Afghanistan has been agreed in August 2008 and construction of the transmission line is proceeding. Another project is also planned to extend the transmission line to Pakistan and Iran.

Power demand of the Central Asian countries tended to decrease in consequence of chaos after the independence in 1991. However, economy began to recover from middle of 1995, and power consumption began to increase from the beginning of 2000 and nearly reached to the level at the time of Soviet Union collapsed. CAPS is the power system connecting among, Southern Kazakhstan, Kyrgyzstan, Tajikistan, and Turkmenistan (already disengaged), and among all, Uzbekistan consumes more than 50% of total energy.

Kyrgyzstan and Tajikistan have large hydropower plants taking advantage of their location in the upper area of Syr Darya River and Amu Darya River. These two countries accounts for 78% of total installed capacity of hydropower facilities in four countries of Kyrgyzstan, Tajikistan, Uzbekistan, and Southern Kazakhstan.

3 UNDP Tajikistan, Energy Efficiency Master Plan for Tajikistan, January 2011
4 JICA report: Study on Power Generation and Regional Cooperation on Water Resources in Central Asia, 2009

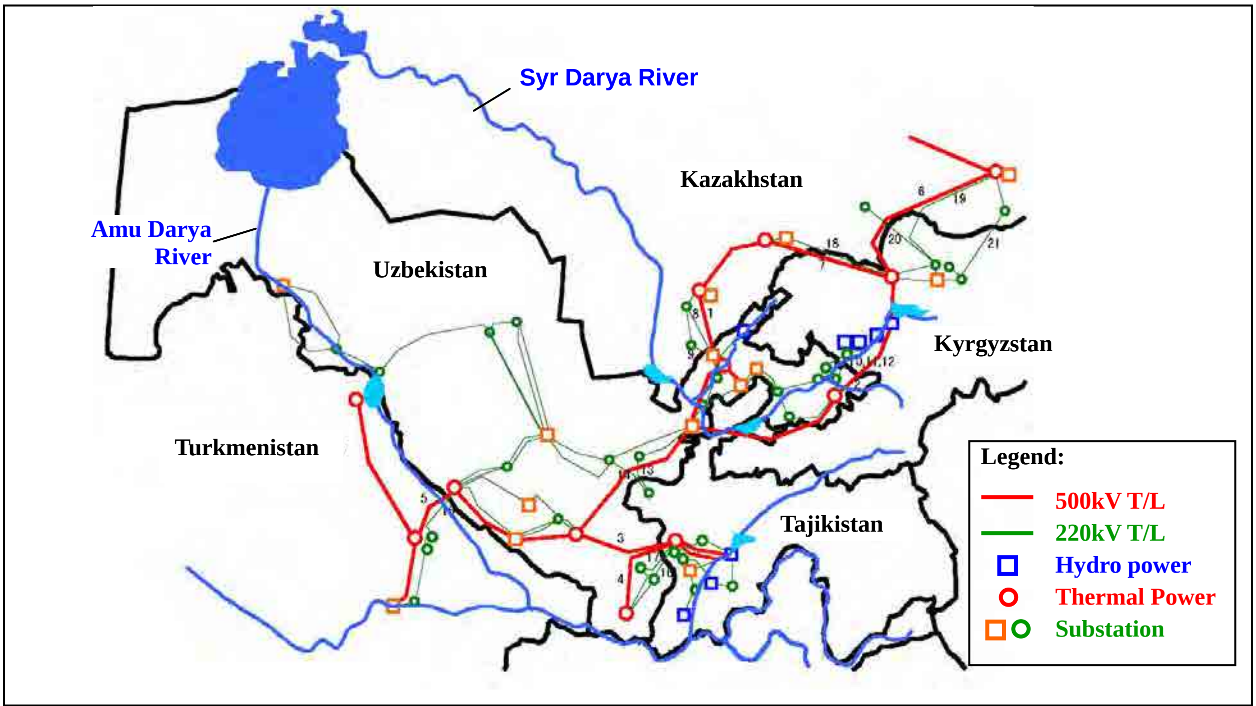


Fig. 2.1-5 Overview of the Central Asian Power System (CAPS)

Table 2.1-6 Overview of the Central Asian Power System

No.	Line	Point 1	Point 2	Voltage (kV)	Length (km)	Capacity (MVA)
Uzbekistan - Kazakhstan						
1	L-501	Tashkent TPP	Chimkent SS	500	104.3	2000
8	L-2-4	Tashkent TPP	Chimkent SS	220	117.21	360
9	L-2-D	Tashkent TPP	Djilta SS	220	110.5	360
Uzbekistan - Kyrgyz						
2	L-504	Lochin SS	Toktogul HPP	500	178	2000
10	L-Kr-U	Yulduz SS	Kristall SS	220	62	314
11	L-Kr-S	Sardor SS	Kristall SS	220	69.3	314
12	L-Kr-K	Kyzyl-Ravat SS	Kristall SS	220	28.1	524
Uzbekistan - Tajikistan						
3	L-507	Guzar SS	Regar SS	500	250.3	2000
4	L-508	Surkhan SS	Regar SS	500	162.3	2000
13	L-Rudaki	Sary-Bazar SS	Rudaki SS	220	86	314
14	L-Samarkand	Samarkand SS	Rudaki SS	220	86.35	314
16	L-R-Sh	Sherabad SS	Regar SS	220	49.5	118
17	L-R-G	Gulcha SS	Regar SS	220	45	118
Kazakhstan - Kyrgyz						
6	L-514	Almaty SS	Bishkek SS	500	298.6	1897
7	L-515	Djambul SS	Bishkek SS	500	210.8	2143
18	L-D-F	Djambul TPP	Bishkek SS	220	178.4	263
19	L-A-G	Almaty SS	Glavnaia SS	220	198.7	263
20	L-G-Ch	Shu SS	Glavnaia SS	220	173.8	263
21	L-B-Z	Zapadnaiy SS	Bistrovka SS	220	80	263
Uzbekistan - Turkmenistan						
5	L-512 (off)	Karakul SS	Serdar SS	500	369	2000
15	L-K-4 (off)	Karakul SS	Chardjou SS	220	67.4	314

Srouce : Uzbekenergo, NDC KEGOC

(2) Power Stations in Tajikistan

Electric power is supplied in Tajikistan by hydropower 98% and thermal power 2% on kWh basis. There are two thermal power stations in the country, of which total installed capacity is 318MW. One is 198 MW Dushanbe thermal power station (5 units) using petroleum fuel, which started its operation in 1955, and another is 120MW Yanvan gas-fired thermal power station (2 units), which started its operation in 1969.

List of hydropower stations are shown in Table 2.1-7. Installed capacity of existing plants and planning sites in Khatlon are 4,555.05MW and 5,522MW. Five small hydropower plants with the capacity no more than 10 MW are listed in Table 2.1-7.

Table 2.1-7 List of Hydroelectric Power Stations (HPS)

No.	Name of Station	Installed capacity (MW)
Matcha river		
1	Matcha HPS*2	90
2	Riamut HPS*2	75
3	Oburdon HPS*2	120
4	Darg HPS*2	130
5	Sangistan HPS*2	140
Fandarya river		
6	Fandarya HPS*2	300
Zeravshan river		
7	Ayni HPS*2	160
8	Zeravshan HPS*2	150
9	Dupulin HPS*2	200
10	Penjikent HPS-1*2	50
11	Penjikent HPS-2*2	45
12	Penjikent HPS-3*2	65
Varzob river		
1	Varzob HPS-1	7.15
2	Varzob HPS-2	14.76
3	Varzob HPS-3	3.52
Vakhsh river		
1	Rogun HPS *1	3600
2	Shurob HPS *2	850
3	Nurek HPS	3000
4	Baipaza HPS	600
5	Sangtuda HPS-1	670
6	Sangtuda HPS-2 *1	220
7	Golovnaya HPS	240
8	Prepadaya HPS	29.95
9	Central HPS	15.1
Syr daria river		
1	Kairakkum HPS	126

No.	Name of Station Obi Hingob river	Installed capacity (MW)
Obi Hingob river		
1	Sangvor HPS*2	200
2	Urfatin HPS*2	250
3	Shtien HPS*2	200
4	Nurabad HPS-1*2	200
5	Nurabad HPS-2*2	160
Surhob river		
1	Dombrachin HPS*2	20
2	Nazarmergan HPS*2	10
3	Yormazor HPS*2	10
4	Garm HPS*2	400
Panj river		
1	Barshor HPS*2	300
2	Anderob HPS*2	650
3	Pish HPS*2	320
4	Rushan HPS*2	3000
5	Yazgulem HPS*2	850
6	Granit gate HPS*2	2100
7	Shirgavat HPS*2	1000
8	Hostav HPS*2	1200
9	Dashtijum HPS*2	4000
10	Jumar HPS*2	2000
11	Moscow HPS*2	880
12	Kokchin HPS*2	350
Kafirnigan river		
1	Vistan HPS*2	45
2	Sarvoz HPS*2	50
3	Yavroz HPS*2	90
4	Lower Kafirnigan*2	72
Gunt river		
1	Pamir HPS-1*1	28
2	Horog HPS	8.7
Total (Existing)		**29295.18 (4935.18)**

Note: Total (MW) is newly calculated.
*1 under construction
*2 under plan
(shaded) HPSs in Khatlon

Source : Barki Tojik

(3) Power Development Plan

Tajikistan has many large rivers and great hydropower potential as shown in Table 2.1-8. Development of new hydropower plants is the highest priority project in order to resolve the problem of power shortage in the country and additionally export the surplus power. Thus, hydropower is expected as only potential resource in this resource-poor country (Aluminum, main industry in Tajikistan, is refined from bauxite imported from Ukraine).

Some projects have been implemented such as Sangtuda I Hydropower Plant (670 MW) which was constructed under the Russian fund and started its operation partially in 2009 and Sangtuda II Hydropower Plant (220 MW) which was constructed by Iran and started its operation in 2010. Additionally, construction of Rogun Hydropower Plant (3,600 MW) is in the final stage and the first and second units will start their operation in 2012. It is planned to resolve the problem of power shortage in the country and enable to export the surplus power after completion of these plants.

Tajikistan has additional many potential sites for dam and the construction is planned to be implemented one after another. These projects are based on water resources of Amu Darya River and it is expected to be effective to reduce flood damage in the lower basin. However, forming consensus with Uzbekistan is required for the development because this country in the lower basin has been consistently opposing dam construction.

Table 2.1-8 Hydropower Potential in Tajikistan

River Name	Hydropower Potential (TWh)	Development potential technically and economically (TWh)	Rate of development potential
Pianj	122.9	82.0	67%
Kafirnigan	37.2	8.7	23%
Surhob/Obihingoy	26.3	16.4	62%
Zeravshan	33.9	10.6	31%
Total	220.3	117.7	53%

Source : Barki Tojik

(4) Development Program for Small Hydropower Plants

“Long-term Program for Development of Small Power Plants for the Period 2009-2020” has been approved by the Government of Tajikistan on February 2, 2009 № 73). In order to implement this program, governmental organization of Tajikistan is expected to induce foreign capitals as well as the national budget. Additionally, necessary action by MEI, Barki Tojik, local government, and municipalities is also expected. Potential capacity of small hydropower stations and development programs for small hydropower are shown in Table 2.1-9 and Table 2.1-10.

In the message of the government of Tajikistan, sustainable development of national economy is impossible without full energy independence. The government of Tajikistan announced promoting the advancement of power industry.

Interest to small hydro in Tajikistan has arisen long time ago. The first small hydro-electric power station, Varzob HPS-1, with capacity 7.15 MW was built in 1936 and has been operating until the present days. In 1949-1950 in the Republic was worked out “the scheme of using water power resources of the small water courses for electrification of agriculture use”, aimed at the full electrification overall territory.

Table 2.1-9 Potential Power and Energy of the Small Hydropower

Regions	Potential		Feasible	
	N thous. kW	E bil. kWh	N thous. kW	E bil. kWh
Sogd Region	1288.00	11,28	450.8	3.95
Hatlon Region, towns and regions of republican subordination	16056	140.65	5619.6	49.23
Gorno-Badahshan Autonomous Region	3713.0	32.53	742.6	6.51
Total in Tajikistan	21057.0	184.46	6813.0	59.69

Source: Ministry of Energy and Industry (MEI)

Table 2.1-10 Development Programs for Small Hydropower

№	Name of SHEPS	Technical parameters		Location (city, region)	Preliminary cost in thous. US Dollars	Source of finance
		Installed capacity kW	Power generation per year thous. kWh			
1	2	3	4	5	6	7
Short-term Program of construction, 2009-2011						
Average SHEPS						
1	"Marzich"	4305	25830	Ayni	3433	IDB
2	"Shash-Bolon"	185	1110	Nurabad	489	IDB
3	"Sangikar"	1006	6036	Rasht	1133	IDB
4	"Fathobod"	283	1698	Tajikabad	780	IDB
5	"Pyatovkul"	1106	6636	Jirgitol	1721	IDB
6	"Horma"	334	2004	Baljuvon	529	GRT, OJSHC "Barki Tojik"
7	"Toj"	305	1830	Shahrinav	540	GRT, OJSHC "Barki Tojik"
8	"Shirkent-3"	576	3456	Tursun-Zade	883	GRT, OJSHC "Barki Tojik"
9	"Kuhiston"	500	3000	Matcha	600	GRT, OJSHC "Barki Tojik"
10	"Cheptura"	500	3000	Shahrinav	320	GRT, OJSHC "Barki Tojik"
11	"Tutak"	650	3900	Rasht	780	GRT, OJSHC "Barki Tojik"
12	"Pushti bog"	200	3000	Baljuvon	240	GRT, OJSHC "Barki Tojik", The Ministry of Finance
13	"Dizhik"	260	1151	Ayni	853	ADB (JFPR No.9089 TAJ)
14	"Hovaling"	100	600	Hovaling	120	UNDP
15	"Bohtar"	1280	11059.2	Bohtar	1500	
16	"Kulyab"	220	1900.8	Kulyab	230	State Committee on invest. and adm. of state property
17	"Surhteppa-1"	330	1980	Jaloliddin Rumi	396	Customs service under GRT
53	"Humdon"	70	210	Nurabad	84	
54	"Hakimi-2"	60	180	Nurabad	72	
55	"Yahak-yust"	40	120	Nurabad	48	
56	"Layron"	50	300	Tavildara	60	
57	"Lochurg"	80	480	Tavildara	96	
58	"Bomgura"	75	450	Vahdat	90	

№	Name of SHEPS	Technical parameters		Location (city, region)	Preliminary cost in thous. US Dollars	Source of finance
		Installed capacity kW	Power generation per year thous. kWh			
1	2	3	4	5	6	7
59	"Chidoidi"	70	210.0	Jirgital	84	
60	"Chashmasori"	70	420	Fayzabad	84	
61	"Shahriston-2"	40	86.4	Shahristan	48	
62	"Tutkul"	65	561.6	Jaloliddin Rumi	78	
63	"Pingon"	50	300	Rasht	60	
64	"Duoba"	70	151.2	Ayni	84	
65	"Guan"	80	691.2	Kuhistoni Mastjoh	96	
66	"Hujaho-1"	70	151.2	Ganji	84	
67	"Juyi Nav"	60	129.6	Ganji	72	
68	"Asht"	50	108.0	Asht	60	
69	"Mulokoni"	60	518.4	Baljuvon	72	
70	"Sulton Uvays"	80	691.2	Hovaling	96	
	Total	***32850***	***185067.2***		***39380***	
Long-term Program of construction, 2016-2020						
Average SHEPS						
1	"Yazgudom-3"	1900	16000	Vanj	3800	Local and international investors
2	"Yazgudom-4"	1900	16000	Vanj	3800	
3	"Yazgudom-5"	1900	16000	Vanj	3800	
4	"Sorvo"	150	900	Vahdat	180	
5	"Paldorak-1"	250	2160	Kuhistoni Mastjoh	300	
6	"Rukshif-1"	200	3456	Kuhistoni Mastjoh	240	
7	"Samjon"	500	3000	Kuhistoni Mastjoh	600	
8	"Padask"	880	5280	Kuhistoni Mastjoh	1056	
9	"Iskich"	500	3000	Gissar	600	
10	"Fayzobod"	465	3459.6	Abdurahmon Jomi	558	
11	"Javoni"	170	1020	Rogun	204	
12	"Guli Surh"	100	600	Rogun	120	
13	"Lugur"	350	2100	Rogun	420	
14	"Shingilich"	130	390	Rasht	156	
15	"Runob"	250	750	Rasht	300	
16	"Hadiriyon"	250	1500	Rasht	300	
17	"Chafr"	100	600	Rasht	120	
18	"Kalanak"	120	720	Rasht	144	
19	"Sipoding"	120	360	Rasht	144	
20	"Voydara"	100	300	Nurabad	120	
21	"Sangvor"	100	600	Tavildara	120	
22	"Charsem"	10000	60000	Shugnan	12000	
23	"Namadgut"	1500	13000	Ishkashim	168	
24	"Roshorv"	600	5000	Rushan	720	
25	"Yamchun"	140	840	Ishkashim	168	

№	Name of SHEPS	Technical parameters		Location (city, region)	Preliminary cost in thous. US Dollars	Source of finance
		Installed capacity kW	Power generation per year thous. kWh			
1	2	3	4	5	6	7
26	"Bichhari”	140	840	Vanj	168	
27	"Kishtudaki Nav”	196	423.3	Penjikent	235	
28	"Padrud”	1134	6804	Penjikent	1361	
29	"Kurgovad”	1500	10000	Darvaz	1800	
30	"Leninobod”	145	820.8	Jilikul	174	
31	"Dukak”	300	1800	Nurabad	360	
32	"Layrui”	150	450	Nurabad	180	
Mini SHEPS						
33	"Shodmoni”	60	360	Nurabad	72	
34	"Langar”	30	180	Nurabad	36	
35	"Sandon”	30	180	Nurabad	36	
36	"Kabutiyon”	30	180	Nurabad	36	
37	"Ulfatobod”	30	180	Nurabad	36	
38	"Hasandara”	60	360	Nurabad	72	
39	"Sari pulak”	30	180	Nurabad	36	
40	"Chavji”	60	360	Nurabad	72	
41	"Girdob”	40	240	Nurabad	48	
42	"Langar”	60	360	Tavildara	36	
43	"Roga”	30	180	Tavildara	36	
44	"Margzor”	40	240	Rogun	48	
45	"Neknot”	80	480	Penjikent	96	
46	"Puli Girdob”	45	270	Penjikent	54	
47	"Hujaho-2”	60	259.2	Ganji	72	
48	"Obchi-1”	40	86.0	Ganji	48	
49	"Basmanda-2”	80	172.8	Ganji	96	
50	"Guliston”	50	175	Muminabad	60	
51	"Shahrinav”	30	105	Muminabad	36	
52	"Kaskun”	50	150	Nurabad	60	
53	Vaygon”	40	345.6	Kuhistoni Mastjoh	48	
	Total	***26801***	***175735.3***		***32161***	
189	**Total**	**103181**	**641645.9**		**123134**	

Note: Islamic Development Bank (IDB)
Government of Republic of Tajikistan (GRT)
Open Joint Stock Holding Company (OJSHC) “Barki Tojik”

Source: MEI

The government of Tajikistan indicates 39 candidate sites for small hydropower development in “Small Hydropower Development Program in Khatlon from 2009-2020”. List of these sites is shown in Table 2.1-11.

Table 2.1-11 Small Hydropower Plants for Long-term Construction Program in Khatlon for the Period of 2009 – 2020

No.	Plant Name	Technical Specification		Preliminary cost: (Thousand of US$)	Number of generator
		Installed power (kW)	Energy production (kWh)		
1	2	3	4	5	6
Khatlon Region					
Khovaling District					
1	Hovaling «Ховалинг»	100	600	120	1
2	Obi Rushan «Оби Рушан»	15	90	18	1
3	Ghonbahsh «Чонбахт»	320	2764.8	384	2
Bohtar District					
4	Bokhtar «Бохтар»	1280	11059.2	1500	1
Rumiskie District					
5	Sitorai Surh «Сито раи сурх»	760	3830.4	912	2
6	Surhteppa -2 «Сурхтеппа -2»	1250	6300	1500	2
Parharski District					
7	Syrhob «Сурхоб»	60	360	72	1
8	Shabboda «Шаббода»	200	1728	240	1
Baseiski District					
9	Michyrin «Мичурин»	30	180	36	1
10	Toskala «Тоскалъа»	165	1425.6	198	2
11	Shobika 1-2 «Шобика 1-2»	320	5529.6	384	2
12	Kamolobod «Камолобод»	190	1641.6	228	1
Dangara District					
13	Armyhon «АрМYFOН»	165	1425.6	198	1
14	Nurbakhsh «Нурбахш»	5000	30000	6000	2
15	Tutkul «Туткул»	65	561.6	78	2
16	Gulbulok «Гулбулок.»	100	864	120	2
Balduron District					
17	Pashti bog «Пушти БОF»	200	1200	240	1
18	Peshtova -1 «Пештова -1»	55	475.2	66	1
19	Peshtova -2 «ПеШТQва-2»	320	2764.8	384	1
20	Mulokoni «Мулокони»	60	518.4	72	2
Muminabod District					
21	Tole «Толеъ»	65	561.6	78	1
22	Syrhak-1 «Сурхак -1»	150	1296	180	1
23	Syrhak-2 «Сурхак -2»	150	1296	180	2
24	Guliston «Гулистон»	50	175	60	3
25	Shahrinav «Шахринав»	30	105	36	3
Shypabadski District					
26	Shohona «Шохон»	235	1410	282	1
27	Dashtijum «Даштичум»	280	1680	336	1
Kyrob					
28	Lylikutal «Луликутал»	80	480	96	1
29	Dahana 1-5 «Дахана 1-5»	1600	13824	1920	2
30	Tokakapa «Токакапа»	125	1080	150	2
Jilikul District					
31	Pakhtakor ««Пахтакор»	330	2257.2	396	1
32	Lohyti «ЛохутИ»	280	1814.4	336	2
33	Leninobod«Ленинобод»	145	820.8	174	3
Jomi					
34	Yakkatut «Яккатут»	280	1915.2	336	1
35	Shurobod-1 «Шурободˍ-1»	375	2790	450	2
36	Shurobod-2 «Шурободˍ-2»	120	1036.8	144	2
37	Faizobod «Файзобод»	465	3459.6	558	3
Bahmski District					
38	Gilikul «Чиликул»	1360	7790.4	1632	2
Temurmalik District					
39	Temurmalik «Темурмалик>	100	600	120	2

Source : MEI

(5) Project of Renewable Energy Development

The other well-known renewable energy are wind and solar power. An effective use of wind-power plants is possible only with definite speed more than wind velocity of 5m/sec. The government institution of MEI, OJSHC “Barki Tojik”, Government Agency “Project Management Unit of electric energy sector” is going to construct and put into operation in the regions of the Republic 2-3 wind power stations with capacity 20-100kW until 2012.

Today, Tajikistan is reluctant to consider solar power prospective in terms of difficult internal procurement. Annual duration of sun shining in the national territory is fluctuated from 2000 to 3000 hours per year. In the most habitable districts like Gissar and Vahsh valleys or in Soghd Region, the duration of sun shining exceeds 2700 hours per year.

(6) Organizations of Power Sector

MEI and Barki Tojik are responsible institution for the power sector in Tajikistan and they are also officially implementing this Study. MEI will be the main institution for this project throughout the design stage and construction stage if the fund is provided for the candidate sites. After starting the operation, responsibility and management of the plant will be succeeded by Barki Tojik.

Barki Tojik, however, is actually cautious about management and maintenance of small hydropower plants because of their bitter experiences in the past as expected power was not available in winter due to insufficient hydrological survey and electricity sales was lower than payable tax for asset of a plant. Consideration for these issues is required in the case of development by grant-aid.

Organization charts of MEI and “Barki Tojik” are shown in Fig.2.1-6 and Fig.2.1-7.

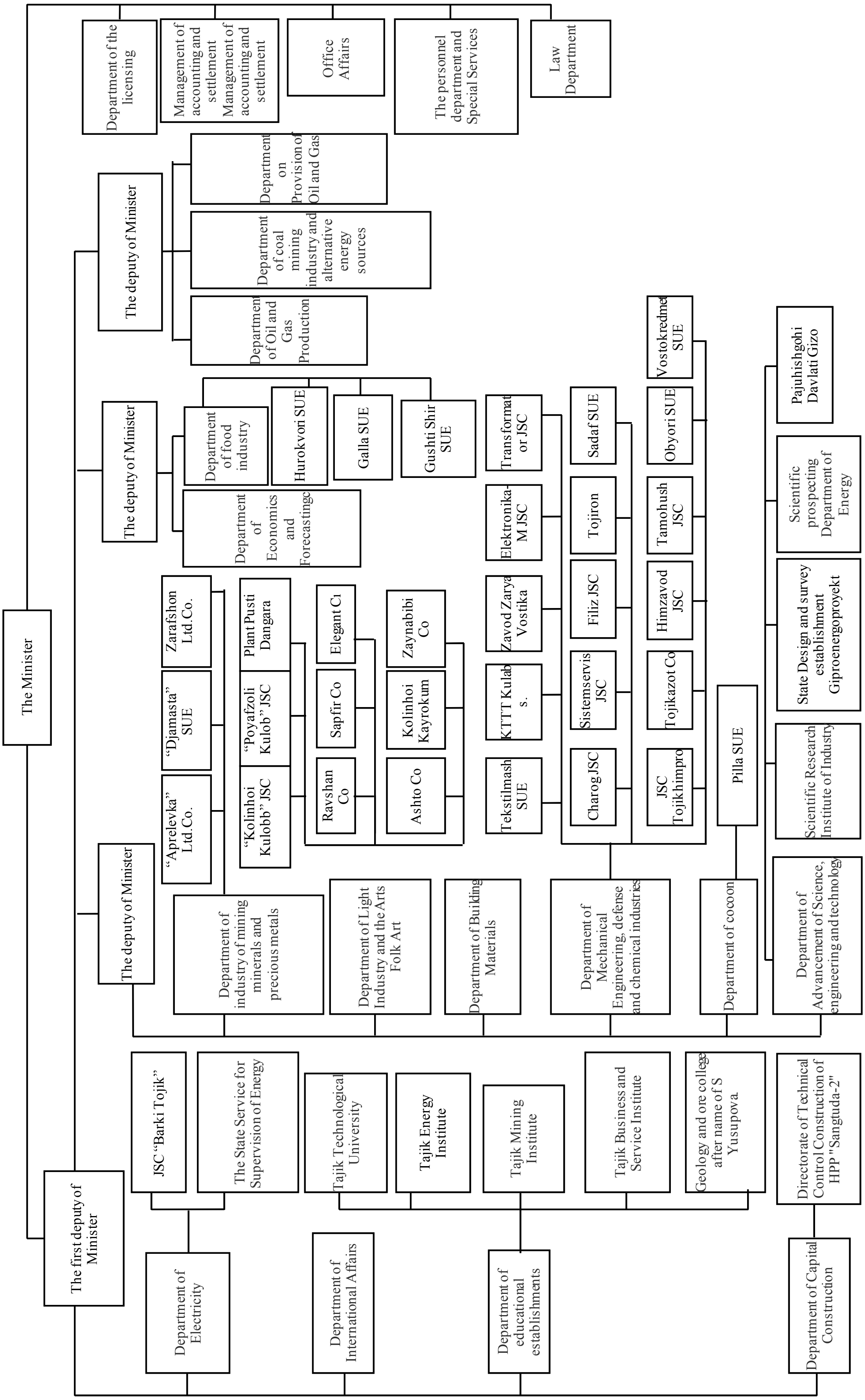


Fig. 2.1-6 Organization chart of MEI

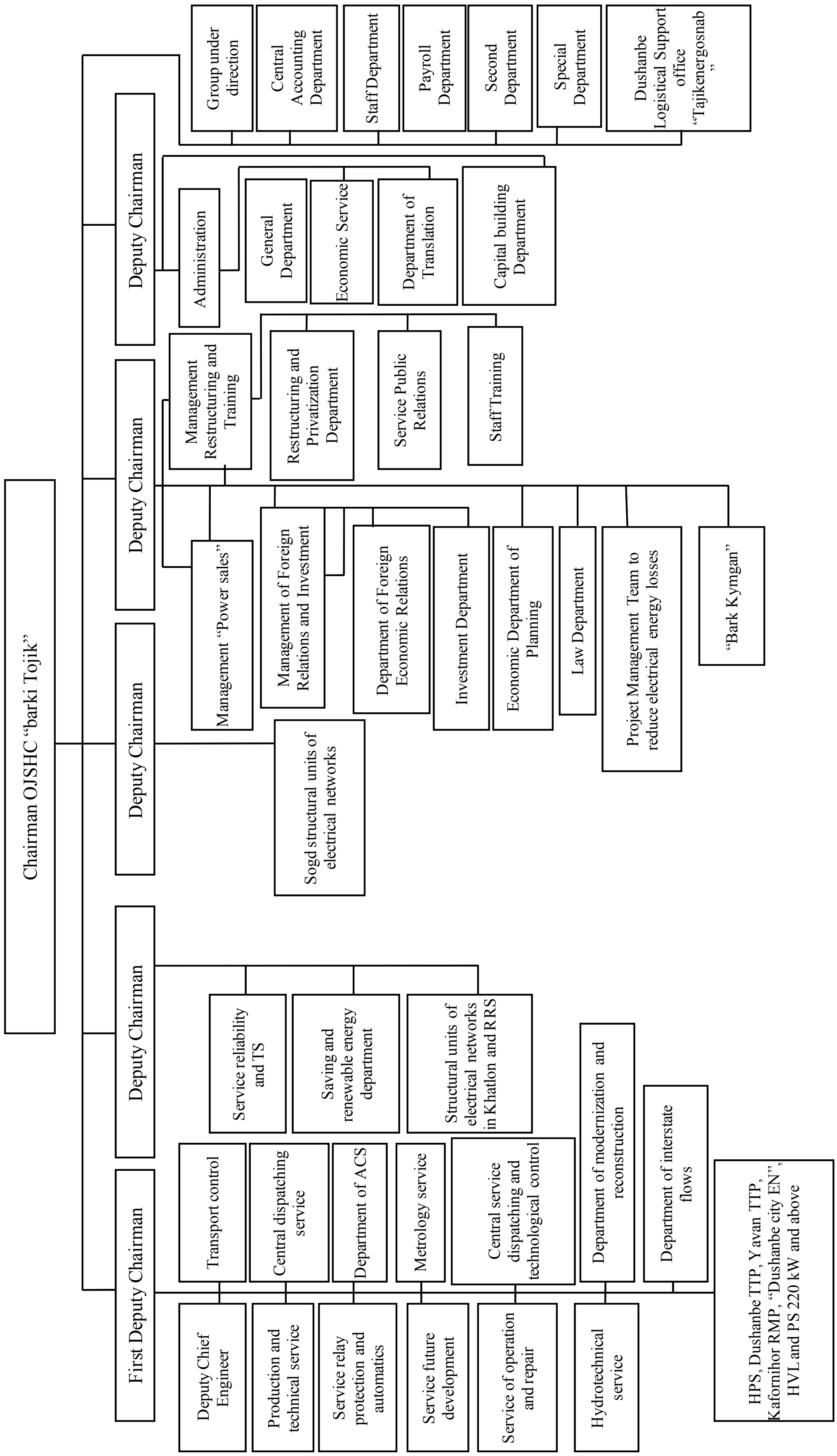


Fig. 2.1-7 Organization Chart of Barki Tojik

(7) Laws and Procedures for Hydropower Development

1) Water rights for development of a small hydropower plant

Water rights for a small hydropower plant should be applied to the local department of water resources. Department of water resources in Khatlon will deal with a problem when there is a concern about water rights such as conflict with irrigation water. Application (and permission) method for water rights and required documents for small hydropower development is described in guideline for development of small hydropower plants (in Russian) established by UNDP, MEI, and Barki Tojik in 2011.

2) Ownership of a hydropower plant

The government of Tajikistan can expropriate the potential site subject to a letter of agreement between the owner and the government, even though it is private property such as Bohtar site. It used to take about six months until application of expropriation was approved, but now, necessary time for the procedure is reduced to 3 days – 30 days due to the presidential decree. Law of land expropriation is controlled by Department of land management and the presidential decree is controlled by office of the President.

(8) Assistance Situation by Other Donors

1) UNDP

UNDP is currently implementing two Mini-Hydro Power (MHP) projects as follows.

a) Establishment of MHP Development Strategy

Laws and regulations for MHP development are not established yet in Tajikistan. Thus, each hydropower plant has been developed case by case. Technology transfer is implemented to MEI and Barki Tojik for the purpose of promotion of MHP development project (investigation, design, and operation), encouragement of investment and fund, and establishment of standard for the system such as Power Purchase Agreement (PPA).

b) Promotion of renewable energy

Activities such as establishment of Energy Efficiency Master Plan, foundation of Trust Fund by foreign donors, and implementation of pilot projects are carried out to promote renewable energy development.
As a pilot project, 200 kW Nulofar hydropower plant has been constructed at the site 20km away from Dushanbe. This plant is operated by the local community. The power supply and demand of this plant is stable and it sells the power to the main grid in summer and supply to community in winter.

UNDP is implementing technology transfer projects for promotion of small hydropower, regional development, standardization of spare parts and construction, etc.

Technical issues for small hydropower projects in Tajikistan are considered unestablished standard, deficiency of construction technology and operational ability. It causes a problem that spare parts cannot be obtained in the country or cannot be synchronized with a grid, because electrical equipment is of various specifications and various countries of origin.

It is most important for MHP project in Tajikistan that stable power generation is available throughout the year. Therefore, minimum discharge is adopted to design discharge. There are a little data of river discharge in Tajikistan and power development is planned according to hearing at the site. Power generation is often not available in winter because of freeze of the river.

Criteria for screening of the potential sites for MHP project by UNDP is: 1) River discharge is available throughout the year, 2) Current situation of electrification in the villages, 3) Condition of power supply, 4) Existence of public facilities such as a hospital, school, etc., 5) Regional characteristics such as border area with Afghanistan, and 6) Economic effect by the development.

2) Asia Development Bank (ADB)

ADB focuses on assistance for sectors of energy, transport, and welfare. Their assistance for power sector is mainly for enhancement of power supply (large-scale hydropower and transmission lines) and structural reform and reconstruction of the government organizations.

ADB will provide grant assistance of US$ 122 million for the purpose of repair of Nurek hydropower plant and substation and extension of transmission line at northern grid. They are also planned to enhance their assistance to development of hydropower plants in the future.

ADB provide technical assistance for reorganization of Barki Tojik by evaluating and improving their finance, economy, technology, etc. They also provide soft component for capacity building of the staff of Barki Tojik.

ADB considers that the problem in Tajikistan is significantly low electricity tariff than other countries and large power loss (technical and commercial loss). ADB does not consider about assistance to small hydropower generation due to the limited budget.

2.2 NATURAL CONDITION

2.2.1 Topography and Geology

(1) Topographic Condition

Tajikistan is located at the southeastern part of Central Asia, between 36°40´and 41°05´ of northern latitude and 67°31´ and 75° 14´ of eastern longitude. The country area is 143,100 km^2. It borders with Afghanistan, Uzbekistan, Kyrgyzstan, and China and is close to India, Pakistan, Turkmenistan and Iran.

Tajikistan is one of the links between the Atlantic Ocean and Pacific Ocean on the Eurasian highland belt. Mountains occupy approximately 94% of the territory of Tajikistan and more than half of mountains area is located at an elevation of over 3,000m. Pamir’s Mountains located at eastern part of Tajikistan have some of the world’s highest mountain peaks – Ismail Samani Peak 7,495m, Lenin Peak 7,135m and are called as “The Roof of the World”. Pamir Mountains range from 5,000 to 7,000m and stretch 800km across Tajikistan. These mountains are arising from the shock waves created by the Indian sub continental smashing into Eurasian plate over 100 million years ago.

Khatlon, target province of this Study is located at the southwestern part of the country. The border of Khatlon are the northern part; along the foothills of the southern slope of the Hissor range, the eastern part; on the western slopes of the ridge Hazratishoh, the western part; on the slopes of the ridge Babatag and the south faced to the Afghanistan. The Kurgan-Tyube province and Kulyab province merged into Khatlon province in 1992. The capital of Khatlon is Kurgan-Tyube. Khatlon has an area of 24,600km^2 which occupies 17.2% of the country.

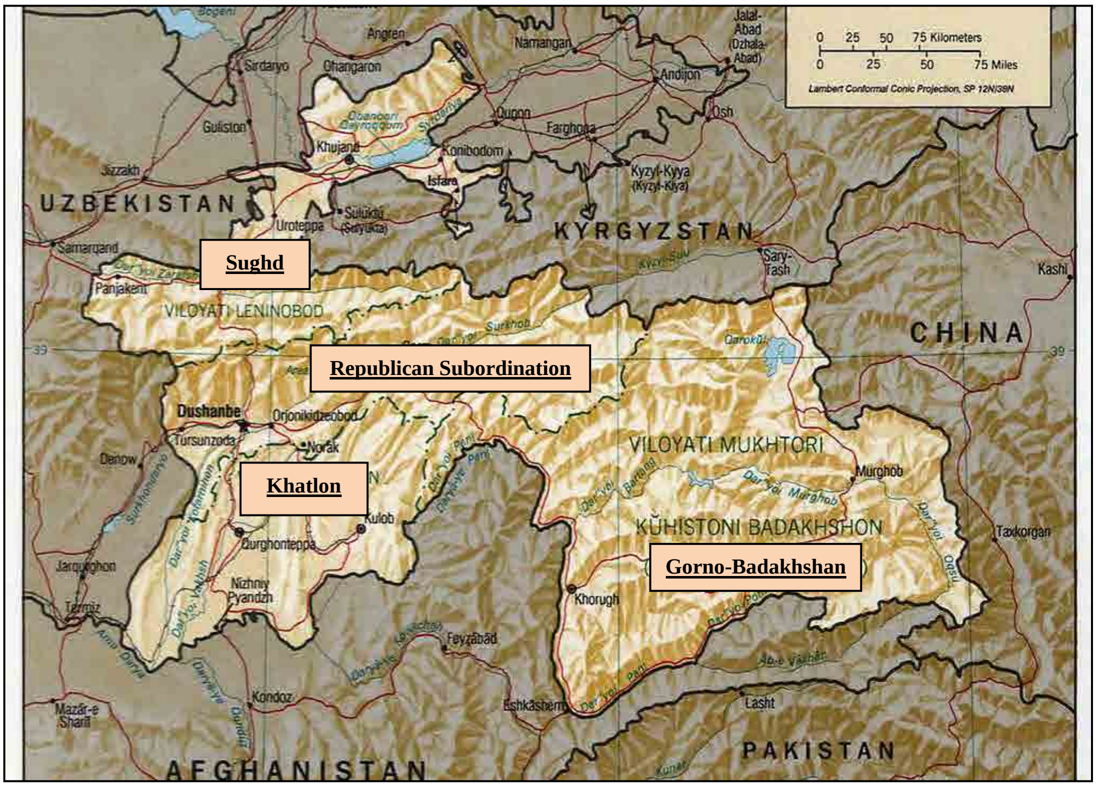


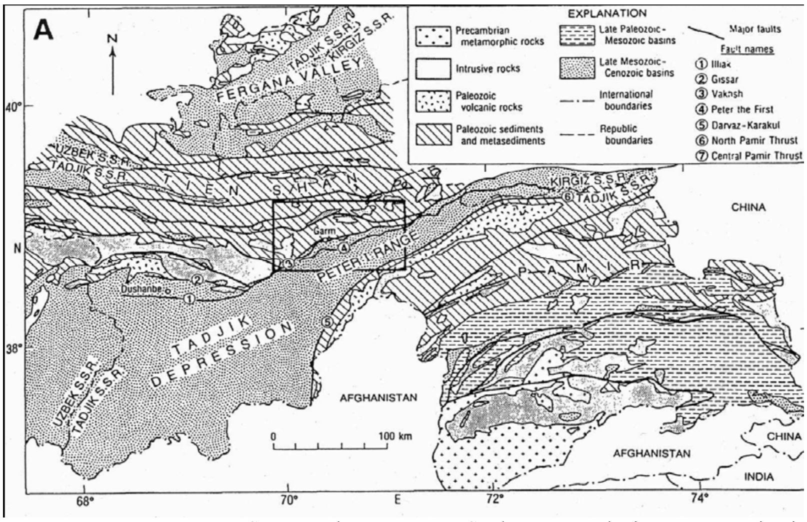
Fig. 2.2-1 Territory of Tajikistan

(2) Geological Condition

Many kinds of rocks and deposits dated back to the various geological epoch form diverse geological structure in Tajikistan. Quaternary, Neogene and Palaeogene geological systems can be observed in the southwest and north of the country. Cambrian, Ordovic, Jurassic, Cretaceous, Permian, Carbon can be observed in central of the country. Upper Cambrian, Jurassic, Permian, Carbon and Triassic can be observed in the Pamir's Mountains.

Tajikistan is rich with coal, mercury, antimony, tin, gold, silver, and other mineral resources. More than 400 deposits were discovered and 70 are being exploited.

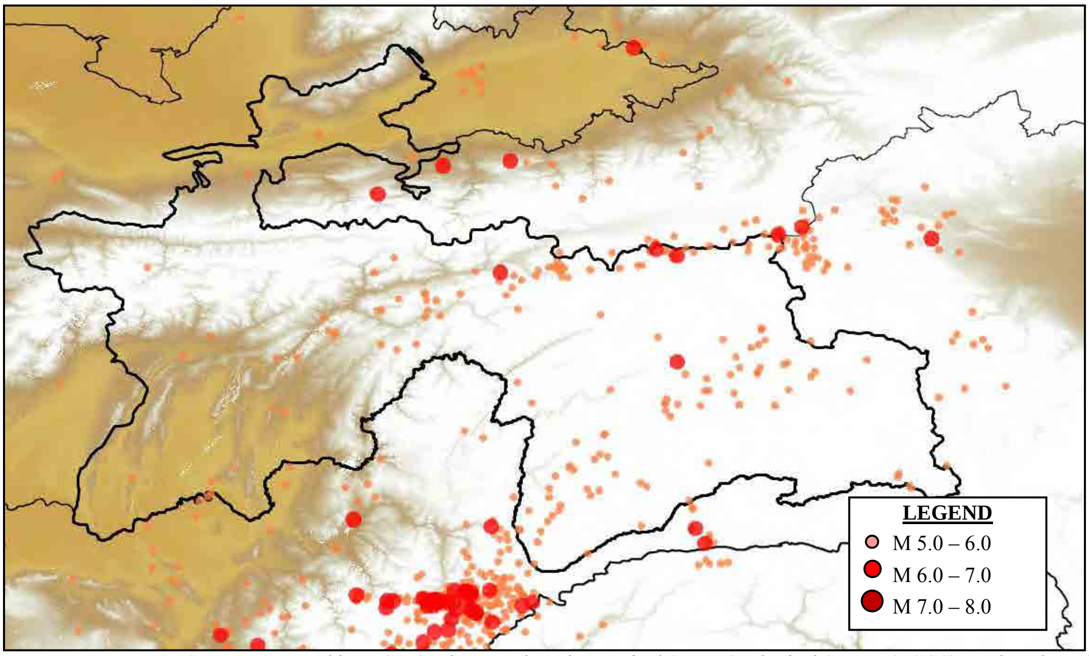
Khatlon is located at Tajik depression. Vast alluvial cone is formed by Vakhsh river, Kafirnigan river and Pyanj river. Sedimentary of late Mesozoic –cenozoic basins are observed.



Source : The Preparatory Study on Natural Disaster Prevention in Pyanj River (JICA 2006)

Fig. 2.2-2 Geological Map of Tajikistan

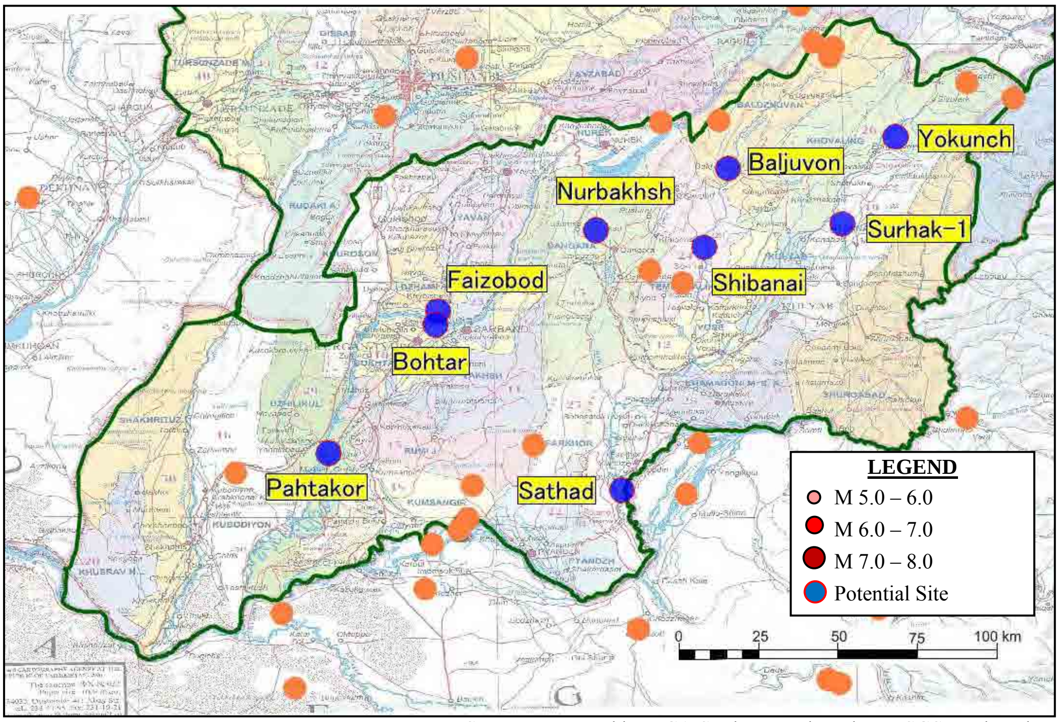
Tajikistan has been suffered a lot of earthquakes with more than Magnitude 5 especially from central to northeastern part of the country. Earthquake with magnitude 6.8 hit border area between Gorno – Badakhshan province and Kyrgyzstan in 1978. Recently an earthquake with magnitude 5.7 hit Obikhingou of the central part of Tajikistan in May 2012 and at least a man are killed.



Source: Prepared by JICA Study Team based on United States Geological Survey (USGS) Earthquake Information

Fig. 2.2-3 Earthquake Distribution Map in Tajikistan (Over Magnitude 5, 1973 – 2012)

Fig. 2.2-4 and Table 2.2-1 show the location of earthquakes with over magnitude 5 at Khatlon province in past forty years. Fourteen times earthquakes with over magnitude 5 have been recorded at Khatlon province especially in province border area of northeastern part. Earthquakes have been occurred within 20km of Nurbakhsh, Sathad, Shibanai and Baljuvon in past 40 years. As there were no earthquakes with over magnitude 6, Khatlon can be regarded as area of low seismic risk.



Source : Prepared by JICA Study Team based on USGS Earthquake Information

Fig. 2.2-4 Earthquake Distribution Map in Khatlon (Over Magnitude 5, 1973 – 2012)

Table 2.2-1 List of Earthquake in Khatlon (Over Magnitude 5, 1973 – 2012)

ID	Year	Month	Magnitude (M)	Depth (km)	Latitude	Longitude
1	2010	8	5.4	23	38.452	69.637
2	2008	10	5.2	10	38.559	70.338
3	2008	9	5.4	1	37.328	68.928
4	2007	6	5.3	31	37.296	68.903
5	2006	7	5.6	34	37.255	68.828
6	2005	9	5.1	48	38.659	69.96
7	2005	9	5.0	44	38.632	69.95
8	1998	9	5.0	33	38.447	69.473
9	1992	12	5.2	35	37.422	68.942
10	1991	4	5.5	33	37.457	68.273
11	1978	11	5.0	26	38.516	70.469
12	1977	2	5.0	59	37.535	69.115
13	1977	3	5.2	10	38.029	69.442
14	1977	3	5.0	14	37.994	69.534

Source: Prepared by JICA Study Team based on USGS Earthquake Information

2.2.2 Hydrology and Meteorology

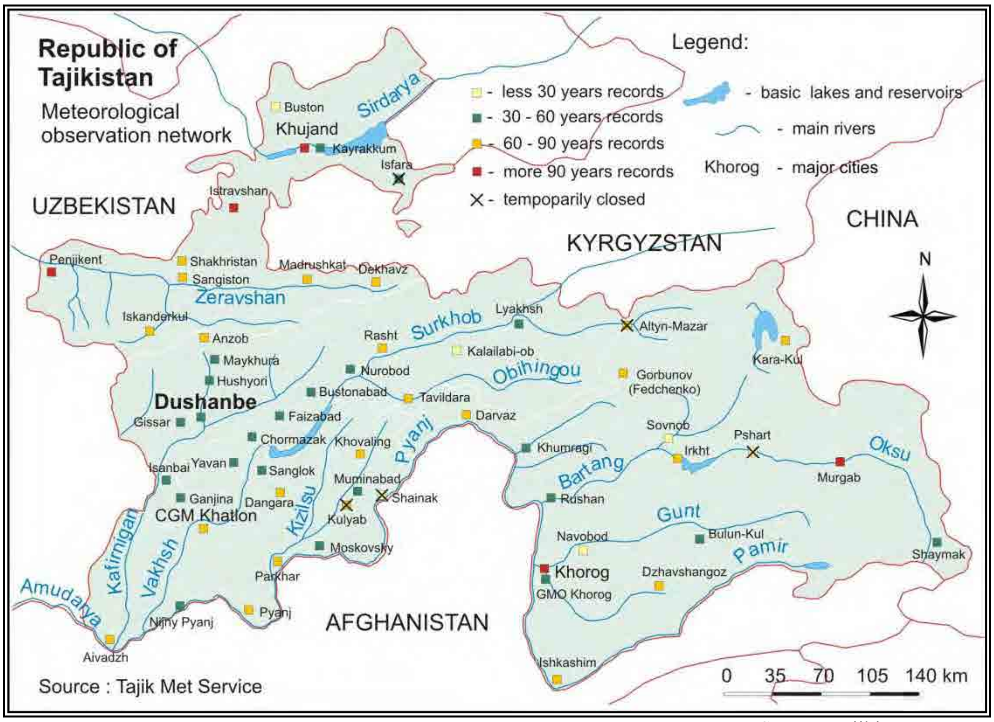
(1) Hydrological and Meteorological Observation Station in Tajikistan

Hydrological and meteorological observation in Tajikistan have been conducted at 56 meteorological stations and 96 hydrological stations operated by Hydro and Meteorological Agency since 1926.

1) Meteorological Observation Station

Location of meteorological stations in Tajikistan is shown in Fig. 2.2-5. Items of meteorological observation are as shown below. However there are a lot of missing data.

Daily	Monthly
- Rainfall - Temperature - Humidity - Atmospheric Pressure - Wind pressure, direction	- Evaporation - Solar Radiation

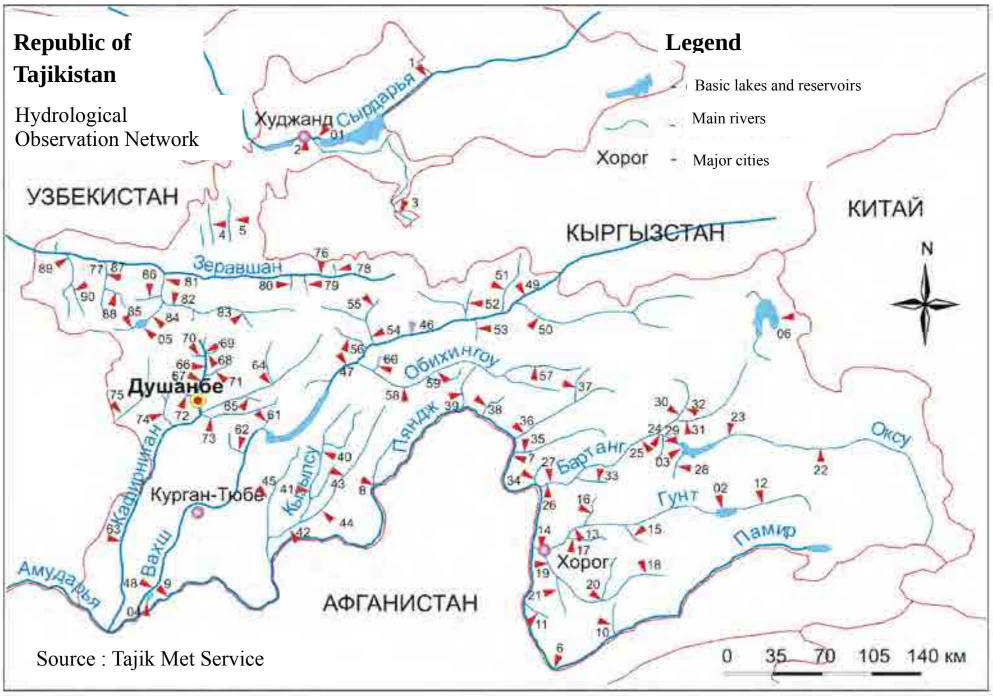


Source: Tajikistan Meteorological Service

Fig. 2.2-5 Meteorological Observation Station in Tajikistan

2) Hydrological Observation Station

Location of hydrological stations in Tajikistan is shown in Fig. 2.2-6. Hydrological observation consists of two observation items. One is daily measurement of water level and another is discharge measurement accordingly. The latter is conducted to seek for the relational expression between water level and discharge. This expression is called as H-Q curve and daily record of water level is converted into discharge data by this curve.



Source: Tajikistan Meteorological Service

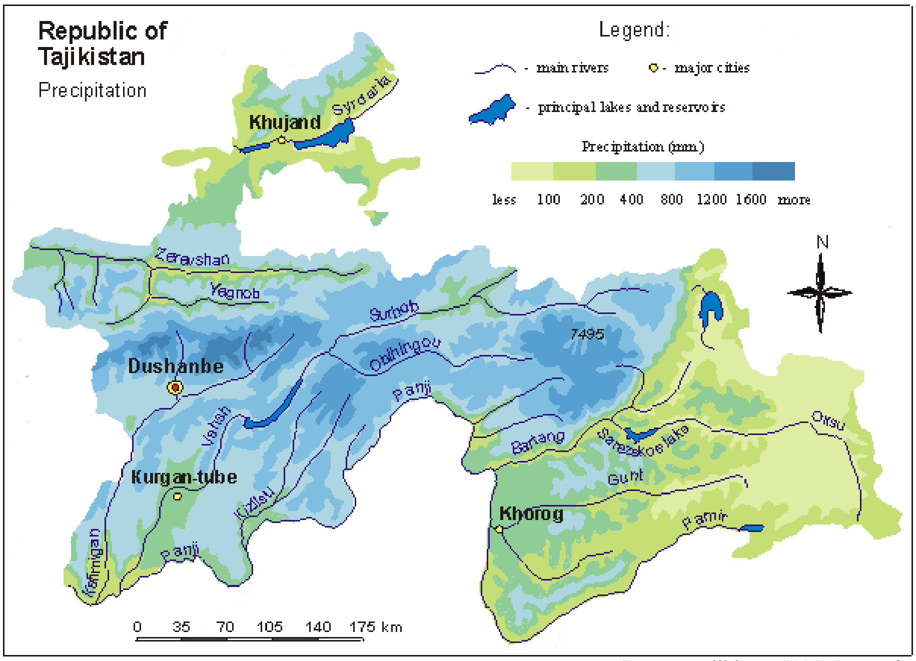
Fig. 2.2-6 Hydrological Observation Station in Tajikistan

(2) Meteorological Condition

Tajikistan has diverse meteorological conditions because of various regional natural conditions and terrain reliefs from mountain areas with the elevation of 7,000m to flat area. According to Keppen's climate classification, central to western parts of country is classified into Warm Summer Continental climates (Dsb and Dsc). Southwestern part is Mediterranean climates (Csa) and a part of area along Pyanj river and Syrdarya river are Steppe climates (BS). Pamir, western part of the country is occupied by Tundre climates (ET).The contrast combination of arid, sub-arid, and humid conditions, with the precipitation fluctuation from 70 to 2000 mm a year, promoted formation of complex, particularly rich flora of nearly 10,000 species and vegetation.

The annual average radiation varies from 2090 to 3160 hours, the average air temperature varies from +17°C in the south of the country to -7°C in the Pamir. The most severe climate is observed in the Eastern Pamir, where the annual average temperature is from -1 to -6ºC. The absolute minimum temperature was registered at the Bulunkul Lake in the Eastern Pamir (minus 63^{o}C) and the absolute maximum temperature was at the Shaartuz (+48^{o}C) in the southern Khatlon province.

The average annual amount of precipitation in Tajikistan is 760 mm. In hot deserts of southern Tajikistan and in cold high-mountains of the Eastern Pamir, the annual average precipitation varies from 70 to 160 mm. However, it sometimes exceeds 2,000mm a year at the central part of the country.

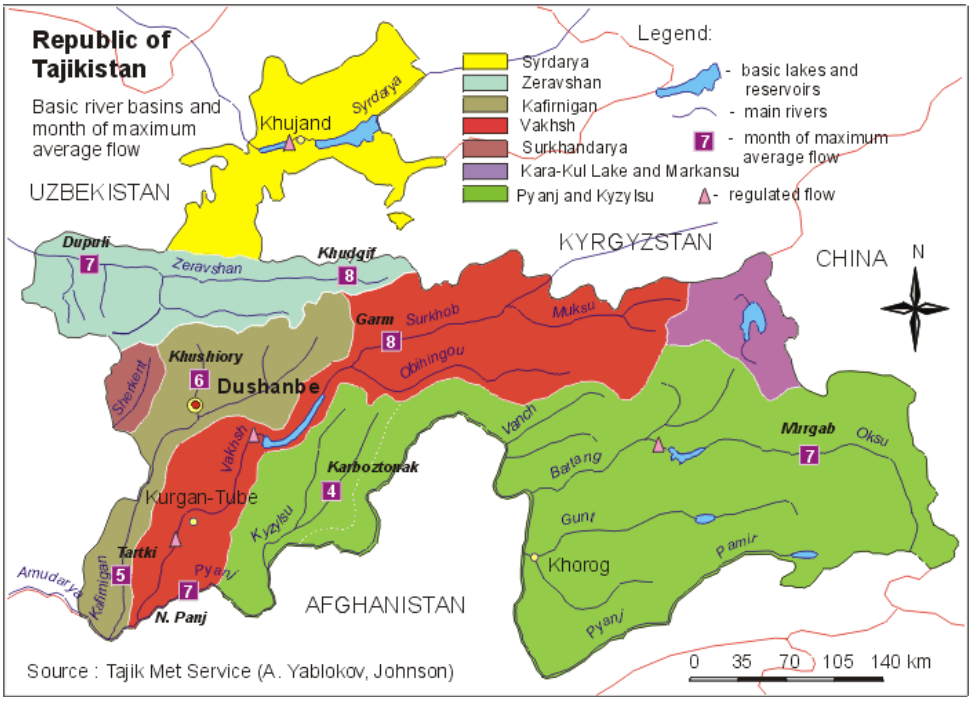


Source: Tajikistan 2002, State of Environment Report

Fig. 2.2-7 Distribution Map of Annual Precipitation in Tajikistan

(3) Hydrology

Tajikistan has rich water resource. Although Tajikistan has occupied appropriate 20% of the total area of the Aral Sea basin, the mountain zone gives about 90% of the total surface runoff. Tajikistan's water resources are mainly formed by glacier melting and precipitation.



Source：Tajikistan 2002, State of Environment Report

Fig. 2.2-8 Main Hydrological Systems in Tajikistan

Table 2.2-2 (1/5) Main River System in Tajikistan (Syrdarya River)

River Basin	Name	Flow Into	Length (km)	River-Basin Area (km)	Fall of the Water Surface (m)	Source Type
Isfana	Isfana	Syrdarya	69	539	-	
Khojabakirgan	Khojabakirgan	Syrdarya	117	2,150	-	
Oksu	Suluistyk (Istyk)	Oksu	115	1,330	1,010	
	Oksu	Syrdarya	93	1,170	-	
Seldara	Balandkiik	Seldara	71	1,630	2,000	
Shirinsay	Shirinsay	Syrdarya	108	780	-	

Table2.2-2 (2/5) Main River System in Tajikistan (Zeravshan River)

River Basin	Name	Flow Into	Length (km)	River-Basin Area (km)	Fall of the Water Surface (m)	Source Type
Fandarya	Yagnob	Fandarya	116	1,660	2,000	Glacial-snow
	Fandarya	Zeravshan	24	3,230		Glacial-snow
Kshtut	Kshtut	Zeravshan	53	863	2,680	
Magiyan	Magiyan	Zeravshan	67	1,100	2,520	
Zeravshan	Zeravshan (Matcha)	-	877	12,300	-	Glacial-snow

Table2.2-2 (3/5) Main River System in Tajikistan (Pyanj River)

River Basin	Name	Flow Into	Length (km)	River-Basin Area (km)	Fall of the Water Surface (m)	Source Type
Kafirnigan	Khanaka	Kafirnigan	61	630	2,930	
	Lliak	Kafirnigan	97	829	1,880	
	Sardaimiena	Kafirnigan	66	1,190	2,660	
	Varzob	Kafirnigan	71	1,740	3,090	Glacial-snow
	Kafirnigan	Pyanj	387	11,600	2,970	Glacial-snow
Vakhsh	Ragnov	Obikhingou	62	781	1,080	
	Obikhingou	Vakhsh	196	6,660	2,020	Glacial-snow
	Yavansu	Vakhsh	102	1,190	870	
	Alayskaya	Vakhsh (Surkhob)	235	8,380	-	
	Sorbog (Gorif)	Vakhsh (Surkhob)	81	1,780	2,280	
	Vakhsh (Surkhob)	Pyanj	524	39,100	3,100	Glacial-snow
Kizilsu	Obimazar	Kizilsu	62	411	1,440	
	Tairsu	Kizilsu	118	1,860	1,350	
	Yaksu	Kizilsu	160	2,710	3,060	Snow-rain
	Kulyabdarya	Yaksu	55	796	730	
	Kizilsu	Pyanj	230	8,630	2,370	Snow-rain
Bartang	Akbaytal	Bartang	81	1,650	1,590	
	Bartang	Pyanj	528	24,700	-	Glacial-snow
Gunt	Shakhdara	Gunt	142	4,180	2,630	Glacial-snow
	Tokuzbulak	Gunt	62	1,110	1,490	
	Gunt (Alichur)	Pyanj	296	13,700	2,440	Glacial-snow
Kudara	Kokuybelsu	Kudara	102	2,300	1,500	
	Tanymas	Kudara	70	1,850	1,100	
Pamir	Pamir	Pyanj	117	4,320	1,310	Glacial-snow
Vanch	Vanch	Pyanj	103	2,070	1,790	Glacial-snow
Yazgulem	Yazgulem	Pyanj	80	1,970	1,720	Glacial-snow

Table2.2-2 (4/5) Main River System in Tajikistan (Surkhandarya River)

River Basin	Name	Flow Into	Length (km)	River-Basin Area (km)	Fall of the Water Surface (m)	Source Type
Surkhandarya	Shirkent	Karatag	57	550	2,770	
Surkhandarya	Karatag	Surkhandarya	99	2,430	3,420	Glacial-snow

Table2.2-2 (5/5) Main River System in Tajikistan (Others)

River Basin	Name	Flow Into	Length (km)	River-Basin Area (km)	Fall of the Water Surface (m)	Source Type
Issykbulak	Issykbulak	Yashilkul Lake	51	598	980	
Karajilga	Karajilga	Karakul Lake	62	972	1,160	
Karamazar	Karamazar	-	58	544	2,260	
Kattasay	Kattasay	-	58	631	-	
Shurbulaksay	Shurbulaksay	-	92	712	-	
Utkansay	Utkansay	-	57	248	2,020	

There are 947 rivers with length more than 10 km in Tajikistan and the average annual flow formed equals 64km³/year. The main rivers in Tajikistan are the Pyanj, Kafirnigan, Vakhsh, Kizilsu, Syrdarya, Zeravshan and Surkhandarya. Pyanj (Amudarya) river and Syrdarya river are international rivers which flow into Aral sea at Central Asia. Pyanj is trans-boundary river shared by Afghanistan, Tajikistan, Turkmenistan and Uzbekistan. Syrdarya is shared by Kyrgyzstan, Uzbekistan, Tajikistan and Kazakhstan.

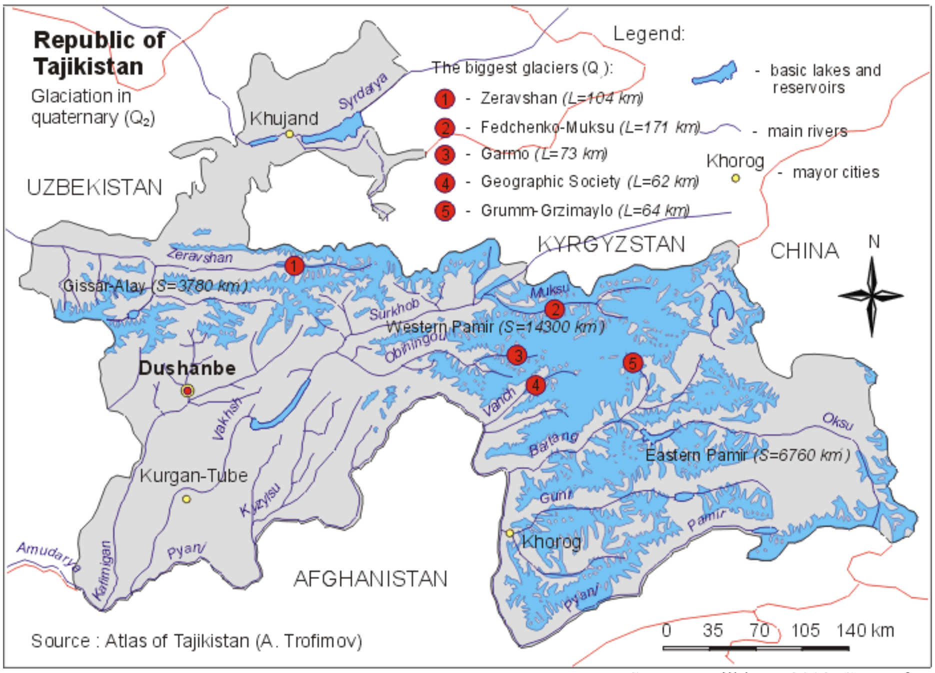
There are around 1,300 lakes in Tajikistan with total reservoir area of 705 km². 73% of them are located in Pamir-Alay Mountains area at an elevation of 3,500-5,000m. Lakes in Tajikistan contain over 46.3 km³ of water, including 20 km³ of fresh water. Most lakes in mountains area are hard to access and therefore are not well-studied. There are currently 9 operational water reservoirs containing total volume 15.34 km³ of water. Largest Main reservoirs are Kairakum at the Syrdarya river and Nurekat at the Vakhsh river. They are used for electric power generation, irrigation, fish breeding, water supply, and mudflow protection. Main lakes and reservoirs are shown in Table 2.2-3.

There are 14,509 glaciers in Tajikistan covering total area of 11,146 km² which occupies 8 percent of the country's territory. The total glacier stock amounts to 845km³, 13 times higher than the annual flow of all Tajik rivers and 7 times higher that of the average annual flow of all rivers within the Aral Sea Basin.

Glaciers with an area of over 1km² form only 20% of total. However they contain 85 percent of total ice volume. Glacier melting comprises up to 25% of all water resources and it supplies 50% of summer flow in dry years.

Table 2.2-3 Main Lakes and Reservoirs in Tajikistan

Name	Water-surface area (sq km)	Catching Area (sq km)	Altitude Above Sea Level (m)	Volume (million cubic meter)
Akkul	1.9	32	4,485	-
Bulunkul	3.4	535	3,757	-
Chakankul	9.2	721	4,126	-
Chapdara	3.2	24	4,529	-
Drumkul	1.5	278	3,335	-
Farkhad Reservoir	-	-	300	46.0
Iskanderkul	3.4	760	2,195	-
Karakul	380.0	4,150	3,914	-
Kattasay Reservoir	2.04	-	1,165	55
Kayrakkum Reservoir	520.0	-	347	4,160
Kukjigit	6.7	-	4,262	-
Marguzor	1.2	178	2,139	-
Muminabad Reservoir	3.4	-	1,204	25
Nurek Reservoir	106.0	-	910	10,500
Payron	0.14	-	-	-
Rangkul	7.8	1,890	-	-
Rivankul	1.1	102	3,803	-
Salangur	2.4	90.3	4,172	-
Sarez	86.5	16,500	3,239	-
Sasykkul	8.9	-	3,852	-
Selbur Reservoir	2.3	-	581	20
Shodavkul	2.2	80	3,239	-
Shorkul	15.4	2,410	-	-
Turumtaykul	8.9	49	4,213	-
Tuzkul	1.3	-	3,798	-
Yashilkul	35.6	5,280	3,734	-
Zaroshkul	5.5	77.5	4,518	-
Zorkul	38.9	1,080	4,126	-



Source: Tajikistan 2002, State of Environment Report

Fig. 2.2-9 Glaciers in Tajikistan

Table 2.2-4 Main Glaciers in Tajikistan

Name	River Basin	Location	Area (km^2)
Abdukagor	Vanch		28.7
Academy of Sciences	Muksu		46.0
Aiujilga	Muksu		32.2
Bashurvdara	Bartang		60.2
Beleuli	Sauksay		22.5
Big Saukdara (25.2 km)	Sauksay	Zaalayskiy Range	69.2
Bivachny (27.8 km)	-	Academy of Sciences Range	197.0
Chekmantash	Sauksay		34.2
Darvaz (16.6 km)	Obimazar	Darvaz Range	44.0
Devlokhan	Obikhingou		20.5
Fedchenko (71.2 km)	Muksu	North Pamir	907.0
Fortambek	Muksu		74.5
Gando (22.5km)	Obikhingou	Academy of Sciences Range	55.0
Garmo (27.5 km)	Obikhingou	Academy of Sciences Range	153.3
Geographical Society	Vanch	Academy of Sciences Range	81.8
Grum-Grjimaylo (36.7 km)	Tanymas	Tanymas river-head	160.0
Jalaykumsay	Balandkiik		26.5
Kommunizm Academy	Muksu		33.5
Komsomolec	Vanch		21.2
Korjenevskogo	Kyzylsu (Alayskaya)		89.1
Kuzgun	Sauksay		73.2
Kyzylsu	Muksu		29.2
Lenin	Yazgulem		79.9
Maliy (Minor) Tanymas	Muksu	Academy of Sciences Range	66.5
Mazardara (19.5 km)	Yazgulem	Yazgulem River-Head	32.5
Mazorsky (17.3 km)	Obikhingou	Darvaz Range	35.0
Medvejiy	Vanch		24.7
Moskvina	Muksu		46.9
Mushketova	Muksu		31.0
Nalivkina	Muksu		101.5
October (17.6 km)	Karakul Lake	Zaalaysky Range	116.0
Oshanina (Muzgazy)	Muksu		28.7
Petra Pervogo (Peter the Great)	Ragnov		22.5
Pravy (Right) Dustizor	Vanch		29.2
Radoc	Bartang		29.8
Rakzou #1 (16.5 km)	Yazgulem	Yazgulem River-Head	76.5
Safedob	Gunt		21.5
Severny (North) Kyzkurgan	Balandkiik		52.0
Severny (North) Tanymas	Tanymas		61.0
Severny (North) Zulumart	Sauksay		39.8
Shteklozar (Markovskogo)	Gunt		38.0
Sugran (24.2 km)	Muksu	Petra Pervogo Range	48.0
2nd Tanymas	Tanymas		21.8
3rd Tanymas	Tanymas		25.1
Udarif	Bartang		28.2
Vitkovskogo	Muksu		54.0
Yazgulemdara	Bartang		58.6
Zapadny (West) Beleuli	Sauksay		22.3
Zeravshan (26.5 km)	Zeravshan	Zeravshan River-Head	41.0
Zordi-Birauso	Obikhingou		31.8

(4) Hydrological and Meteorological Condition in Khatlon

1) Meteorological Condition

Southwestern part of Khatlon where is confluence area of Pyanj river with Kafirnigan river and Vakhsh river is occupied by Steppe climates (BS). Western part including the Kurgan Tyube of province capital is Mediterranean climates (Csa) and eastern part including Kulyab of second city is Warm Summer Continental climates (Dsb).

The average annual temperature at an elevation of 300-500m varies in 16-17°C, and at an elevation of 1,100-1,200m in 11-13°C. Precipitation falls mostly as rain in Khatlon. Average annual precipitation ranges from 300 to 700mm. Amount of rainfall increases on the plains and foothills from south to north and also with altitude increases. However, the annual precipitation could drop to 50-60% of the average mentioned above in past dry years.

The Fig. 2.2-10 indicates monthly absolute maximum temperature, monthly absolute minimum temperature, Monthly average temperature and annual precipitation in Kurgan Tyube in 2011.

Annual average temperature is 17.7°C. While maximum temperatures in May – August are over 40°C, minimum temperatures are below 20°C. The daily range between maximum and minimum is large throughout the year. Annual precipitation is 311mm. 90% of total precipitation is concentrated during winter season from November to March. There are little precipitations during summer season from April to September. No precipitations are observed from July to September.

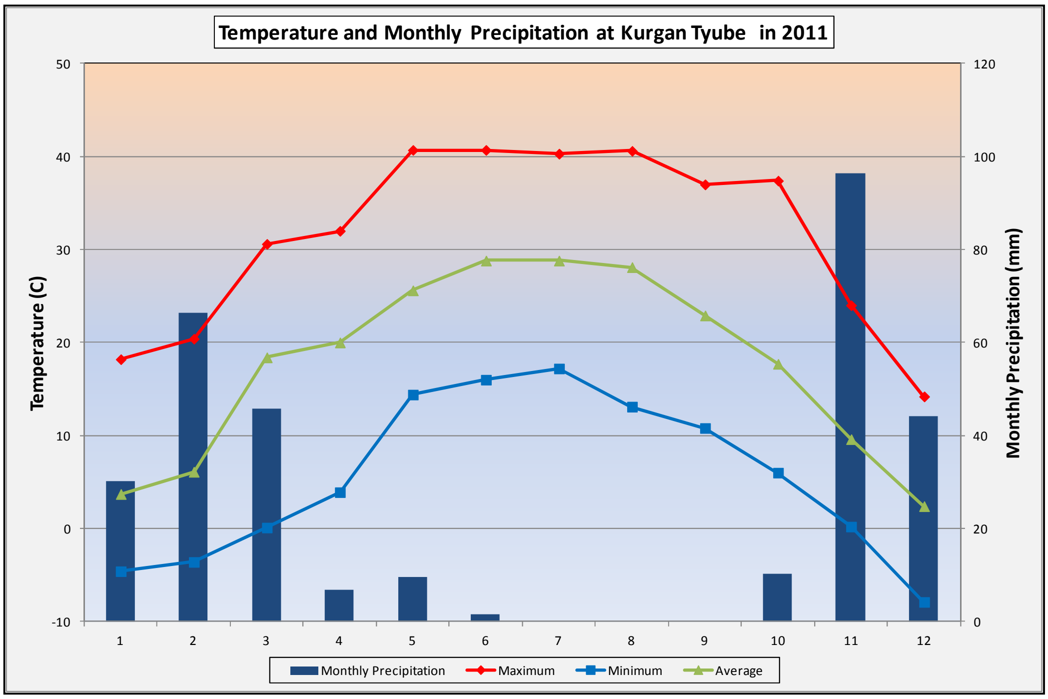


Fig. 2.2-10 Meteorological Condition in Kurgan Tyube (2011)

2) Hydrological Condition

Main rivers of Khatlon province are Pyanj river bordering with Afghanistan and the first tributary rivers of Pyanj, Kafirnigan, Vakhsh, Kizilsu and Obinunoc. Location map of main rivers of Khatlon and mini-hydropower potential sites is shown in Fig. 2.2-11.

Regarding to hydropower potential sites in this Study, Nurbakhsh, Pakhtakor, Faizobod and Bohtar are located in Vakhsh river basin and these sites are planned as hydropower plants using artificial canals for irrigation, pipe water and so on.

Surhak-1, Yokunch, Shibanai and Baljuvon are located at Kizilsu river basin. Yokunch and Baljuvon are planned as hydropower plants at tributary of Kizilsu. And Surhak-1, Sathad and Shibanai are planned using artificial canals. The outline of Vakhsh river and Kizilsu river is mentioned below.

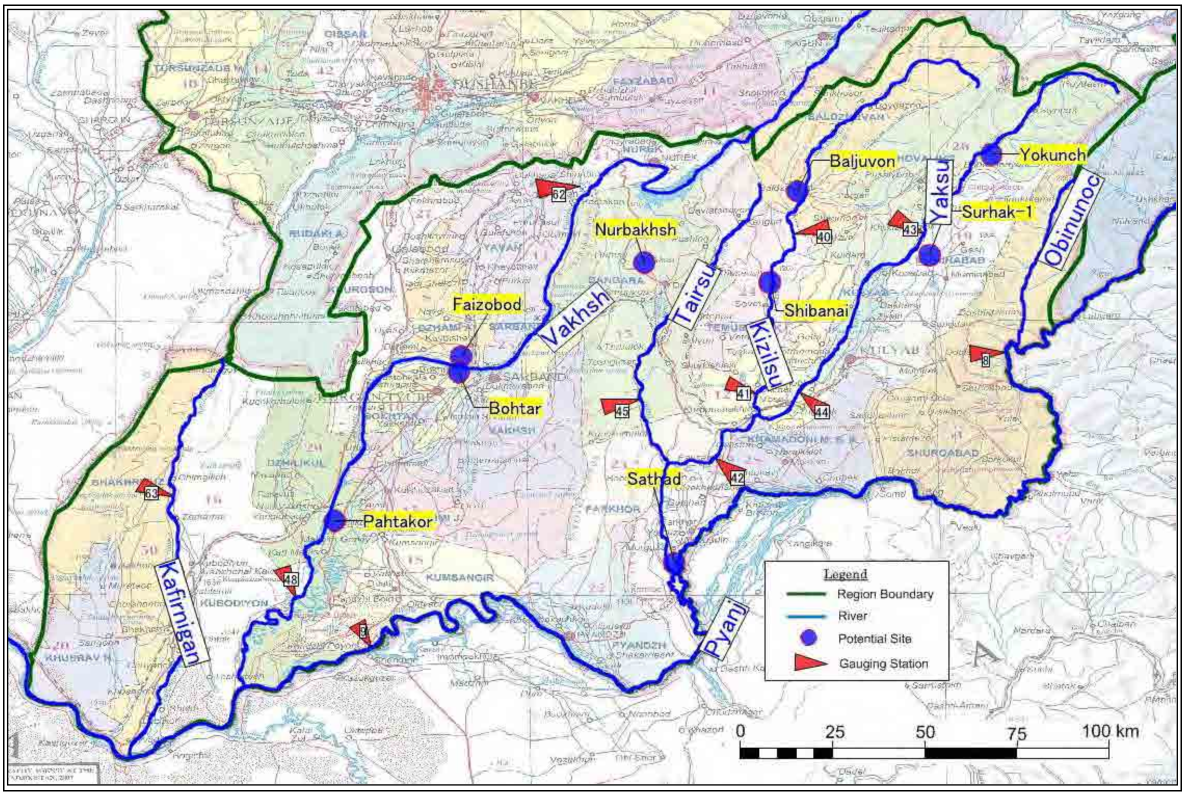


Fig. 2.2-11 Main River System and Potential Sites in Khatlon

Vakhsh River

	
Vakhsh River	PK46 (Irrigation Canal)

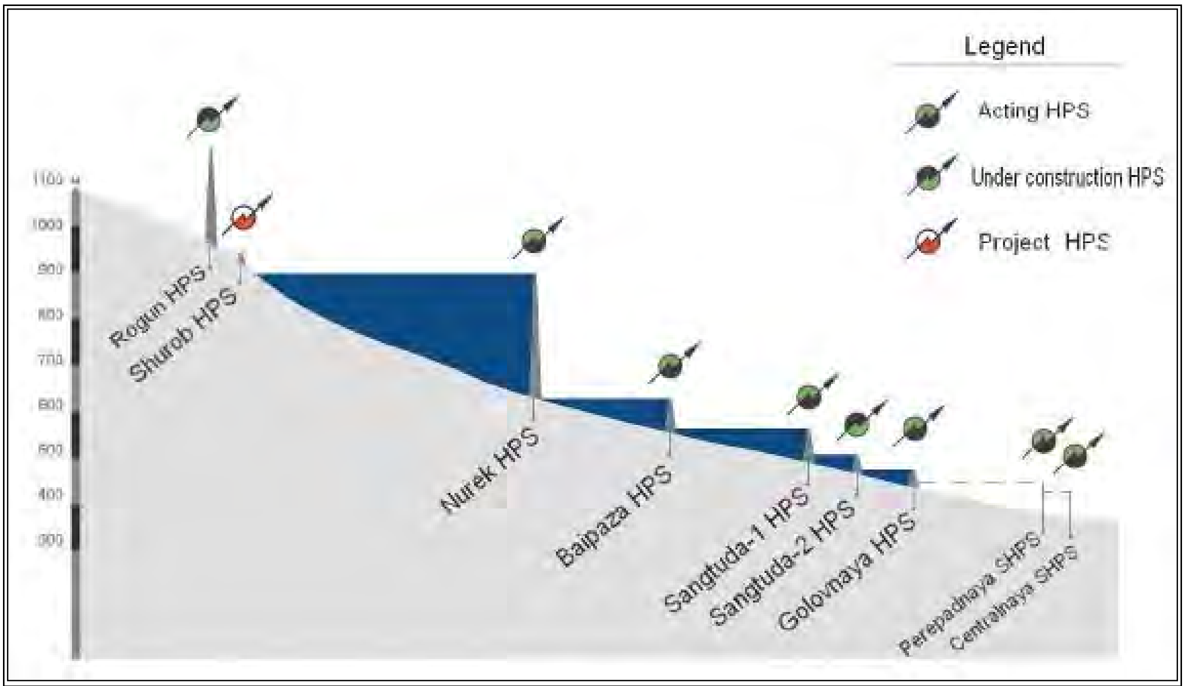


Fig. 2.2-12 Hydropower Plants in Vakhsh River

Vakhsh river sourced by glaciers at Pamir has 524km length and 39,100km^2 basin area. There are six hydropower plants along Vakhsh river with total capacity of 4,555MW, namely Nurek (3,000MW) which is largest capacity hydropower plant in Tajikistan, Baipaza (600MW), Sangtuda-1 (670MW), Golovnaya (240MW), Prepadaya (29.95MW) and Central (15.1MW). In addition to them, two new hydropower plants, Rogun (3,600MW) and Sangtuda-2 (220MW) are at the construction stage and Shurob (800MW) is at the planning stage. River profile with hydropower plants is shown in Fig. 2.2-12.

Khatlon province has a flourishing agriculture of cotton. Many artificial canals with source from Vakhsh river are constructed. Irrigated lands by Vakhsh river concentrates up to 80% of all staple cotton crops cultivated in Tajikistan. The slope and hilly areas are used for planting potatoes, grains, vegetables, rice, grapes and orchards. Location map of existing hydropower plants and potential sites is shown in Fig. 2.2-13.

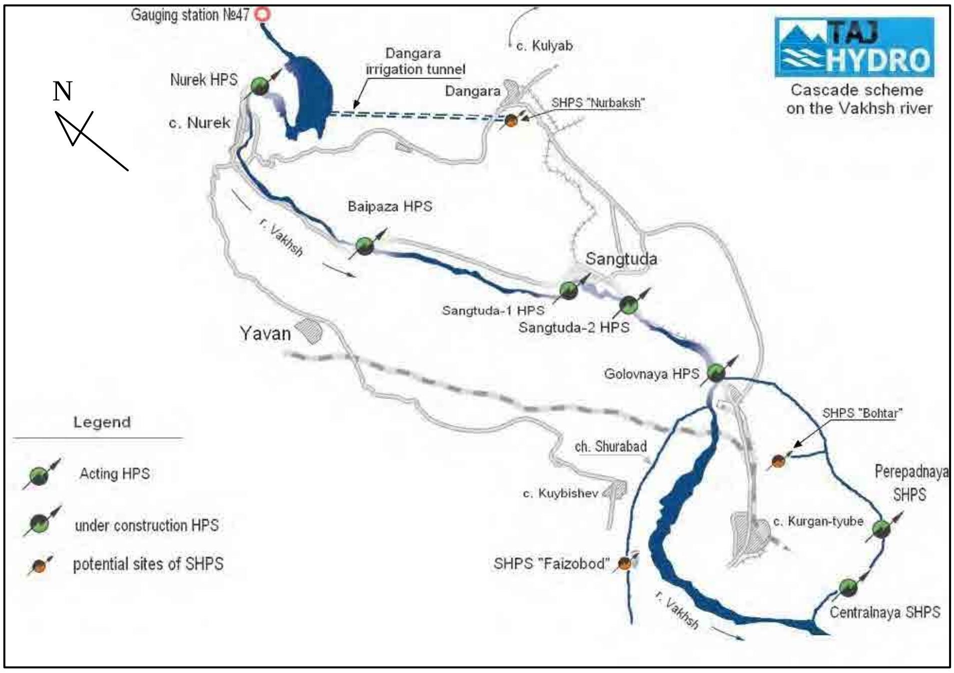


Fig. 2.2-13 Location Map of Potential Sites at Vakhsh River System

Monthly average discharge of 48-Zapat (1983 - 1992) gauging station at lower stream is shown in Fig 2.2-14. Monthly minimum discharge is November (Average 357.6m^3/s) and monthly maximum is July (Average 357.6m^3/s). Annual range of monthly discharge is approximately 2.9 times. Flood season by melting glaciers and snow lasts from April to September and the peak runoff occurs in July – August.

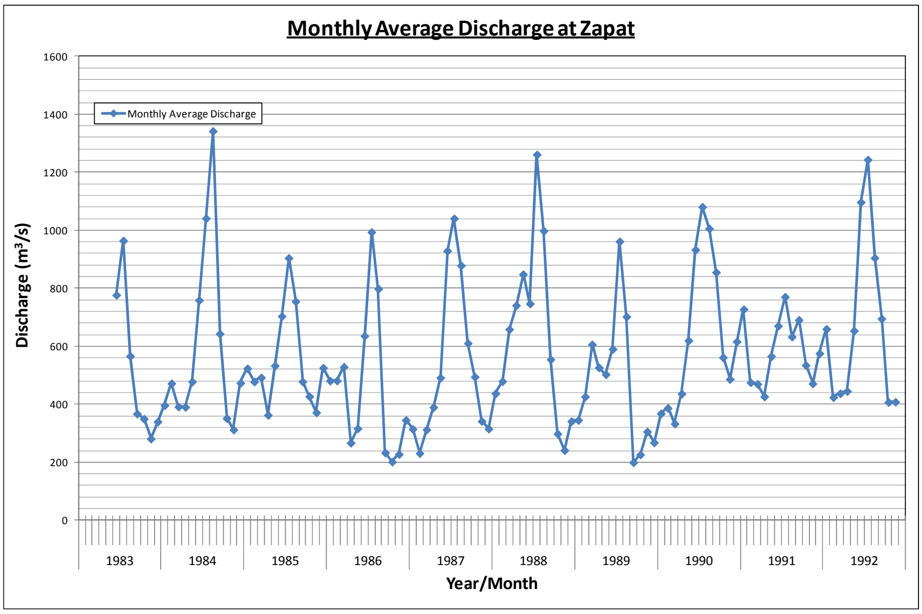


Fig. 2.2-14 Monthly Average Discharge at 48-Zapat of Vakhsh River (1983 – 1992)

Kizilsu River

	
Kizilsu River	Yaksu River

Kizilsu river flows at western part of Khatlon province and has 230km length and 8,630km^2 basin area. Kizilsu river consists of main river and two tributary rivers, Taisru and Yaksu. Monthly average discharge of observation stations at 40-Bobonshaid (1980 - 1992) of Kizilsu river, 41-Samonchi (1980 - 1992) of Kizilsu river and 43-Kanoztonak of Yaksu river are shown in Fig 2.2-15, Fig 2.2-16 and Fig 2.2-17.

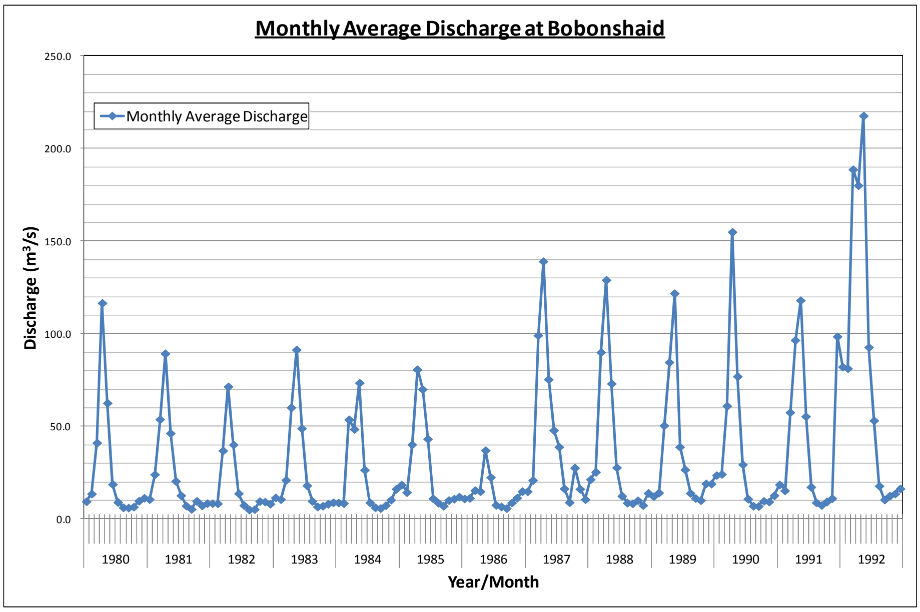


Fig. 2.2-15 Monthly Average Discharge at 40-Bobonshaid of Kizilsu River (1980 – 1992)

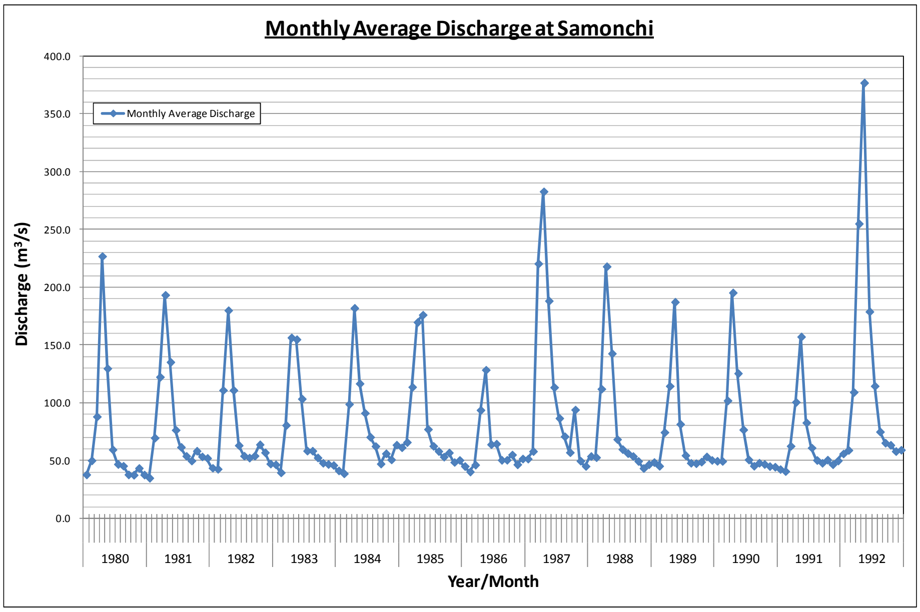


Fig. 2.2-16 Monthly Average Discharge at 41-Samonchi of Kizilsu River (1980 – 1992)

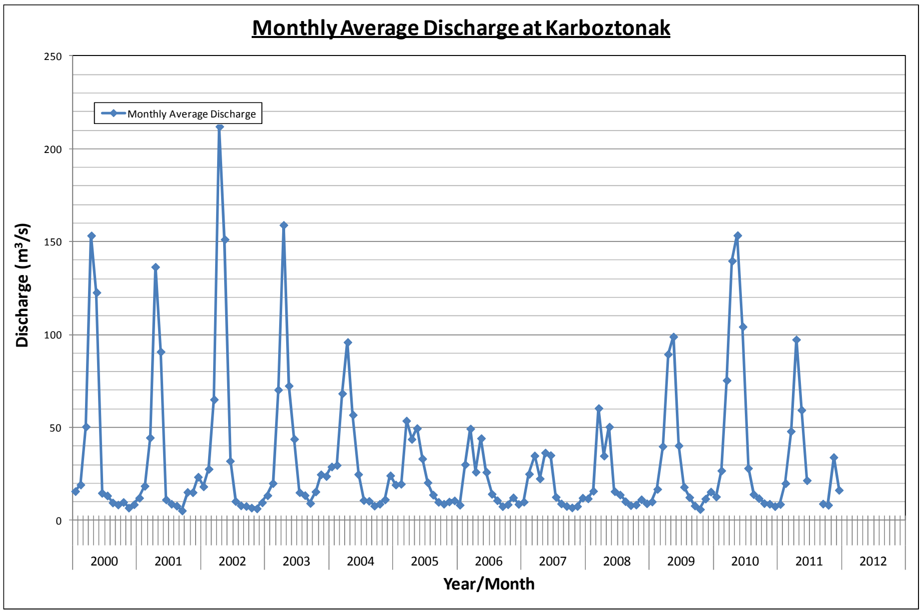


Fig. 2.2-17 Monthly Average Discharge at 43-Karboztonak of Yaksu River (2000 – 2012)

Kizilsu river is sourced by snow melting and rainfall from northeastern mountain area with an elevation of 2,000 – 3,000m. Discharge of each station follows:

ID	Station	Minimum	Maximum	Flood Season	Annual Range
40	Bobonshaid	September (7.8m^3/s)	April (100.8m^3/s)	April to June	12.9
41	Samonchi	January (7.1m^3/s)	April (188.2m^3/s)	April to June	4.0
43	Karboztonak	September (8.8m^3/s)	April (104.8m^3/s)	April to June	11.9

Flood season lasts from March to June and the peak runoff occurs in April. 40-Bobonshaid and 43-Karboztonak located at upper streams have narrow catchment area and large annual range. Discharge at low water season should be taken account into planning of power generation of Yokunch and Baljuvon located nearby these stations.

The biggest discharge of 1,310m^3/s was registered on 10th of May, 1969. The water includes lots of sedimentary particles and fractional loads and it reached up to 0.5ton/s. Sediments of Kizilsu river reaches around 18 million tone in a year and its riverbed is not steady and transformed. For the countermeasure of flood, riverside villages construct big bunds. Runoff on the mountain area with poor vegetation causes mudflows of the river.

2.2.3 Ecosystem

Changeable mountain climatic conditions and hard natural historical processes promoted formation of a unique biological diversity in Tajikistan. The richness of biodiversity is observed at the genetic, species, population, biocoenosis, and ecosystem levels; there are many relict and endemic species. Most of the components are vulnerable to anthropogenic impacts. The area of contemporary Tajikistan contains more than 9 thousand species of sporebearing and flowering plants and over 13 thousand of animal species. The Red Data Book of Tajikistan includes 226 plant and 162 animal species, which are rare or endangered.

Table 2.2-5 Main Components of Biodiversity

No.	Composition	Number
1.	Ecosystems	12 types
2.	Types of vegetation	20 types
3.	Flora	9771 species
4.	Wild relatives of cultivated plants	1000 species
5.	Endemic plants	1132 species
6.	Plants, listed in the Red Data Book of Tajikistan	226 species
7.	Fauna	13531 species
8.	Endemic animals	800 species
9.	Animals, listed in the Red Data Book of Tajikistan	162 species
10.	Agricultural crops	500 varieties
11.	Domestic animals	30 breeds

Source: National Strategy and Action Plan Conservation and Sustainable Use of Biodiversity, 2003

(1) Vegetation and Flora

The contrast combination of arid, sub-arid, and humid conditions, with the precipitation fluctuation from 70 to 2000 mm a year, promoted formation of complex, particularly rich flora (9,771 species) and vegetation, from broadleaf forests and boreal meadows to subtropical and tropical deserts.

The main types of vegetation are shown below;

- Broad-leaf forest (*Acer turkestanicum, Juglans regia*)
- Tugai forest (*Populus pruinosa, Elaeagnus angustifolia*),
- Small-leaf forest (*Betula tianschanica*)
- Juniper forest (*Juniperus turkestanica*, *J.seravschanica, J.semiglobosa*)

- Xerophylous light forest (*Pistacia vera, Amygdalus bucharica*)
- Brushwood (*Rosa kokanica, R.divina, Aflatunia ulmifolia, Exchorda Albertii, Ephedra equisitina*)
- Semiwoody-semibrush vegetation (*Haloxylon persicum, Salsola richterii, Calligonum caput medusae, C.griseum, C.arborescens, C.calcareum, Hammada leptocloda, Artemisia kochiiformis, Ceratoides papposa*, *Cousinia pannosa, C.stephanophora*)
- Steppe (*Festuca alaica, F.subcata, F.pamirica, Artemisia dracunculus*)
- Semisavanna (*Prangos pabularia, Inula grandis, Ferula kuhistanica*),
- Meadow (*Polygomum coriarum, Ligularia thomsonii*, *Acantholimon tatarica, Onobrychis echidna*)

The most valuable representative communities of biodiversity which need protection are as follows: juniper, birch, and walnut forests, ash trees, aflatunia, and pagoda tree brushwoods, mountainous steppes, meadows, tugai, saxaul, and pistachios. They are threatened not only by a reduction of their areas, but also by a destruction of their community structures and a loss of valuable plant and animal species.

More than 2,500 species of plants are defined in flora from other nature-geographic areas of Tajikistan. Some of these are cultivated flora introduced in botanical gardens and parks and grown on the slopes as fast-growing woody plants. The most typical species, common in Tajikistan are: pine (*Pinus*), spruce (*Picea*), oak (*Quercus*), bastard acacia (*Robinia pseudacacia*), chestnuts (*Aesculus*), soapberry tree (*Koelreuteria paniculata*), oriental tree of heaven (*Ailanthus orientalis*), cypress (*Cupressus*), and many others. All are used for planting out.

Table 2.2-6 List of Flora

No.	Type, class	Total			introducent			Wild relatives		
		species	genus	family	species	genus	family	species	Genus	family
1.	Algae	2145	500	100	–	–	–	2145	500	100
2.	Fungi	2233	284	78	–	–	–	2233	284	78
3.	Lichenes	524	85	27	–	–	–	524	85	27
4.	Bryophyta	358	144	52	–	–	–	358	144	52
	Total:	**5260**	**1013**	**257**	**–**	**–**	**–**	**5260**	**1013**	**257**
5.	Pteridophyta	22	14	5	–	–	–	22	14	5
6.	Gymnospermae	35	9	5	9	6	3	26	3	2
7.	Angiospermae, including:	4454	973	113	312	106	4	4142	867	109
	・Monocotylenae	752	161	18	22	6	–	730	155	18
	・Dicotyledonae	3702	812	95	290	100	4	3412	712	91
	Total:	**4511**	**996**	**123**	**321**	**112**	**7**	**4190**	**884**	**116**
	Grand Total:	**9771**	**2009**	**380**	**321**	**112**	**7**	**9450**	**1897**	**373**

Source: National Strategy and Action Plan Conservation and Sustainable Use of Biodiversity, 2003

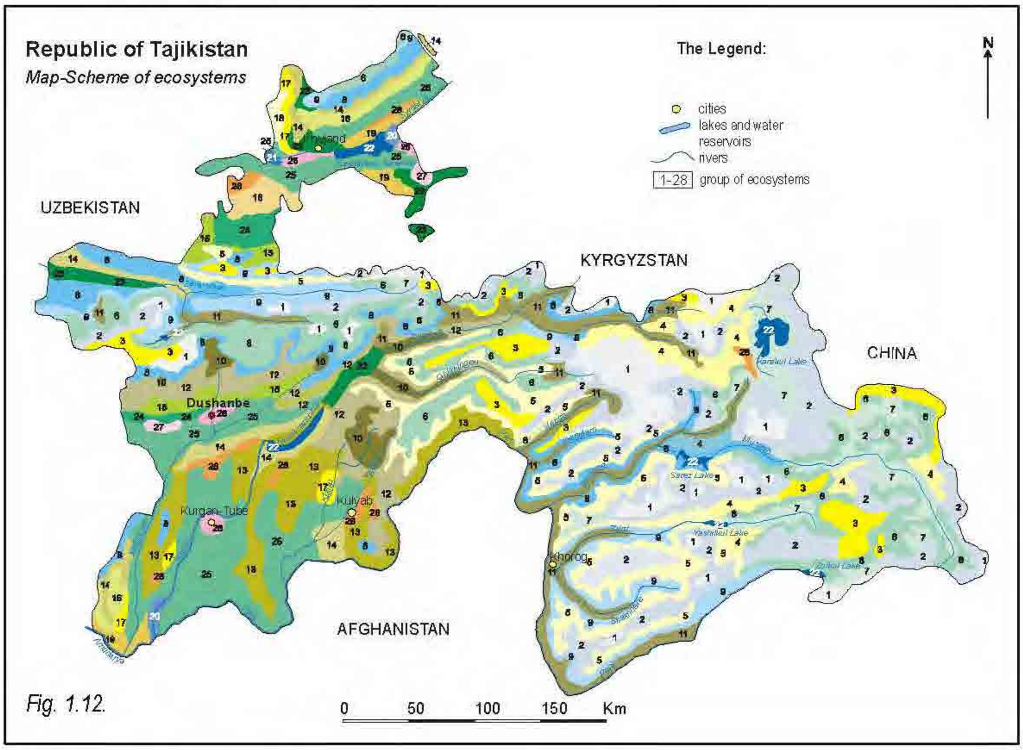


Fig. 1.12. **Legend to Map-Scheme of ecosystems**

Nival Glacier Ecosystems
- 1 Glaciers and snowfields
- 2 Rocks and taluses with rare vegetation

High Mountain Desert Ecosystems
- 3 Rare vegetation
- 4 Wormwood-teresken, steppe
- 5 Dwarf-shrub-steppe

High Mountain Meadow and Steppe Ecosystems
- 6 Forbs meadow steppe, thymes
- 7 Low-grass meadow, swamp

Mid-Mountain Conifer Forest Ecosystems
- 8 Various-shrub steppe and light forest
- 9 Forbs meadow-forest

Mid-Mountain Mesophyllic Forest Ecosystems
- 10 Broad-leaf forest
- 11 Flood-plain small-leaf forest
- 12 Light forest, foliage tree, mesophyllic shrub

Mid-Mountain Xerophytic Light Forest Ecosystems
- 13 High-grass, shrub, pistachio
- 14 Forbs wormwood, almond

Mid-Low-mountain Semisavanna (savannoide) Ecosystems
- 15 High-grass
- 16 Forbs and shrub
- 17 Low-grass semisavanna

Foothill Semidesert and Desert Ecosystems
- 18 Low-grass, saltwort-wormwood
- 19 Sand, semi-woody, shrub

Wetland Ecosystems
- 20 Tugai
- 21 Meadow, swamp
- 22 Wetland

Agroecosystems
- 23 Gardens, forest-plantations, personal plots
- 24 Rain-fed pastures
- 25 Irrigable pastures

Urban Ecosystems
- 26 Municipal
- 27 Industrial

Ruderal-degraded Ecosystems
- 28 Weed, ruderal

Fig. 2.2-18 Map of Vegetation

Source: National Strategy and Action Plan Conservation and Sustainable Use of Biodiversity, 2003

(2) Fauna

The fauna of Tajikistan is diverse in its genetic composition. The mountain fauna is richer than that of the plains; it contains a considerable number of European-Siberian and Eastern Asian elements. The fauna of lowland hot deserts has a lot of Indo-Himalayan, Ethiopian, and Mediterranean species.

A considerable diversity of environmental conditions, ecosystem variations and plant communities rich in composition and structure, as well as ancient many-pole faunogeneses promoted the conservation and development of over 12 thousand species of invertebrates and 531 species of vertebrate animals on the territory of Tajikistan.

Mammals (Mammalia) of Tajikistan include 84 species, grouped in 47 genera, 22 families, and 6 orders: insectivorous, cheiroptera, hares, rodents, carnivorous, and ungulates.

Aves (birds) is the most numerous (in specific composition) class of vertebrates of Tajikistan. Ornithofauna includes 346 species of birds related to 16 orders (table 1.9). According to the type of residence, birds are subdivided into resident, migratory-nesters, birds of passage, and wintering. Birds occur in all ecosystems, and many of their representatives are background. Nearly 10% (37 species) are assigned to rare or endangered. The most critical species are falcons and bustards.

Reptiles (Reptilia) of Tajikistan are very diverse, being represented by 47 species included in 2 orders, 13 families, and 23 genera.

Amphibians (Amphibia) are represented by 2 species: – lake frog (*Rana ridibunda*) and green toad (*Bufo viridis*). The cultivation and watering of desert and fallow lands caused the lake frog area expansion. The green toad in Tajikistan has vertical range spreading and occurs at 300- 3800 masl.

Fish (Pisces) of Tajikistan are currently inhabited by 52 species belonging to 12 families. The most diverse fish populations are those of rivers – 52 species, ponds – 17, lakes – 20, springs – 10. The whole diversity of fish has nearly game species (table 1.12, fig. 1.16), including Amudarya trout (*Salmo trutta morfa fario*), pike (*Esox lucius*), redeye (*Scardinius erythrophthalmus*), Aral asp (*Aspius aspius taeniatus*), etc. The relic and endemic species contain 3 sturgeon species (genus of shovel-nosed pseudosturgeons): Amudarya great – (*Pseudoscaphirhynchus kaufmannii*), Amudarya small (*P.hermanii*) and Syrdarya pseudosturgeon (*P.fedtschenkoi*).

Invertebrates. By the present time, there are 13 thousand species of invertebrate (Invertebrata) animals in Tajikistan, including: protists (Protozoa) – 300 species, parasitic worms (Vermes) – 1400, arachnoids (Arachnida) – 715, insects (Insecta) – 10000, mollusks (Mollusca) – 204.

The negative human impact is also produced on the specific composition and numbers of many groups of invertebrates. The Red Data Book of Tajikistan includes 58 invertebrate animals, 50 of which are insects. Much more species require protection, and the list of rare and endangered species will be increasing, as the invertebrates are being studied.

Table 2.2-7 Specific Diversity of Animals

Taxa	Number		
	Total	Endemic	Listed in the Red Data Book
Invertebrates	**12619**	**799**	**58**
Protozoa	300	-	-
Vermes	1400	-	-
Arachnida	715	-	-
Insecta	10,000	796	50
Mollusca	204	3	8
Vertebrates	**531**	**1**	**104**
Amphibia	2	-	-
Reptilia	47	-	21
Pisces	52	-	4
Aves	346	-	37
Mammalia	84	1	42
Total	**13150**	**800**	**162**

Source: National Strategy and Action Plan Conservation and Sustainable Use of Biodiversity, 2003

(3) Trends of Biological Diversity Transformation

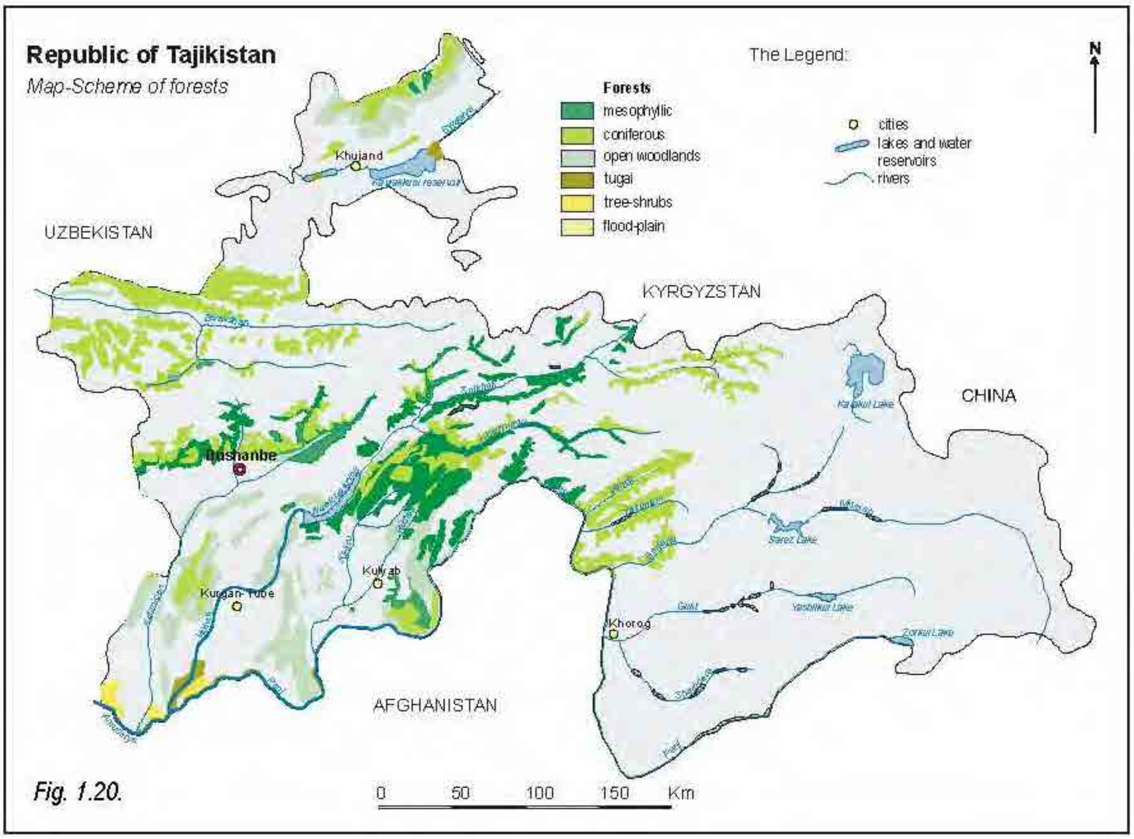
During the last decades, deforestation has become really threatening. The area of valuable juniper (*Juniperus*), walnuts (*Juglans*), birch (*Betula*), and pistachio (*Pistacia*) forests has been reduced by 20-25%. This produces a negative impact on the state of natural ecosystems and coenosis structures. The specific diversity is gradually transforming, and community compositions loosing over 8-10 types of ecosystems in the period of 3-7 years. Tree cutting leads to an outbreak of weeds, alien and quarantine plant species, erosion, and a progressive insiccation and impoverishment of winter pastures. Shrub vegetation is being eradicated and used as fuel. In spite of slightly increased forest areas, the average resource of woods in Tajikistan is being steadily reduced.

Only for the recent 50 years, due to the impact of anthropogenic factor, 226 plant taxa and 162 animal species have become rare or endangered and are listed in the Red Data Book of Tajikistan; 10 vertebrate species are listed in the Red Data Book of the International Union for Conservation of Nature and Natural Resources (IUCN). 3 species of animals and 16 species of plants are extinct.

Table 2.2-8 Type Classification of Forested Areas and Plant Resources

Name	Total Area (ha)
Conifers. including:	146.5
Juniper (*Juniperus)*	146.5
Hard-leaf. including:	62.8
Saxaul (*Haloxylon persicum*)	11.4
Elm (*Ulmus*)	0.7
Ash-tree (*Fraxinus*)	0.7
Maple (*Acer*)	49.1
Bastard acacia (*Robinia pseudacacia*)	0.9
Soft-leaf. including:	14.9
Birch (*Betula*)	1.9
Poplar (*Populus*)	9.3
Tree willow (Salix sp. div)	3.7
Total of major forest-forming breeds	224.2
Other tree breeds. including:	110.3
Almond (*Amygdalus*)	17.6
Walnut (*Juglans regia*)	11.2
Cherry plum (*Prunus sogdiana*)	2.6
Pistachio (*Pistacia vera*)	78.9
Shrubs. including: Tamarisks (*Tamarix*), Wild rose (*Rosa*). barberry (*Berberis*)	66.5
Total:	**401**

Source: National Strategy and Action Plan Conservation and Sustainable Use of Biodiversity, 2003



Source: National Strategy and Action Plan Conservation and Sustainable Use of Biodiversity, 2003

Fig. 2.2-19 Map of Forests

(4) Protected Area

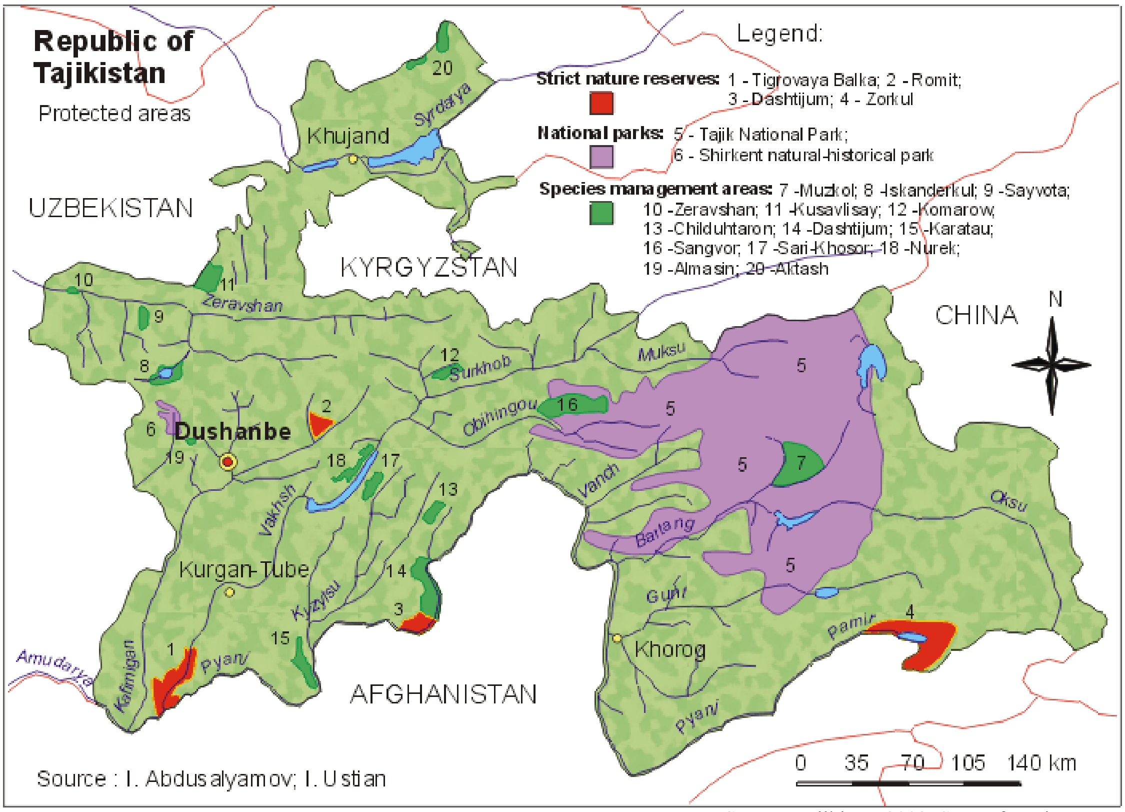
4 reserves and 14 species management areas are registered in Tajikistan by 01.01.2001. According to the data available by the total area of reserves is about 487 ha, or 3.4% of the country area. The total area of Tajik state reserves (according to the data available by 01.01.2002) is about 173.4 ha. Over 35% of animals' species diversity is protected in reserves areas.

There are 5 Ramsar sites in Tajikistan.

Table 2.2-9 Protected Area Resources (01.01.2002)

Protected area category	IUCN category	Number	Area (ha)
Strict Nature Reserves	I	4	173.418
National parks	II	2	2603.6
Nature monuments	III	26	-
Species management areas (Zakazniks)	IV	14	313.390
Tourism and recreation zone	-	3	15.3
Botanical gardens	-	5	0.731
Botanical stations, temporary and permanent points	-	13	10.0
Total:		**67**	**3116.439**

Source: First National Report on Biodiversity Conservation



Source: Tajikistan 2002, State of Environment Report

Fig. 2.2-20 Map of Protected Areas

Table 2.2-10 List of Protected Areas

No.	Name	Type	Year of establishment	Area (ha)	Location	Purpose protected kinds	Species requiring protection
Strict Nature Reserves							
1.	Tigrovaya Balka	Tugai	1938	49,786	Jilikulskiy rayon, khatlon oblast	Comprex: Bukhara Deer, pheasant, hyena, riparian, woodlands, fox	Pheasant (Phasianus colchicus), hyena (Hyaena hyaena), Persian gazelle(Gazella subgutturosa), Bukhara Red deer (Cervus elaphus), graymonitor lizard (Varanus griseus) and waterfowls
2.	Romit	Complex	1959	16,139	Vakhdat (formerly Kafirniganskiy) rayon	Comprex: Bukhara Deer, golden eagle, bear	Golden eagle (Aguila chrysaetus laphanea), brown bear (Ursus arctos), snow leopard (Uncia uncia), Siberian ibex (Capra sibirica)
3.	Dashtijum	Complex, Moutain-forest	1983	19,700	Khamadoni (formerly Moscowskiy) rayon, Khatlon oblast	Comprex: spiralhorn goat	Brown bear (Ursus arctos), Bukhara wild sheep (urial) (Ovis vignei), Tajik markhur (Capra falconeri), partridge (Alectorius keklik), snow leopard (Uncia uncia)
4.	Zorkul	Zoological	1972	16,465	Murgabskiy rayon, Goruy-Badakshan Autonomous oblast	Zoological: mountain goose, arhar, snow leopard, marmot	Bar-headed goose (Anser indicus), Pamir wild ram (argali) (Ovis ammon), Siberian ibex (Capra sibirica), snow leopard (Uncia uncia), red wolf (Canis lupus)
National Parks							
5.	Tajik National Park	Complex, landscape, botanical, zoological	1992	2,611,674	Vanchskiy, Rushanskiy, Shugnanskiy, Murgabskiy, Tavildarinskiy, Jirgitalsiky rayons	-	High-mountain, meadow-steppe, desert ecosystems, tugai, Pamir wild ram (argali) (Ovis ammon), Siberian ibex (Capra sibirica), Snow leopard (Uncia uncia), red wolf (Canis lupus)
6.	Shirkent National-Historical Park	Mountain-forest, landscape biodiversity	1991	31,929	Tursunzadevskiy rayon	-	Bukhara wild ram (urial) (Ovis vignei), Juniper forest (Juniperus), Ungernia
Species management areas (Zakazniks)							
7.	Muzkol	Zoological	1972	66,900	Murgabskiy rayon, Gorny-Badakshan Autonomous oblast	Zoological: mountain goose, arhar, snow leopard, marmot	Bar-headed goose (Anser indicus), Pamir wild ram (argali) (Ovis ammon), Siberian ibex (Capra sibirica), Snow leopard (Uncia uncia)
8.	Iskanderkul	Landscape, Mountain-forest	1969	30,000	Ayninskiy rayon, sogdiyskaya oblast	Landscape, mountain-wood: capricorn	Snow leopard (Uncia uncia), Bukhara wild sheep (urial) (Ovis vignei), birch (Betula)
9.	Sayvota	Mountain-forest	1970	4,139	Ayninskiy rayon, sogdiyskaya oblast	Landscape, mountain-wood	Juniper forest (Juniperus)
10.	Zeravshan	Complex, Tugai forest	1976		Penjikentskiy rayon, sogdiyskaya oblast	Riparian wood-lands, caprcorn, snow leopard, marmot, Bukhara deer	Pheasant (Phasianus colchicus), Bukhara Red deer (Cervus elaphus bactrianus)
11.	Kusavlisay	Mountain-forest	1959	19,800	Istravshanskiy rayon, sogdiyskaya oblast	Comprex: mountaim-wood, juniper	Juniper forests (Juniperus)
12.	Komarow	Mountain-forest	1970	9,000	Rashtskiy (formerly Garmskiy) rayon	Zoological: capricorn, trout	Brown bear (Ursus arctos), Siberian ibex (Capra sibirica), trout (Salmo trutta morfa fario)
13.	Childuktaron	Landscape, Mountain-forest	1970	14,600	Muminabads kiy rayon, Khatlon oblast	Mountain-wood: goat, bear	Juniper forest (Juniperus), brown bear (Ursus arctos), Bukhara wild ram (urial) (Ovis vignei), partridge (Ammoperdix griseogularis), wild boar (Sus scrofa)
14.	Dashtijum	Landscape, Mountain-forest	1972	50,100	Dashtijumskiy rayon, Khatlon oblast	Zoological: spiralhorn goat	Juniper forest (Juniperus), brown bear (Ursus arctos), Bukhara wild ram (urial) (Ovis vignei), partridge (Ammoperdix griseogularis), wild boar (Sus scrofa)
15.	Karatau	Zoological	1972	14,100	Parkharskiy rayon, Khatlon oblast	Zoological: goat, mountain patridge	Bukhara wild ram (urial) (Ovis vignei), partridge (Alectoris graeca), Bukhara Red deer (Cervus elaphus)
16.	Sangvor	High-mountains	1972	50,900	Tavildarinskiy rayon	Zoological: snow leopard, marmot	Pamir wild ram (argali) (Ovis ammon), Tibetian snow partridge (Tetraogallus tibetanus tibetanus)
17.	Sari-Khosor	-	1959	180,000	Baljuanskiy rayon, Khatlon oblast	Comprex: mountaim-wood, bear, capricorn, wild boar	-
18.	Nurek	Complex, Mountain-forest	1984	30,000	Nurek area	Comprex: mountaim-wood, goat, bear, moun-tain partridge, snow leopard, capricorn	Bukhara wild ram (urial) (Ovis vignei), brown bear (Ursus arctos), partridge (Ammoperdix griseogularis), snow leopard (Uncia uncia)
19.	Almasy	Botanical	1983	6,000	Gissarskiy rayon	Botanical	Ungernia victoris
20.	Aktash	Zoological	-	-	-	-	Bukhara wild ram (urial) (Ovis vignei), Vipera lebetina, peregrine falcon (Falco peregrinus), saker falcon (Falco cherrug)

Table 2.2-11 List of Ramsar Sites

Name	Date of Establishment	Area (ha)	Location
Karakul Lake	18/07/01	36,400	ca.39º05’N 073º29’E
Kayrakum Reservoir	18/07/01	52,000	ca.40º20’N 070º10’E
Lower part of Pyandj Rivert	18/07/01		ca.37º10’N 068º30’E
Shorkul and Rangkul lakes	18/07/01	2,400	ca.38º28’N 074º10’E
Zorkul Lake	18/07/01	3,800	ca.37º23’N 073º20’E

(5) Environment in Khatlon Region

The vast majority of the Khatlon residents live in rural areas, about 1.9 million people versus about 400 thousand urban settlers. The Khatlon Region also has the largest portion of irrigated lands in the country, approximately 45 %, of which 34 % are located in the area surrounding the regional administrative capital of Kurgan Tube, and 11 % are in the Kulyab zone. The Khatlon Region hosts a few large industrial complexes: the Vakhsh Azot Fertilizer plant, the Yavan chemical enterprise, as well as a complex for chemical pesticides burial.

The major environmental problems the Region suffers from are: deforestation; land degradation, including degradation of pastureland, ploughing and irrigated lands; as well as inadequate domestic solid waste collection and dumping infrastructure, and contaminated drinking water. There have been become the cause of biodiversity losses.

As in Sughd, the results of recent water quality analysis showed an alarming level of chemical and bacteriological contaminants (47.3 % and 54.7 %, respectively) in samples of water used for drinking and irrigation.

There are 2 strict nature reserves in Khatlon Region, which is Tigrovaya Balka and Dashtidjum (Fig.2.2-20). Due to the measures taken, the unique wetland forests of the dry subtropics zone is preserved in Tigrovaya Balka Reserve. The most favorable area of 21 th. ha of tugai is the left bank of the Vakhsh River. Tugai forests contain rare animal species: pheasant (*Phasianus colchicus*), jungle cat (*Felis chaus oxiana*), Bukhara Red deer (*Cervus elaphus*) and hyena The Red Data Book of Tajikistan includes (*Hyaena hyaena*). Management plan of Tigrovaya Balka Reserve was developed in 2012 with the assistance of UNDP.

Endangered species that has a record of confirmation in Khatlon Region in species listed in the Red Data Book of Tajikistan is shown in Table2.2-12 and 2.2-13.

Table 2.2-12 List of Fauna of Red data Book in Khatlon

№	Class	Order	Family	Scientific Name	CITES Appendix	IUCN	Tajikistan
1	MAMMALIA	EULIPOTYPHLA	SORICIDAE	Suncus etruscus Savi		LC	2
2	MAMMALIA	CHIROPTERA	RHINOLOPHIDAE	Rhinolophus bocharicus Kasch. et Ak.		LC	1
3	MAMMALIA	CHIROPTERA	RHINOLOPHIDAE	Rhinolophus ferrumequinum Schreber		LC	2
4	MAMMALIA	CHIROPTERA	RHINOLOPHIDAE	Rhinolophus hipposideros Bechstein		LC	2
5	MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	Barbastella darjelingensis Dobson			2
6	MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	Eptesicus bottae Peters		LC	2
7	MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	Eptesicus serotinus turcomanus Evers.			2
8	MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	Myotis emarginatus Geoffroy		LC	2
9	MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	Myotis mystacinus Kuhl.		LC	2
10	MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	Otonycteris hemprichii		LC	2
11	MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	Vespertilio savii Bonaparte			2
12	MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	Vespertilio serotinus Schreber			2
13	MAMMALIA	CHIROPTERA	MOLOSSIDAE	Tadarida teniotis Rafinesque		LC	2
14	MAMMALIA	RODENTIA	SCIURIDAE	Spermophilopsis leptodactylus bactrianus Scully			1
15	MAMMALIA	RODENTIA	HYSTRICIDAE	Hystrix leucura satunini Muller			2
16	MAMMALIA	RODENTIA	DIPODIDAE	Allactaga elater		LC	1
17	MAMMALIA	RODENTIA	DIPODIDAE	Allactaga severtzovi Vinogradov		LC	1
18	MAMMALIA	CARNIVORA	URSIDAE	Ursus arctos ssp. Isabellinus	II		2
19	MAMMALIA	CARNIVORA	MUSTELIDAE	Lutra lutra seistanica Birula			2
20	MAMMALIA	CARNIVORA	MUSTELIDAE	Mustela nivalis pallida Barrett-Hamilton			2
21	MAMMALIA	CARNIVORA	HYAENIDAE	Hyaena hyaena L.		NT	1
22	MAMMALIA	CARNIVORA	FELIDAE	Felis chaus oxiana Heptner			2
23	MAMMALIA	ARTIODACTYLA	CERVIDAE	Cervus elaphus ssp. bactrianus	II		1
24	MAMMALIA	ARTIODACTYLA	BOVIDAE	Capra falconeri heptneri Zalkin			1
25	MAMMALIA	ARTIODACTYLA	BOVIDAE	Gazella subgutturosa Gulden.		VU	1
26	MAMMALIA	ARTIODACTYLA	BOVIDAE	Ovis vignei bochariensis	II		1
27	AVES	FALCONIFORMES	ACCIPITRIDAE	Aquila chrysaetus daphanea Menzbier			2
28	AVES	FALCONIFORMES	ACCIPITRIDAE	Circaetus ferox heptneri Dementijev			2
29	AVES	FALCONIFORMES	ACCIPITRIDAE	Gypaetus barbatus hemachalanus Hun.			2
30	AVES	FALCONIFORMES	ACCIPITRIDAE	Hieraaetus pennatus	II	LC	2
31	AVES	FALCONIFORMES	ACCIPITRIDAE	Neophron percnopterus	II	EN	2
32	AVES	FALCONIFORMES	FALCONIDAE	Falco cherrung coatsi Dementijev			2
33	AVES	FALCONIFORMES	FALCONIDAE	Falco pelegrinoides babylonicus Sclat.			2
34	AVES	GALLIFORMES	PHASIANIDAE	Ammoperdix griseogularis Brandt		LC	2
35	AVES	GALLIFORMES	PHASIANIDAE	Phasianus colchicus		LC	
36	AVES	GALLIFORMES	PHASIANIDAE	Phasianus colchicus bianchii But.			2
37	AVES	GRUIFORMES	GRUIDAE	Otis tarda tarda L.			1
38	AVES	CHARADRIIFORMES	BURHINIDAE	Burhinus oedicnemus astutus Hartert			2
39	AVES	CHARADRIIFORMES	GLAREOLIDAE	Glareola pratincola L.		LC	2
40	AVES	COLUMBIFORMES	COLUMBIDAE	Columba palumbus casiotis Bp.			2
41	AVES	COLUMBIFORMES	PTEROCLIDIDAE	Pterocles orientalis arenarius Pallas			1
42	AVES	APODIFORMES	APODIDAE	Apus affinis galilejensis Antorini			2
43	AVES	PASSERIFORMES	TIMALIIDAE	Garrulax lineatus bilkevithi Zarudny			2
44	AVES	PASSERIFORMES	MONARCHIDAE	Terpsiphone paradisi leucogaster Swain			2
45	AVES	PASSERIFORMES	MUSCICAPIDAE	Chaimarrornis leucocephalus Vigors		LC	2
46	AVES	PASSERIFORMES	TURDIDAE	Myophonus caeruleus turkestanicus Zarudny			2
47	REPTILIA	SQUAMATA	GEKKONIDAE	Crossobamon eversmanni Weigmann			1
48	REPTILIA	SQUAMATA	GEKKONIDAE	Teratoscincus scincus rustamowi Szczerbak.			2
49	REPTILIA	SQUAMATA	AGAMIDAE	Phrynocephalus mystaceus Pallas .			1
50	REPTILIA	SQUAMATA	AGAMIDAE	Phrynocephalus sogdianus Cern.			1
51	REPTILIA	SQUAMATA	VARANIDAE	Eremias grammica Licht.			2
52	REPTILIA	SQUAMATA	VARANIDAE	Eremias scripta Str			1
53	REPTILIA	SQUAMATA	VARANIDAE	Typhlops vermicularis Merrem			2
54	REPTILIA	SQUAMATA	VARANIDAE	Varanus griseus	I/w		1
55	REPTILIA	SQUAMATA	BOIDAE	Eryx tataricus	II		2
56	REPTILIA	SQUAMATA	COLUBRIDAE	Boiga trigonatum melanocephala Annandale			2
57	REPTILIA	SQUAMATA	COLUBRIDAE	Lycodon striatus bicolor Nicolsky			2
58	REPTILIA	SQUAMATA	ELAPIDAE	Naja oxiana	II	DD	2
59	REPTILIA	SQUAMATA	Viperidae	Vipera libetina turanica Cemow			2
60	REPTILIA	SQUAMATA	Viperidae	Echis carinatus Schneider			1
61	ACTINOPTERYGII	ACIPENSERIFORMES	ACIPENSERIDAE	Pseudoscaphirhynchus kaufmanni	II	CR	2
62	ACTINOPTERYGII	CYPRINIFORMES	CYPRINIDAE	Aspiolucius esocinus Kessler		VU	2
63	ACTINOPTERYGII	CYPRINIFORMES	CYPRINIDAE	Barbus brachycephalus Kessler			2
64	INSECTA	MANTODEA	MANTIDAE	Amblythespis mistshenko Lindt			1
65	INSECTA	MANTODEA	MANTIDAE	Hierodula tenuidentata Saussure			2
66	INSECTA	MANTODEA	MANTIDAE	Mantis macrocephala Lindt			1
67	INSECTA	MANTODEA	MANTIDAE	Rivetina beybienkoi Lindt			1
68	INSECTA	MANTODEA	EMPUSIDAE	Empusa pennicornis Pallas			1
69	INSECTA	HEMIPTERA	MARGARODIDAE	Porphyrophora cynodontis Arch.			2
70	INSECTA	HEMIPTERA	MARGARODIDAE	Porphyrophora odorata Arch.			2
71	INSECTA	HEMIPTERA	MARGARODIDAE	Porphyrophora sophorae Arch.			2
72	INSECTA	HEMIPTERA	PENTATOMIDAE	Cellobius abdominalis Jak.			2
73	INSECTA	HEMIPTERA	PENTATOMIDAE	Dalpada pavlovskii Kir			2
74	INSECTA	HEMIPTERA	ARADIDAE	Calisius turanicus Kir.			1
75	INSECTA	HEMIPTERA	REDUVIIDAE	Reduvius fedtshenkianus Osh.			1
76	INSECTA	HEMIPTERA	REDUVIIDAE	Stenolemus bogdanovi Osh			2
77	INSECTA	COLEOPTERA	CARABIDAE	Carabus tadzhikistanus Kryzh.			2
78	INSECTA	LEPIDOPTERA	PIERIDAE	Anthocharis tomyris Chr.			2
79	INSECTA	LEPIDOPTERA	LYCAENIDAE	Polyommatus kogistana Gr.-Gr.			2
80	INSECTA	LEPIDOPTERA	SPHINGIDAE	Acosmeryx naga hissarica Stshetkin			2
81	INSECTA	LEPIDOPTERA	SPHINGIDAE	Amorpha philerema Djak.			1
82	INSECTA	LEPIDOPTERA	SPHINGIDAE	Celerio chamyla apocyni Stshetkin			2
83	INSECTA	LEPIDOPTERA	NOTODONTIDAE	Paragluphisia oxiana Djak.			1
84	INSECTA	LEPIDOPTERA	LASIOCAMPIDAE	Taragama fainae Geras.			1
85	INSECTA	LEPIDOPTERA	LEMONIIDAE	Lemonia tancrei Punglr.			1
86	INSECTA	LEPIDOPTERA	NOLIDAE	Nola silvicola Stshetkin			1
87	INSECTA	LEPIDOPTERA	NOCTUIDAE	Catocala optima Stgr.			1
88	INSECTA	LEPIDOPTERA	NOCTUIDAE	Catocala timur A. B.-H.			1
89	INSECTA	LEPIDOPTERA	NOCTUIDAE	Lygephila lubrosa Stgr.			1
90	INSECTA	LEPIDOPTERA	NOCTUIDAE	Pseudohadena seposita Punglr.			1
91	INSECTA	LEPIDOPTERA	GEOMETRIDAE	Eupithecia djakonova Stshetkin			1
92	INSECTA	LEPIDOPTERA	GEOMETRIDAE	Eupithecia dominaria Stshetkin			1
93	INSECTA	HYMENOPTERA	ICHNEUMONIDAE	Barylypa ammabilis Tas.			2
94	INSECTA	HYMENOPTERA	ICHNEUMONIDAE	Diadegma velox Holmg.			2
95	INSECTA	HYMENOPTERA	ICHNEUMONIDAE	Ichneumon sarcitorius L.			2
96	INSECTA	HYMENOPTERA	ICHNEUMONIDAE	Netelia fuscicornis			2
97	GASTROPODA	PULMONATA	PUPILLIDAE	Pupoides coenopictus Hutton			2
98	GASTROPODA	LITTORINIMORPHA	HYDROBIIDAE	Pseudamnicola likharevi Izzat.			2
99	GASTROPODA	LITTORINIMORPHA	HYDROBIIDAE	Pseudamnicola paviovskii Izzatullaev			2

Table 2.2-13 List of Flora of Red data Book in Khatlon

No.	Class	Order	Family	Scientific Name	Appendix	IUCN	Central Asia	Tajikistan
1	AGARICOMYCETES	AGARICALES	AGARICACEAE	Battarrea phalloides Pers.				2
2	AGARICOMYCETES	AGARICALES	PLEUROTACEAE	Pleurotus komarnitzkyi Vassilk.				2
3	AGARICOMYCETES	POLYPORALES	POLYPORACEAE	Polyporus rhizophilus Pat.				2
4	PEZIZOMYCETES	PEZIZALES	MORCHELLACEAE	Morchella steppicola Zer.				2
5	BRYOPSIDA	DICRANALES	FISSIDENTACEAE	Fissidens karataviensis Sams.				2
6	BRYOPSIDA	POTTIALES	POTTIACEAE	Tortula ferganensis Lasar.				2
7	BRYOPSIDA	POTTIALES	POTTIACEAE	Weisia papillosissima Lasar.				3
8	BRYOPSIDA	GRIMMIALES	GRIMMIACEAE	Usmania campylopoda Lazar.				1
9	OPHIOGLOSSOPSIDA	OPHIOGLOSSALES	OPHIOGLOSSACEAE	Ophioglossum bucharicum Fedtsch.				2
10	LILIOPSIDA	ASPARAGALES	ALLIACEAE	Allium ophiophyllum Vved.				2
11	LILIOPSIDA	ASPARAGALES	ALLIACEAE	Allium rosenbachianum Regel				2
12	LILIOPSIDA	ASPARAGALES	ALLIACEAE	Allium stipitatum Regel				2
13	LILIOPSIDA	ASPARAGALES	ALLIACEAE	Allium suworowii Regel				3
14	LILIOPSIDA	ASPARAGALES	XANTHORRHOEACEAE	Eremurus Aitchisonii Baker				3
15	LILIOPSIDA	ASPARAGALES	XANTHORRHOEACEAE	Eremurus candidus Vved.				0,1
16	LILIOPSIDA	ASPARAGALES	XANTHORRHOEACEAE	Eremurus roseolus Vved.				2
17	LILIOPSIDA	CYPERALES	CYPERACEAE	Carex bucharica Kuk.				3
18	LILIOPSIDA	LILIALES	HYACINTHACEAE	Scilla Raevskiana Regel				2
19	LILIOPSIDA	LILIALES	IRIDACEAE	Crocus Korolkovii Regel et Maw				3
20	LILIOPSIDA	LILIALES	IRIDACEAE	Iris darwasica Regel				3
21	LILIOPSIDA	LILIALES	IRIDACEAE	Iris Hoogiana Dykes				3
22	LILIOPSIDA	LILIALES	IRIDACEAE	Iris lineata Foster et Regel				2
23	LILIOPSIDA	LILIALES	IRIDACEAE	Juno leptorrhiza Vved.				2
24	LILIOPSIDA	LILIALES	IRIDACEAE	Juno nickolai Vved.				3
25	LILIOPSIDA	LILIALES	LILIACEAE	Petilium eduardii (Regel) Vved.				3
26	LILIOPSIDA	LILIALES	LILIACEAE	Tulipa lanata Regel				2
27	LILIOPSIDA	LILIALES	LILIACEAE	Tulipa maximowiczii Regel				2
28	LILIOPSIDA	LILIALES	LILIACEAE	Tulipa praestans Hoog				3
29	LILIOPSIDA	LILIALES	LILIACEAE	Tulipa subpraestans Vved.				2
30	LILIOPSIDA	LILIALES	LILIACEAE	Tulipa subqiunquefolia Vved.				2
31	LILIOPSIDA	LILIALES	LILIACEAE	Tulipa tubergeniana Hoog				2
32	LILIOPSIDA	ORCHIDALES	ORCHIDACEAE	Eulophia turkestanica (Litv.) Schlechter	II			1,2
33	LILIOPSIDA	ORCHIDALES	ORCHIDACEAE	Zeuxine strateumatica Schlechter		LC		1
34	MAGNOLIOPSIDA	RANUNCULALES	RANUNCULACEAE	Anemone bucharica Regel				3
35	MAGNOLIOPSIDA	RANUNCULALES	RANUNCULACEAE	Delphinium decoloratum Ovcz.				2
36	MAGNOLIOPSIDA	RANUNCULALES	RANUNCULACEAE	Ranunculus chodshamastonicus Ovcz.				1
37	MAGNOLIOPSIDA	DILLENIALES	PAEONIACEAE	Paeonia intermedia C.A. Mey.				3
38	MAGNOLIOPSIDA	CARYOPHYLLALES	AMARANTHACEAE	Halocharis gossypina Korov. et Kinz.				1
39	MAGNOLIOPSIDA	CARYOPHYLLALES	AMARANTHACEAE	Seidlitzia rozmarinus Bunge.				3
40	MAGNOLIOPSIDA	CARYOPHYLLALES	CARYOPHYLLACEAE	Gypsophila tadzhikistanica Botsch.				2
41	MAGNOLIOPSIDA	CARYOPHYLLALES	CHENOPODIACEAE	Salsola Drobovii Botsch.				1
42	MAGNOLIOPSIDA	CARYOPHYLLALES	CHENOPODIACEAE	Salsola pulvinata Botsch.				2
43	MAGNOLIOPSIDA	CARYOPHYLLALES	PLUMBAGINACEAE(LIMONIACEAE)	Vassilczenkoa sogdiana Linez.				3
44	MAGNOLIOPSIDA	POLYGONALES	POLYGONACEAE	Atraphaxis avenia Botsch.				1
45	MAGNOLIOPSIDA	POLYGONALES	POLYGONACEAE	Polygonum ovczinnikovii Czuk.				2
46	MAGNOLIOPSIDA	MYRTALES	LYTHRACEAE	Punica granatum L.		LC	LC	3
47	MAGNOLIOPSIDA	SAPINDALES	ZYGOPHYLLACEAE	Zygophyllum bucharicum B.Fedtsch.		CR	CR	1
48	MAGNOLIOPSIDA	CUCURBITALES	CUCURBITACEAE	Bryonia lappifolia Vass.				2
49	MAGNOLIOPSIDA	FABALES	LEGUMINOSAE(FABACEAE)	Astragalus insignis Gontsch.				2
50	MAGNOLIOPSIDA	FABALES	LEGUMINOSAE(FABACEAE)	Calophaca sericea Fed.				2
51	MAGNOLIOPSIDA	FABALES	LEGUMINOSAE(FABACEAE)	Chesneya tadzhikistana Boriss.				2
52	MAGNOLIOPSIDA	FABALES	LEGUMINOSAE(FABACEAE)	Keyserlingia mollis (Royle) Boiss.		LC	LC	1
53	MAGNOLIOPSIDA	FABALES	LEGUMINOSAE(FABACEAE)	Onobrychis Gontscharovii Vass.				2
54	MAGNOLIOPSIDA	URTICALES	MORACEAE	Ficus afghanistanica Warb.				3
55	MAGNOLIOPSIDA	URTICALES	MORACEAE	Ficus carica L		LC	LC	3
56	MAGNOLIOPSIDA	ROSALES	ROSACEAE	Amygdalus Vavilovii M. Pop.				3
57	MAGNOLIOPSIDA	ROSALES	ROSACEAE	Crataegus darvasica Pojark.		CR	CR	1
58	MAGNOLIOPSIDA	ROSALES	ROSACEAE	Prunus darvasica Temb.				2
59	MAGNOLIOPSIDA	ROSALES	ROSACEAE	Rosa longisepala Koczk.				2
60	MAGNOLIOPSIDA	BRASSICALES	BRASSICACEAE(CRUCIFERAE)	Arabidopsis bactriana Ovcz. et Junuss.				1
61	MAGNOLIOPSIDA	BRASSICALES	BRASSICACEAE(CRUCIFERAE)	Catenularia hedysaroides Botsch.				2
62	MAGNOLIOPSIDA	BRASSICALES	BRASSICACEAE(CRUCIFERAE)	Stroganovia tolmaczoyii Junuss.				1
63	MAGNOLIOPSIDA	CAPPARALES	CAPPARACEAE	Capparis Rosanoviana Fed.				2
64	MAGNOLIOPSIDA	CAPPARALES	CAPPARACEAE	Cleome lipskyi Pop.				1
65	MAGNOLIOPSIDA	LAMIALES	LAMIACEAE(LABIATAE)	Salvia baldshuanica Lipsky				1
66	MAGNOLIOPSIDA	LAMIALES	LAMIACEAE(LABIATAE)	Salvia Gontscharovii Kudr.				1
67	MAGNOLIOPSIDA	LAMIALES	VERBENACEAE	Vitex agnus-castus L.				3
68	MAGNOLIOPSIDA	APIALES	APIACEAE	Bunium persicum (Boriss.) Fed.				3
69	MAGNOLIOPSIDA	APIALES	APIACEAE	Parasilaus asiaticus M. Pimen.				1
70	MAGNOLIOPSIDA	DIPSACALES	VALERIANACEAE	Valerianella kulabensis Lipsky				2
71	MAGNOLIOPSIDA	ASTERALES	ASTERACEAE(COMPOSITAE)	Cousinia agelocephala Tschern.				1
72	MAGNOLIOPSIDA	ASTERALES	ASTERACEAE(COMPOSITAE)	Jurinea impressinervis Iljin				1
73	MAGNOLIOPSIDA	ASTERALES	ASTERACEAE(COMPOSITAE)	Jurinea tadshikistanica Iljin				1
74	MAGNOLIOPSIDA	ASTERALES	CAMPANULACEAE	Ostrowskia magnifica Regel				3

Red List Category
CITES
Appendix I lists species that are the most endangered among CITES-listed animals and plants.
Appendix II lists species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled.
Appendix III is a list of species included at the request of a Party that already regulates trade in the species and that needs the cooperation of other countries to prevent unsustainable or illegal exploitation.
/r = reservation entered by the named Party
/w = reservation withdrawn by the named Party
IUCN, The Red List of Trees of Central Asia
EX: Extinct
EW: Extinct in the Wild
CR: Critically Endangered
EN: Endangered
VU: Vulnerable
NT: Near Threatened
LC: Least Concern
DD: Data Deficient
NE: Not Evaluated
Red Data Book of Tajikistan
0: disappeared
1: endangered
2: rare
3: decreasing in area

2.3 LEGAL FRAMEWORK OF ENVIRONMENTAL AND SOCIAL CONSIDERATION

2.3.1 Law and Legislation related to Environmental and Social Issues

Laws and legislations related to Environmental and Social Consideration are shown in Table 2.3-1.

The Law on Nature Protection was approved in 1993 and subsequently amended in 1997 and 2002. The laws related to Environmental Impact Assessment (EIA) are Law on Nature Protection (1993), Law on Ecological Expertise (2003), and Procedure of Environmental Impact Assessment (adopted by the Resolution of the Government of RT on 03.10.2006).

Table 2.3-1 Relevant Environmental Laws and their Enactment year

Law and Legislation	Enactment year
Resolution on the Unauthorized Collection of Substances	1990
Land Code of the Republic of Tajikistan	1996
Law on Nature Protectionar	1993
Law on Subsoil	1994
Resolution on State Ecological Review	1994
Law on Air Protection	1996
Law on Specially protected Nature Areas	1996
Law on Fauna Protection and Use	1997
Forestry Code of the Republic of Tajikistan	1997
Water Code of Republic of Tajikistan	2000
Law on Hydrometeorology Activity	2002
Resolution on State Ecological Program	2003
Law on Ecological Expertise	2003
Resolution on Commission on Chemical Security of the Republic of Tajikistan	2003
Law on Flora Protection and Use	2004
Law on Biosafety	2004
Procedure of Environmental Impact Assessment	2006

2.3.2 Organizations related to Environmental and Social Issues

Organizations and agencies related to environmental and social issues are shown in Table 2.3-2.

State Committee for Environmental Protection and Forestry (SCEPF) is the key agency in charge of drafting the laws and legislations related to environmental protection. SCEPF carries out this task with cooperation with other agencies, such as Ministry of Agriculture, Ministry of Health etc. In addition, SCEPF is competent agency for carrying out and appraising the environmental impact studies in Tajikistan. The organization chart of SCEP is shown in Fig. 2.3-1.

Table 2.3-2 Relevant Organizations and Agencies

Name	Abbreviation
State Committee for Environmental Protection and Forestry	SCPEF
HYDROMET	
Department of Environment and Emergency Situations, President Office	DEES
State Committee for Land Management	
Tajik Geological Agency	Tajikgeologia
Ministry of Melioration and Water Resources	
Forestry Agency, Ministry of Agriculture	Tsajikles
State Sanitation and Epidemiology Investigation Center , Ministry of Health	SSEIC
Ministry of Industry	
Ministry of Interior	
Municipal Water Authorities	Vodokanals

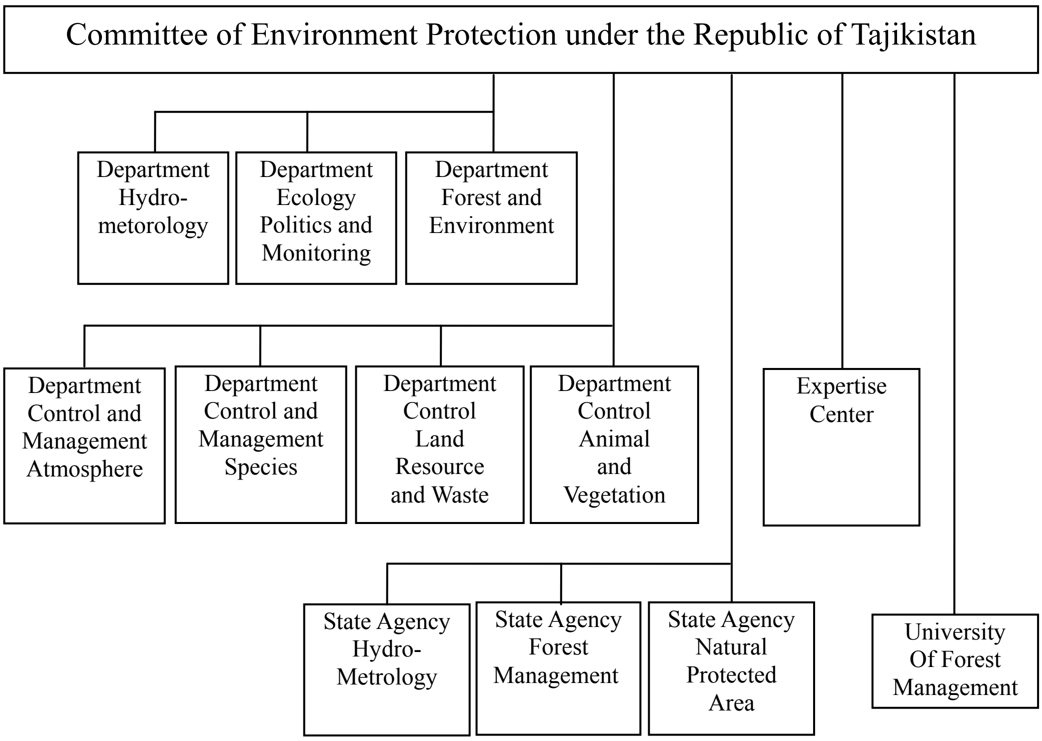


Fig. 2.3-1 Organization Chart of SCEPF

2.3.3 EIA System in Tajikistan

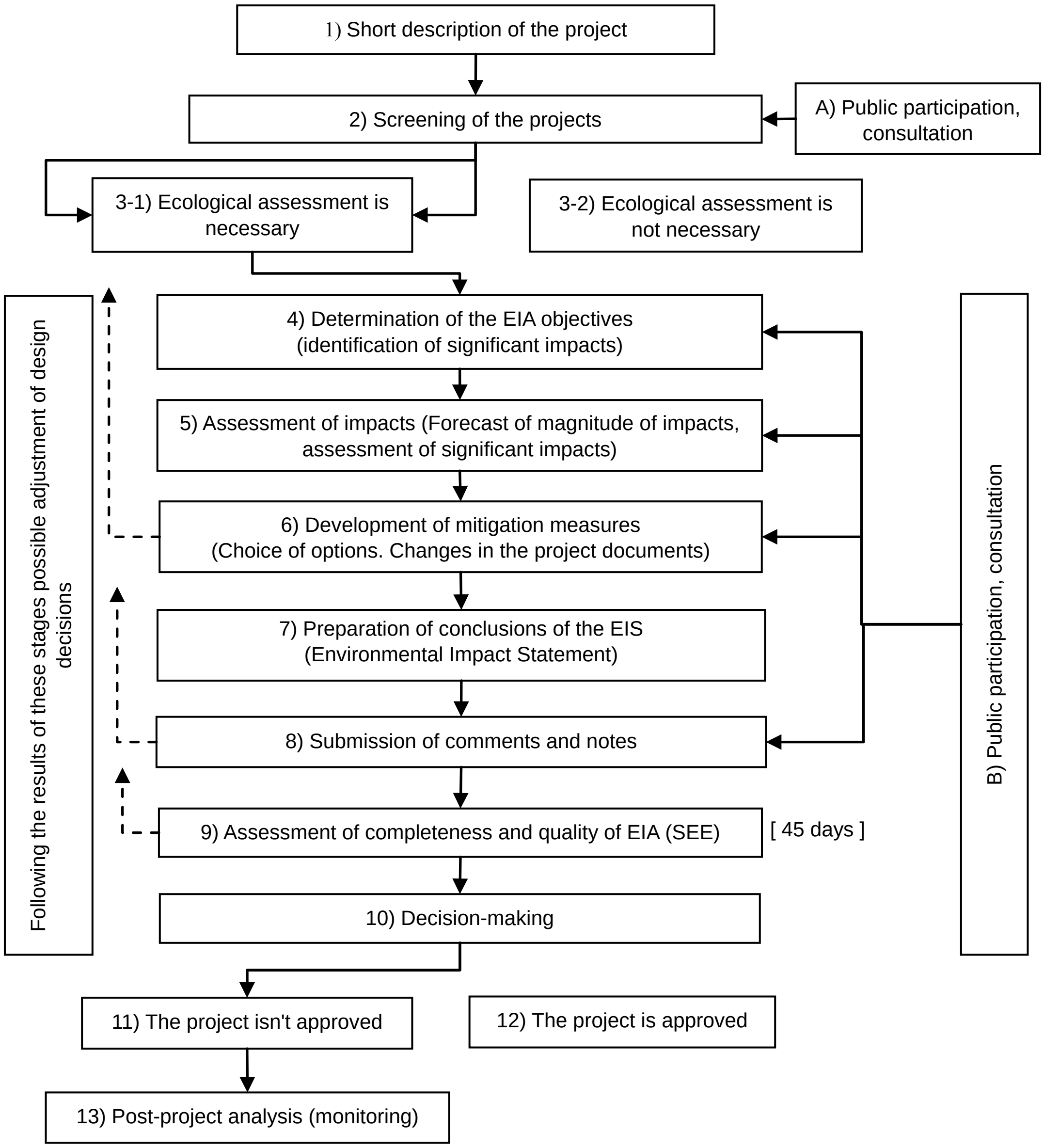
The characteristic of system of EIA in the Republic of Tajikistan is State Ecological Expertise (SEE) as a stage of EIA.

EIA is implemented by the developer of the planned activity (investor, initiator or applicant) or the entity authorized by the developer responsible for conducting EIA of the activity and its proposed alternatives, and for preparing relevant EIA documentation. The main SEE objectives are to define (and implement control over) by the state authorities the compliance of the submitted EIA materials and other documents with the effective legislation and ecological requirements, and applicability of the planned activity. SEE is implemented by the authorized state body or authorized by such body experts or by the *ad hoc* established expert commissions.
The main normative and legal act, the legal basis for the EIA and SEE, is the Law “On Ecological expertise”. The law also contains provisions about EIA that is the part of the process for new projects: “New projects and types of activities which may have environmental impacts shall be subject to environmental impact assessment and to mandatory State ecological expertise” (Part 1, Article 26 Law “On Ecological expertise”).

Objects and types of activities subject to the EIA procedure are followings;

- Hydropower stations, power houses and other furnace units with heat capacity 300 MW
- Units to extract asbestos, asbestos processing and transformation and asbestos products, regarding:
  - asbestos-cement products with annual production over 20000 tn;
  - friction materials with annual production over 50 tn, and
  - other types of asbestos use over 200 tn per year.
- Chemical plants
- Highways construction, speed ways, long-distance rail roads, airports with the length of the main airstrip of 2100 m and longer.
- Oil and gas pipelines with pipes of large diameter.
- Petroleum refinery plants (except for facilities producing only lubricants of crude oil), and units for gasification and coal liquefaction and oily shale with capacity 500 tn/day or more.
- Large dams and water reservoirs.
- Trees felling in large territories.
- Units to utilize wastes for burning, chemical processing or depositing of toxic or dangerous wastes.
- Large facilities to store petroleum, oil-and chemical and chemical products
- Large units for blast-furnace and open-hearth process and nonferrous-metals industry.
- Ground water intake in cases when the annual water volume is 10 mln m^3 and more.
- Large-scale mining, extraction and enrichment on site of ferrous ore and coal.
- Cellulose and paper production with output of 200 metric tons products per day or more after the air drying.

General scheme of EIA Procedure is shown in Fig.2.3-2. SEE will respond with the result to the project proponent within 45 days after the commence day of such application procedure.



Source : Procedure of Environmental Impact Assessment (Resolution of the Government of RT on 03.10.2006, No.464)

Fig. 2.3-2 General Scheme of EIA Procedure