

The development perspective of Hydropower resources of the Pyanj Transboundary River Basin

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ABSTRACT

Pyanj River is Transboundary Rivers (on border of the Republic of Tajikistan and Afghanistan) the left tributary of Amu Darya in the Central Asia. The length of the Pyanj River is 921 km and the area of basins of 114000 km². It is formed by merge of the Pamir and Vahandarya rivers. The average discharges of water 1032 m³/sec. At present time is used basically for irrigation.

1. INTRODUCTION

Water resources are a basis of hydropower of Tajikistan. The general annual potential hydropower resources in republic make up 527 Bln. kWt·h from which not less than 40-50 % are technically possible for development of the hydropower. More than 95 % of all electric power in republic is developed by hydroelectric power stations. In conditions of Tajikistan, the unique hydroelectric power stations constructed on the large rivers, flowing on deep rocky canyons, have not only hydropower, but also water-regulating and meliorative meaning. It is clear that the hydropower resources renewable and also are safe from the point of view of throwing other harmful substances in environment. All these properties do greater traditional hydroelectric power industry non-competition, in perspective, by an energy source in conditions of Tajikistan. Water resources focuses, basically, on the large rivers – Vakhsh, Pyanj, Obi Khingoy and others. The specific saturation of potential water resources makes up significant size – 3682.7 kWt·h on 1 km² territories (the first place in the world), per capita 87800 kWt·h in a year (1-2 places in the world). However, last years of expense of irrational use shortage of the electric power is observed, that negatively influences on social and economic development of republic and well-being of population. In structure of manufacture of primary fuel and energy resources (PFER) in region the leading place occupies now organic fuel (table 1).

Table 1. Structure of primary fuel energy resources production in Central Asia countries (%)

Country	Gas	Oil	Coal	Hydro	Total
Kazakhstan	16	50	33	1	100
Kyrgyzstan	2	5	11	82	100
Tajikistan	2	1	1	96	100
Turkmenistan	83	17	0	0	100
Uzbekistan	84	13	2	1	100

Thus about half of total amount of power resources to fit to the natural gas which basic stocks are concentrated in Turkmenistan and Uzbekistan. The second place in structure of the primary energy carriers made by the states of the Central Asia, occupies oil, to 80 % of its extraction to fit to Kazakhstan. In power balance of Kyrgyzstan and Tajikistan the huge

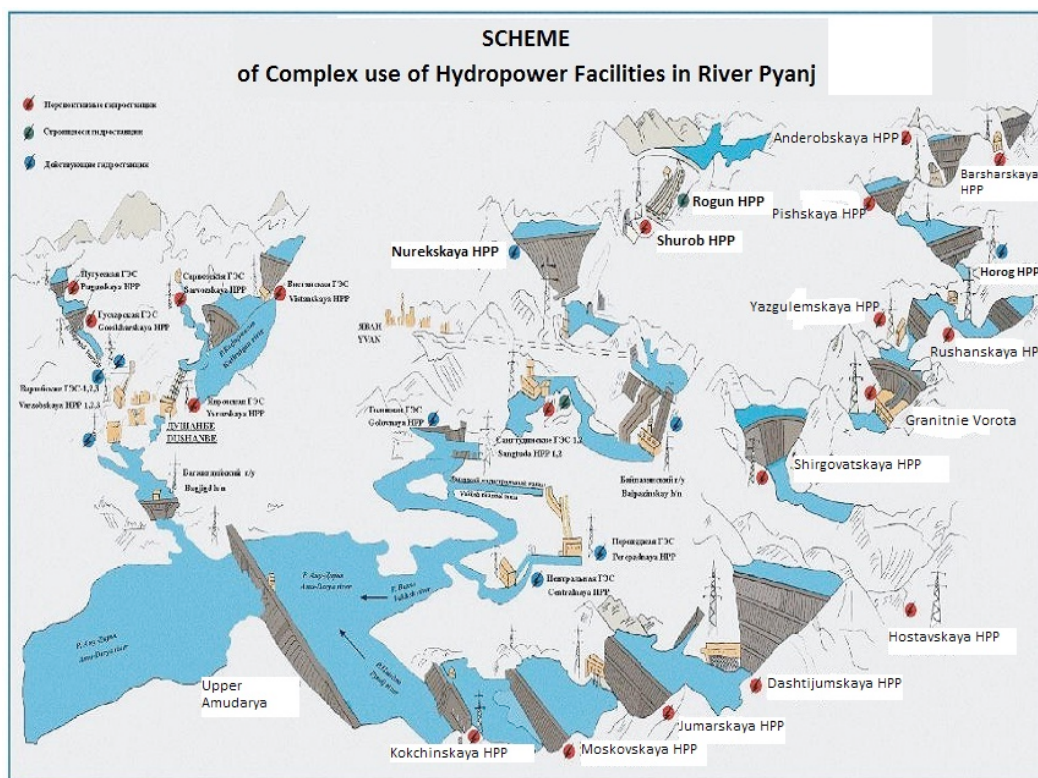
share to fit to hydroenergy. In structure of internal manufacture of primary fuel and energy resources (PFER) hydropower makes accordingly 82 and 96 %. However, in structure cumulative fuel-power balance of region the hydropower share is insignificant now (about 2 %).

Pyanj River is Transboundary Rivers (on border of the Republic of Tajikistan and Afghanistan) the left tributary of Amu Darya in the Central Asia. The length of the Pyanj River is 921 km and the area of basins of 114000 km². It is formed by merge of the Pamir and Vahandarya rivers. The average discharges of water 1032 m³/sec. At present time is used basically for irrigation.

On 27 April, 2005 between Governments of the Republic of Tajikistan and the Government of Islamic Republic Afghanistan is signed Agreement about cooperation in the field of joint development of hydropower resources of the river Pyanj and development of interstate transmission lines. On the river Pyanj the basic inflow of Amu Darya economically soundly building of 14 hydroelectric power stations by capacity from 300 MWt to 4000 MWt with the production of electricity of 86.3 Bln. KWt·h/year. By 2025 as a result of intensive development of water-power resources of the Pyanj river basin electric power development can reach level of 80 Bln. KWt·h/ year. The Amu Darya River in the length 2580 km, on the power stocks is considered the most important energy source of Afghanistan to components of 50 % of all resources of the country. Only economically effective hydropotential of the Amu Darya River makes 37.5 Bln. kWt from which 33 kWt to fit to Pyanj Rivers.

Table 2. Hydropower station on the Pyanj River [Verkhoturov]

Name	Capacity of (MWt) (km ³)	Output, (TWt·h/years)	Head (m)	Useful volume reservoir
Namangutskaya*	2.5	0.018	36	0
Barsharskaya	300	1.6	100	1.25
Anderobskaya	650	3.3	185	0.1
Pishskaya	320	1.7	90	0.03
Khorogskaya	250	1.3	70	0.01
Rushanskaya	3000	14.8	395	4.1
Yazgulemskaya	850	4.2	95	0.02
Granites gate	2100	10.5	215	0.03
Shirgovatskaya	1900	9.7	185	0.04
Khostovskaya	1200	6.1	115	0.04
Dastidzumsкая	4000	15.6	300	10.2
Dzumarskaya	2000	8.2	155	1.3
Moscowskaya	800	3.4	55	0.04
Kokchinskaya	350	1.5	20	0.2
Nijni-Pyanjskaya	600	3.0		



Source: The Ministry for Foreign Affairs of Tajikistan

2. Pyanj River basin of Northern Afghanistan.

River basins of Northern Afghanistan are located in the north of the central Hindu Kush ridge. Almost all rivers of northern Afghanistan originate from this mountain ridge and flow in northern and northwest direction. Hydrographically all northern river basins in the north Afghanistan belong to basin of Amu Darya. The Amu Darya basin area makes approximately 534740 km² and high-rise marks change from maximum in 7134 m a. s. l. on Pamir in the east where Amu Darya originates to minimum in 320 m a.s.l. Hydrographically the northern Afghanistan river basin is subdivided now on two basins units:

- Pyanj-Amu basin in the northeast, including the basic inflows of Kokcha and Kunduz;
- Northern basin characterized so-called «blind rivers», that is the former inflows which already throughout several centuries don't run into Amu Darya, leaving the big desert Shortepa between a place of disappearance of these rivers in Dashti Shortepa and Amu Darya.

The current way of distribution of water of the Amu Darya River is based on Tashkent Agreement 1987 which regulates a water use share in Aral Sea basin – namely, water resources of Amu Darya and Sir-Darya – between five the Central-Asian countries till now without any account water division for Afghanistan. Now, water use in five states of basin is estimated as in Table 3.

Table 3. Water resources of the Aral Sea Basin and Mid annual volume water use of Central Asia countries

Country of the Amu Darya River Basin use(%)	Mid-annual volume Water use(Mln.m ³)	Share from the total Mid-annual volume Water
Tajikistan	7500	11
Afghanistan	5000	7
Uzbekistan	33000	47
Kyrgyzstan	1500	2
Turkmenistan	23000	33
Total		100

All rivers originating from the Central mountain ridge Hindu Kush (Southern border of Amu Darya basin watershed) go down to northern plains located in basin of northern rivers of Afghanistan along the left coast of Amu Darya. The general Afghani area belonging hydrographically to the Amu Darya basin includes northern basins and the Pyanj-Amu basin covering the area in 167473 km² from which 693 km² (basin Pyanj-Amu – 54 %) intensively drainages Afghani the rivers running into Amu Darya. Hence, a share of the Afghani territory in the Amu Darya basin makes 31 % or one third in comparison with other four coastal states. The considerable area of this Afghani territory, which most part make northern plains located on the left coast of Amu Darya, it is possible to irrigate (about 800000 ha), however now, by estimations, 385000 ha are irrigated only.

By estimations (Indicators of world development, WB, Washington, 2001) it is expected that in 2010 the population of Afghanistan will reach somewhere about 35Mln. persons from which approximately 8 million (23 %) lives in Northern Afghanistan, being in regular intervals distributed, approximately on 4 million, in two basic parts of river basin (Pyanj-Amu and Northern basins). Population density in the irrigated territories located along the river of Amu Darya and its basic inflows is high 48 persons on km².

The Department of Energy and water resources of Afghanistan has developed the concrete plan for development taking into account possibilities of the country available nowadays. About it the day before, acting in Volusi Dzhirga, the candidate for Ministers of Energy and water resources Mohammad Ismail Han has declared. Mohammad Ismail Han has informed that the Department of Energy and water resources taking into account necessary requirements have begun work in 3 directions. In particular, as he said, the ministry intends to carry out reforms for revival and improvement of system of water supply and a water management, to continue the national program of development of water sources, strengthening of coast of the rivers.

Till now from planned 3200 projects for five years realization of 1200 programs is finished, has informed fulfilling duties of the Minister of Energy and water resources of the Afghanistan: "Volumes of water stocks from 22 Mln.m³ of water are finished to 24 Mln.m³ that gives the chance to irrigate 330 Th. ha of the agriculture lands". Now the Department of Energy and water resources of Afghanistan for the purpose of an estimation of water-supplies in the rivers and lakes of Afghanistan, and also an estimation of resources of water from deposits has established the equipment on 105 centers on control of water resources in 22 provinces of the country. In total it is about the country planned to establish such 177 centers. For five next years in branch it is planned to realize 2100 projects connected with water supply and an irrigation, having finished the areas of the new irrigated earths to 780 Th. ha.

The Department of Energy and water resources for the purpose of preservation of water resources and infrastructure creation plans to create 208 water basins, including 20 large, has specified fulfilling duties of the minister. These 20 largest water basins are planned to create in 5 water regions of the country. Among them such water tanks as the Kunarsk water basin, the Coma, Gamberi, Kal-e-Besh and et.al. European Union and Afghanistan signed the agreement according to EU will allocate the financial help at a rate of 36 Mln.USD for improvement of water resources management in the north of Afghanistan. According to Mohammad Ismail Han, the help most part will be directed on performance of the projects connected with use of resources of Amu Darya. The minister is assured that with realization of the projects planned by its department it will be possible to irrigate about 50 Th.ha of agriculture lands. Rational use of water resources can positively affect a standard of living of the majority of the population of the north of the country.

In 2006 the Minister of Energy and water resources of Afghanistan Ismail Khan has made a number of rigid statements concerning savings of water potential of the country. He considers that thanks to snowfalls annually in the country are formed 75 Bln.m³ of water from which only 30 % are spent inside, and other part – leaves the Afghani territory in the form of the rivers and streams. For savings of water potential of the country the minister has suggested to construct dams, reservoirs and channels.

The project of development of water resources of the Pyanj River has been made in the USSR when in 1970 the Central Asian branch of the Hydroproject has developed "the Scheme of complex use of the Pyanj and the Amu Darya Rivers on a boundary site between the USSR and Afghanistan". This scheme has been confirmed in the USSR, but hasn't received realization because of difficult relations between the USSR and Afghanistan.

To 2020 year three planned basic irrigational projects will include in addition about 200 Th.ha of the irrigated lands, therefore the irrigation total area in the Afghani part of the Amu Darya basin will make approximately 600 Th.ha and therefore an annual maximum water intake from Pyanj, Amu Darya and Kokcha, Kunduz will make 6000 Mln.m³.

2.1. Long-term plans of use of water resources of the Pyanj River Basin in Afghanistan

2.1.1. The irrigation and Hydroelectric power station (HPS) building in downstream of Kokcha River.

Realization of the first phase of this project has begun before 1980, but because of war works have been stopped. The equipment design, and also technical and economic the project substantiation has been executed with support of experts of the former USSR. For the period 2004 -2009 the Feasibility Report it has been finished by the well-known international consulting firm taking into account new social and economic and ecological requirements. Now preparation for tender carrying out is spent on detailed studying of the project which includes following services and works:

- Maintenance of a necessary quantity of water for an irrigation of the existing of 96 Th.ha lands;
- Maintenance of a necessary quantity of water for an irrigation of 37000 ha new mastered agriculture lands;
- Building of HPS by capacity in 42 MWt and maintenance with the electric power of the machine irrigation and the next settlements;
- The contribution to maintenance of national food safety by means of production more a crop;

- Creation of possibility of employment for increase in incomes of the local the population. Project performance is broken into phases: restoration of 96 Th. ha roughly should be finished by 2016 and the irrigation of the new lands of 37 Th.ha by 2020.

2.1.2. The Kelagaysk project- irrigation and hydroelectric power station building

This project is carried out on the river Kunduz, one of inflows of Amu Darya in a province Baghlan. Researches and design works also were carried out at technical and the financial help of experts of the former USSR in 70 and 80th years. Recently was the new feasibility report well-known is executed the international consulting firm taking into account all new requirements.

The basic characteristics of the project:

- Reliable water supply for an irrigation of the existing of 43250 ha of agriculture lands;
- Reliable water supply for an irrigation of 25365 ha new mastered of agriculture lands;
- Production of electric power by building of hydroelectric power with capacity of 60 MWt.

The project is at present on design stages and its finish it is expected by 2020.

2.1.3. Irrigation and Hydroelectric power station building in upstream of Amu Darya or downstream Pyanj Rivers

This project is carried out on the river Kunduz, one of inflows of Amu Darya in a province Baghlan. Researches and design works also were carried out at technical and the financial help of experts of the former USSR in 70 and 80th years. Recently was the new feasibility report well-known is executed the international consulting firm taking into account all new requirements.

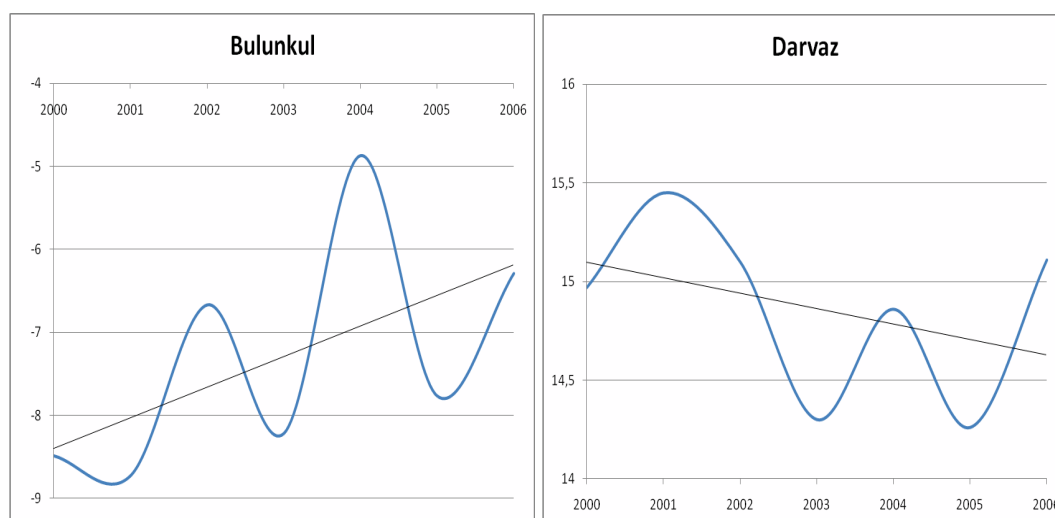
At present the project is at an initial stage of planning. By estimations, nevertheless, potentially suitable area for an irrigation exceeds 500 000 ha already mastered and the new lands. The capacity of under construction hydroelectric power station can reach 1000 MWt. It is expected that in the following of 10 years 215 Th. ha of the lands will be irrigated.

Rational use of water resources of Afghanistan is impossible today without maintenance with the qualitative hydrological information. At the heart of reception of the authentic and universal information regular long-term supervision over various hydrological characteristics and a condition of water objects of republic lie. All are more loudly distributed appeals to apply methods of complex water resources management (CWRM), recognized as a key component of successful water resources management at the UN conference on water resources in Mar del Plata, Argentina, in 1977 and at the UN conference on inhabitancy of the person in Stockholm in 1972. They are widely used now in the developed countries as the most suitable way of the decision of problems of water resources management. In a reality to apply CWRM it is difficult, as they demand much more the information, than simple water resources management.

3. MODERN STATE OF HYDROMETEOROLOGICAL NETWORK IN PYANJ RIVER BASIN.

As it is known, efficient control any real process probably only in the event that is known the future condition of system, and the last is established in advance, due to mathematical modeling. Thus, efficient control depends on level justify techniques of forecasting of dynamics of considered process. Forecasting watersheds of the rivers should be considered as the activity normalizing functioning of manufacture. Efficiency of wildlife

management is reached by means of Hydrometeorological maintenance. It assumes not only rational, but also optimum use of knowledge of forthcoming changes of the rivers discharge for the economic organization of hydrotechnic points. Productivity of industrial operations and other actions depending from watershed of the rivers will be that above, than more optimum system of Hydrometeorological maintenance. Decisions made by the consumer in this case will be decisions water-economic which are based on the information arriving from prognostic divisions and should provide the maximum benefit or the minimum losses at performance of the set industrial operations. In the Pyanj river basin on the territory of Tajikistan there are 43 Hydroposts in 41 from which water level measurement is spent. According to the working plan in 40 Hydroposts should it is spent gauging of the water discharge of the rivers. Hydroposts of Gunt-Alichur, Bartang-Pshart are completely destroyed. Four Hydroposts of the Pyanj River (Ishkoshim, Shidz, Khirmanjo and Nijni Pyanj) concern border stations which with 1992 on 2004 didn't work. Since 2004 measurements only a water level has been renewed. Hydroposts in the rivers Kizilsu, Toirsu and Jaksu (Bobokhonshaid, Kurbonshaid, Somonchi, Shahbur and Vose) have failed as a result of flooding 1992 and 1998. The insufficiency and reliability of meteorological data now is main problems of Pyanj River Basin. At the analysis of the meteorological a database on four meteorological stations (Bulunkul, Darvaz, Ishkoshim and Khorog) of the Pyanj River Basin from 1960 on 2010 we weren't possible manage a continuous line of the data on change of temperature, precipitation except for the data on temperature for period 2000-2006 years (Fig.1).



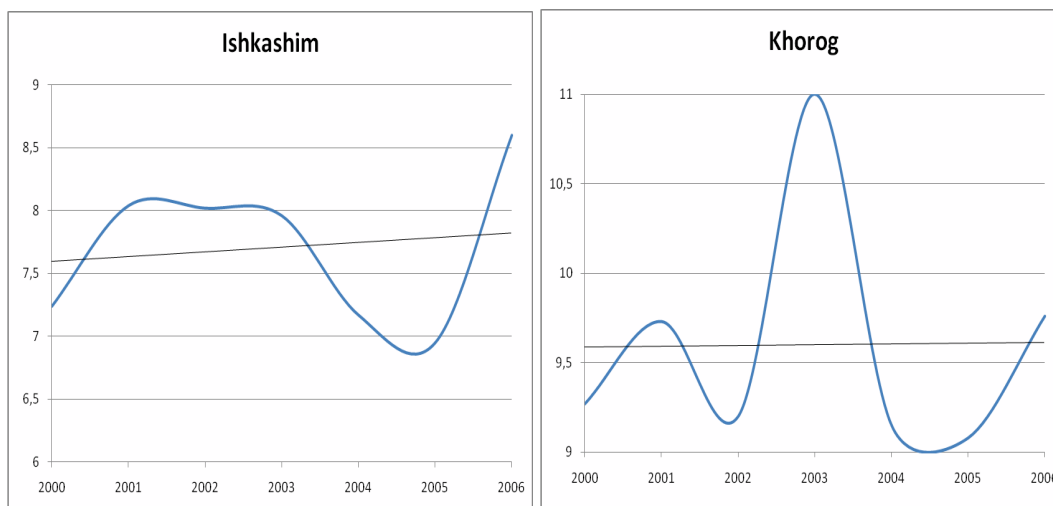


Figure 1. Trends of temperature change in Pyanj River Basin according to data of four stations for 2000-2006 periods

The similar situation is observed also in the Afghani part of the Pyanj River basin. About this are testify Table 1 and Table 2 where the data about availability of the meteorological data on the basic inflows of the Pyanj River the river Kunduz and Kokcha basins is presented.

Table 4. Availability of hydrological date in Kokcha River Basin

River	Name of Station	Available Data (Years)
Warduch	Near Baharak	1970-1978
Warduch	Shashpul	1970-1978
Keshem	Near Keshem	1970-1978
Kokcha	Near Jurm	1970-1978
Kokcha	Near Keshem	1970-1978
Kokcha	Khojaghar	1965-1978

Table 5. Availability of hydrological date in Kunduz River Basin

River	Name of Station	Available Data (Years)
Bamyan	Bamyan	1970-1976
Bamyan	Ahangaran	-
Bamyan	Doab	1968-1978
Foladi	Bamyan	1971-1976
Andrab	Doshi	1965-1978
Farkhar	Pul-i-mustan	1967
Farkhar	Near Taloquan	1968-1978
Taloquan	Pul-i-Chugha	1965-1978

The government of the Republic of Tajikistan taking into account importance of protection of the population from flooding the investment project "Management of risk of flooding in Khatlon area" which is financed by the Asian Bank of Development has supported.

According to the working project plan a recovery work at these stations and building of water gauging is provided.

CONCLUSION

Thus, results of the spent analyses shows that the Pyanj River Basin possesses a unique stock of hydropower resources. The present stage of development of hydropower resources is characterized by working out of feasibility reports on objects and negotiations between the next states Tajikistan and Afghanistan on their effective development. Building of hydraulic engineering constructions on inflows and the Pyanj River opens wide prospect on development of new farmlands in territory of Afghanistan and by that to provide food safety of the country. Efforts of two states of Afghanistan and Tajikistan with support of financial institutions and the international organizations conduct work on restoration old and building of new and modern Hydrometeorological stations

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