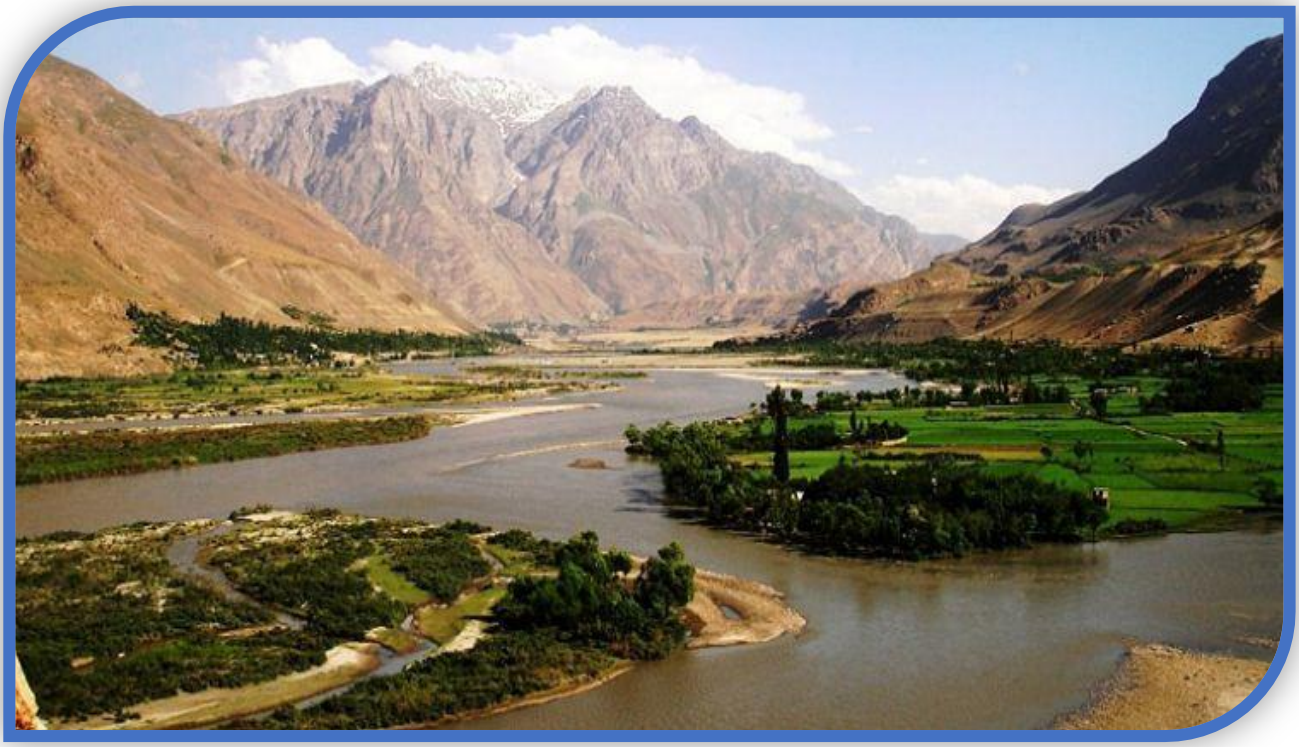
MINISTRY OF ENERGY AND WATER RESOURCES
OF THE REPUBLIC OF TAJIKISTAN

TA 9183-TAJ: WATER RESOURCES MANAGEMENT IN THE PYANJ RIVER BASIN

PYANJ RIVER BASIN MANAGEMENT PLAN
EXECUTIVE SUMMARY



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List of Abbreviations

ADB	Asian Development Bank
ALRI	Agency for Land Reclamation and Irrigation of the Government of Tajikistan
CESCD	Committee on Emergency Situations and Civil Defense
CBA	Cost Benefit Analysis
CSSES	Center for State Sanitary and Epidemiological Surveillance
EBRD	European Bank for Reconstruction and Development
EIRR	Economic Internal Rate of Return
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	FAO Statistical Databases
GDP	Gross Domestic Product
GIS	Geographic Information System
Ha	Hectare
JFPR	Japan Fund for Poverty Reduction
IDB	Islamic Development Bank
I&D	Irrigation and Drainage
IWRM	Integrated Water Resources Management
Km	Kilometer
KfW	German Development Bank
kWh	Kilowatt Hour
M&E	Monitoring and Evaluation
MEWR	Ministry of Energy and Water Resources of the Government of Tajikistan
NDS	National Development Strategy 2030 of the Government of Tajikistan
NDRRS	National Disaster Risk Reduction Strategy 2018
OSCE	Organization for Security and Cooperation in Europe
O&M	Operation and Maintenance
PRB	Pyanj River Basin
PRBMP	Pyanj River Basin Management Plan
RBO	River Basin Organization
RBC	River Basin Council
SCADA	Supervisory Control and Data Acquisition
SDG	Sustainable Development Goals
SUE KMK	State Unitary Enterprise for Utilities Management
TA	Technical Assistance
UN	United Nations
$	United States Dollars, Currency of the United States of America
VAT	Value Added Tax
WRZ	Water Resources Zone
WSS	Water Supply and Sanitation
WUA	Water User Association

1. INTRODUCTION

1.1 BACKGROUND

1. The Pyanj River Basin Management Plan (PRBMP) was prepared under the project "Water Resources Management in the Pyanj River Basin" (PRB), financed by the Asian Development Bank (ADB) through the Japan Fund for Poverty Reduction (JFPR) technical assistance (TA) 9183-TAJ. The project supports the Government of Tajikistan in: (i) achieving the goals of the water sector reform in Tajikistan; and (ii) the formation by Tajikistan and Afghanistan of a Joint Commission for effective management of the PRB resources based on the principles of integrated water resources management (IWRM), as well as establishment of River Basin Organization (RBO) and River Basin Council (RBC),

2. The PRBMP will guide the planning, development, and sustainable management of water resources within the Tajik part of the PRB[1] and will provide a mechanism for coordinating developments that may have impacts on the quantity and quality of the water resources, and protection of ecosystems. It also incorporates flood and drought management plans and a framework for monitoring and evaluation of water resources development.

3. The report is presented in three volumes: Volume 1 contains the PRBMP; Volume 2 – the Annexes to the Plan, and Volume 3 – the Pyanj River Basin Atlas.

1.2 POLICY AND INSTITUTIONAL CONTEXT

4. In December 2015, the Government of the Republic of Tajikistan adopted the Water Sector Reform Program of Tajikistan, 2016-2025, comprising a set of actions aiming to increase the effectiveness and efficiency of water management by introduction of IWRM principles at national and basins' levels and, as a result, to boost the national agriculture production.

5. As part of the institutional reforms in the water sector, two key institutions were established: (i) the Ministry of Energy and Water Resources (MEWR) responsible for water policy and regulation, and (ii) the Agency for Land Reclamation and Irrigation (ALRI) is an authorized state body for the development of unified state policies and legal regulations for land melioration and irrigation, also responsible for the irrigation and land reclamation oversees the development, management, and operation and maintenance (O&M) of water infrastructure.

6. In addition, staff, infrastructure, and equipment capacities in the water sector will be improved to ensure continued implementation of the reform and adoption of IWRM principles for river basin planning. The transformation process includes balanced allocations of water, based upon hydrological boundaries, and preparation of evidence-based river basin management plans developed under the actual and foreseen conditions of climate change risks, and in consultation and dialogues with stakeholders.

7. RBOs and RBC have been established as water governance and advisory institutions that will execute, and update river basin management plans. The RBO and RBC also have coordination and regulation roles in PRB management on behalf of MEWR. Relevant government strategies, legislation and institutions are described in Annex 1.

2. METHODOLOGY FOR THE PRBMP FORMULATION

8. The PRBMP is being prepared in line with the Tajikistan national development policies and the methodology formulated by the "National Water Resources Management Project," and by the "Basin Planning and Management of the Kafarnigan River" project.

[1] A similar ADB-funded project (48042-001-AFG "Panj–Amu River Basin Sector Project") supports the water resources planning within the Afghan portion of the basin. This report covers only the Tajik part of the basin.

9. The steps of the planning process[2] for river basin planning are: (i) basin delineation study; (ii) legal framework requirements; (iii) establishment of a basin planning database; (iv) key basin characteristics and analysis; (v) identification of significant basin water issues; (vi) vision, goals and objectives of the basin plan; (vii) program of measures to implement the plan; (vii) implementation monitoring and evaluation; and (viii) consultation and adoption of the plan.

2.1 DATA COLLECTION, MAPPING AND CONSULTATION

10. Hydrometeorological and infrastructural data for the basin was collected, and the main PRB features – e.g. the watershed boundaries, groundwater resources, irrigated land areas and demographic factors were determined. The hydrological characteristics of basin - formation of river flow, annual fluctuations in river discharge, and properties of small rivers were also established.

11. The PRB inventory was undertaken to form a single geographic information system (GIS with a database recording the points of surface and groundwater intakes, the wastewater discharge points, key water infrastructure, and boundaries of irrigation and drainage (I&D) systems managed by water users' associations (WUAs). Annex 2 of the main report provides a detailed description of the work undertaken within the Basin.

12. Thereafter, the PRB atlas was prepared, including 31 maps, which are compiled based on historic data, satellite images and advanced GIS technologies. Initial training in the use of database system and its management has been provided to the RBO on administration and maintenance of the database. The PRB atlas is presented in Annex 3 of the main report and Annex 4 describes the project database.[3]

13. Three River Basin Dialogues[4] with key stakeholders (MEWR, ALRI, local government administrations, etc.) were convened between September 2018 and September 2019 to present the objectives and methods of river basin planning, current major water issues and to provide guidance on the PRBMP formulation.

3. KEY FEATURES OF THE RIVER BASIN

3.1 TOPOGRAPHY AND GEOGRAPHY

14. Tajikistan is located in the South-East of Central Asia and its total area is 142,600 km^2. Tajikistan is bordered in the west and north with Uzbekistan – 910 km, Kyrgyzstan – 630 km, in the south with Afghanistan – 1,030 km, and in the east with China – 430 km.

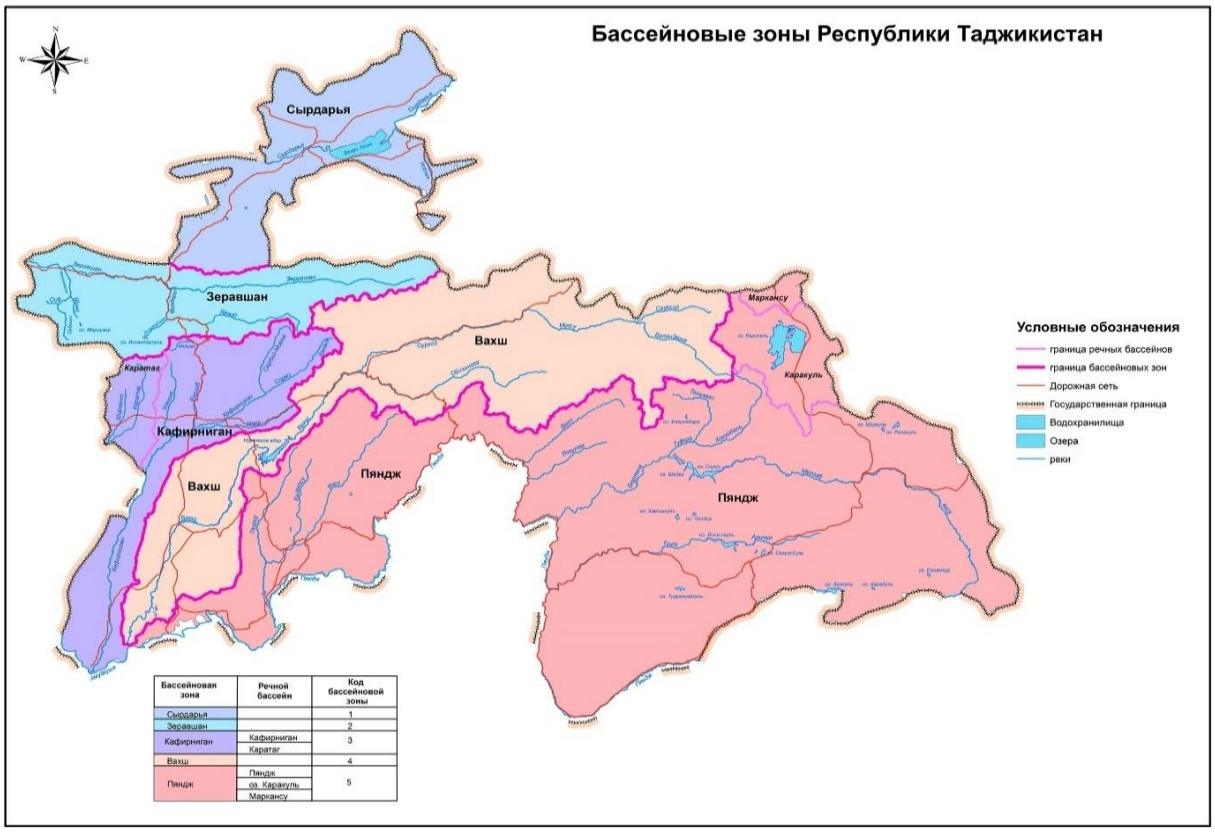
15. The Pyanj River forms the 1,200 km long southern border of the country and flows in the Amu Darya River downstream of its confluence with the Vaksh River below the Pyanj town. Pyanj is the longest and largest river of Tajikistan and is fed from a number of areas the largest of which are Pamir, Gunt, Bartang, Yazgulem, Vanj and Kizilsu.

16. The Pyanj River Basin is the largest of the five basins in Tajikistan (see

[2] It should be noted than these steps are not entirely sequential – some run concurrently, but many early steps generally need to be completed before later steps are completed.
[3] Digital and hard copies of the atlas and the database were provided to stakeholders in December 2019.
[4] River Basin Dialogues were a precursor to formation of the Basin Councils that include key basin stakeholders.

17. Figure **1**) with a catchment area of about 114,500 km^2, located about 60% in Tajikistan, and 40% in Afghanistan. The river source lies in the Pamir mountains at an altitude of over 7,000 m.

Figure 1: Major River Basins in Tajikistan



18. The main tributaries of the Pyanj River system in Tajikistan are westward flowing rivers draining the Pamir Mountains of the Gorno-Badakshan region (such as the Gunt, Bartang and Vaksh rivers) and the Kizilsu/Yaksu River system of central Tajikistan which merges with the Pyanj River near Farkhor. The Basin can be sub-divided into distinct sub-catchment areas: (i) the small southerly-draining direct tributaries of the Pyanj draining the Pamir mountains within Ishkoshim District; (ii) the Gunt sub-catchment (including the Shahdara river); (iii) the Bartang sub-catchment; (iv) the Yazgulum sub-catchment; (v) the Vanj sub-catchment; (vi) the small direct tributaries of the Pyanj draining the Khazrati-Baba ridge, generally in a south-easterly direction; (vii) The Kizilsu/Yaksu catchments; and (viii) the Lower Pyanj floodplain.

19. In this report, the first five water resource zones (WRZ) are considered the Badakshan WRZ (roughly corresponding to the GBAO area). The sub-catchments 6 and 7 are considered the Kizilsu-Yaksu WRZ; and sub-catchment 8 is considered the Lower Pyanj WRZ.

3.2 POPULATION, POVERTY AND GENDER

20. Geographically, the territory of PRB is part of the Gorno Badakhshan Autonomous Oblast (GBAO) and the Khatlon Oblast of Tajikistan. On the territory of the basin there are 19 districts, 2 cities, 9 urban settlements and 122 jamoats.

21. **Population:** The total PRB population in 2018 was 1,751,500 people. The urban population represents 16.9% and rural 83.1%. Over the past 11 years, the population of the basin has increased by 334,600 people or 23.6%, The average annual population growth rate was 2.1%, including 2.2% in rural areas and 1.7% in urban areas.

22. Forecasts indicate that the population of the basin may increase by 26.2% (27% in rural and 22.4% urban areas) and amount to 2,304,700 persons by 2030 and may affect the future use of water resources.

23. **Poverty:** While the poverty rate in Tajikistan is declining steady in recent years: from 81% in 1999 to 31% in 2015[5], PRB remains the poorest basin in the country, with highest rates observed in GBAO where the general poverty level was 39.3% and extreme poverty was 17.3%. In Khatlon district these indicators were 37.4% and 19.5% respectively.

24. **Gender:** The National Strategy[6] for the Promotion of the Role of Women in the Republic of Tajikistan for 2011-2020 recognizes that due to the high level of labor migration the majority of women are employed in agriculture. Therefore, the Strategy directs to enhance women's education, improve women's access to land, simplify the procedures for providing loans to women, and re-train them to develop their agricultural production skills.

25. Despite of the adoption of gender-sensitive policy documents, land use certificates are most often issued only in the name of the male head of a family. As a result, women's access to land in PRB remains low - out of 45,766 dekhkan farms, only 11.5% are headed by women. The lack of access to land is often the cause of women's limited control over the land and water resources - the most important production base in the basin. Although more women than men work in the irrigated agriculture sector, their participation in WUAs is very low, and only about 1% of the leadership positions in PRB water management are held by women.

26. The Gender Action Plan (GAP) in Annex 5 and the program of measures in Section 19.4 of the main report outline actions for enhanced participation of women in water management, establishment of gender balanced emergency response teams, as well as pilot projects and targeted allocation of grants.

4. ENVIRONMENT

27. The Pyanj River Basin is a substantially pristine natural environment, preserved because of its remote location and sparse density of population. Its mountains and steep river valleys are stark and rugged, and formidable. Population centers in the Tajik portion of PRB include Khorog in the upper basin, and the Vose-Kulyab region in the lower basin. In Khorog there is little industrial development, and the changes to the natural environment in the city area are largely due to the establishment of residential areas on the banks of the Pyanj River and its tributaries.

28. In the Vose-Kulyab Region there is more significant change to the natural environmental conditions due to the extensive irrigated lands located in the plains there, and minor industrial development within the urban areas. There has also been pressure from livestock grazed on pasture lands, and from the felling of trees on the hillsides. The alluvial floodplain of the lower Pyanj, and the floodplain of the Yakhsu and Kizilsu rivers have also been significantly impacted by the development of irrigated lands, farming and livestock rearing activities.

29. Areas outside the extensive irrigation developments have not been significantly impacted by land use changes. Natural mineral resources of the basin are largely unexploited, thus representing limited environmental changes.

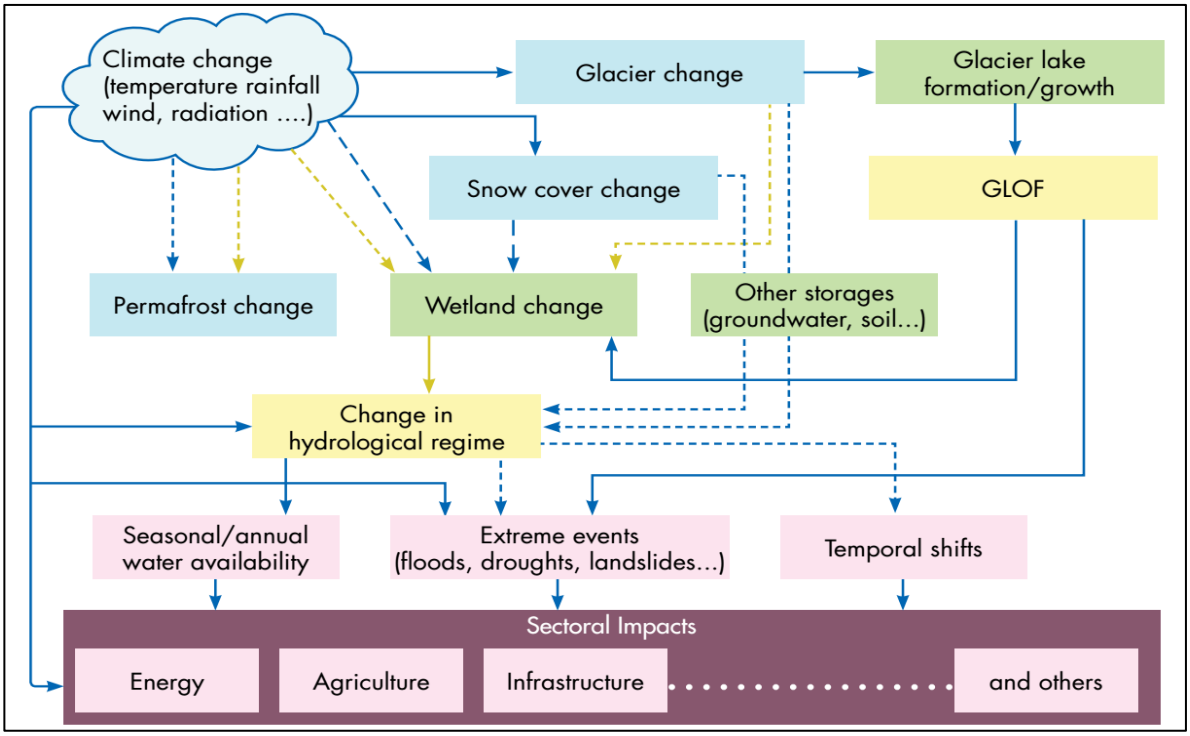
5. CLIMATE CHANGE

30. Tajikistan's climate is continental, subtropical, and semiarid, with some desert areas. The PRB and its water resources are expected to be impacted by changes to the climate brought about by anthropological impacts on the global climate systems. In general, the impacts of climate change are likely to be felt in a number of areas – as illustrated in the following figure.

[5] Global Partnership for Effective Development Cooperation. 2016. Monitoring Profile: Tajikistan, October 2017.

[6] National Strategy for the Promotion of the Role of Women in the Republic of Tajikistan for 2011-2020, 29 May 2010

Figure 2: Impacts of Climate Change on Hydrological Cycle



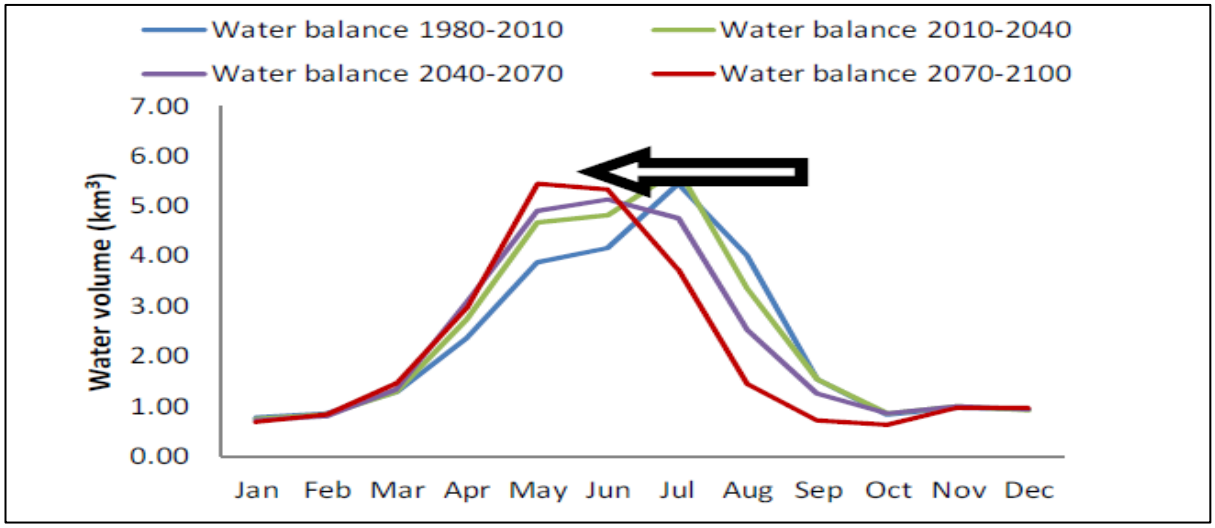
Source: Impacts of Climate Change on Cryosphere, Hydrological Regimes and Glacial Lakes of the Himalayas, ICIMOD 2016.

31. The anticipated impacts of climate change for the Pyanj River Basin comprise:

- "Air temperatures in Vakhsh and Pyanj River basins will increase by approximately 1.7°C between 2010 and 2050 and by 3.5°C between 2010 and 2100;
- Mean annual evapotranspiration will increase in line with air temperature;
- Maximum and minimum daily air temperatures are likely to increase;
- Due to higher mean temperatures annual rainfall is likely to increase while annual snowfall is likely to decrease;
- Changes in the profiles of mean monthly rainfall and snowfall are expected; and the magnitude of extreme daily precipitation is likely to increase;
- Annual mean river flow is likely to increase in glacial sub-basins for the next 50-60 years due to the increase in the air temperature and the resulting increase in snow and ice melt rate. Towards the end of the 21st century annual flow may decrease in some sub-basins as smaller glaciers start to disappear;
- In non-glacial sub-basins, there may be changes in the profiles of monthly flows due to the projected increases in rainfall and decreases in snowfall;
- There may be greater variability in annual flow by the end of the 21st century due to increasing rainfall runoff and decreasing contribution from snow and ice melt;
- There may be a gradual change in the seasonal distribution of river flow, with high flows occurring earlier in the year;
- The magnitude and frequency of mudflows and floods is likely to increase.

32. While the climate change impact on the overall flow in the Pyanj River is significant, in rivers where glacial melt makes a more significant contribution to the overall flow this impact is greater. These changes also alter the timing of peak flows within the river, see Figure 3.

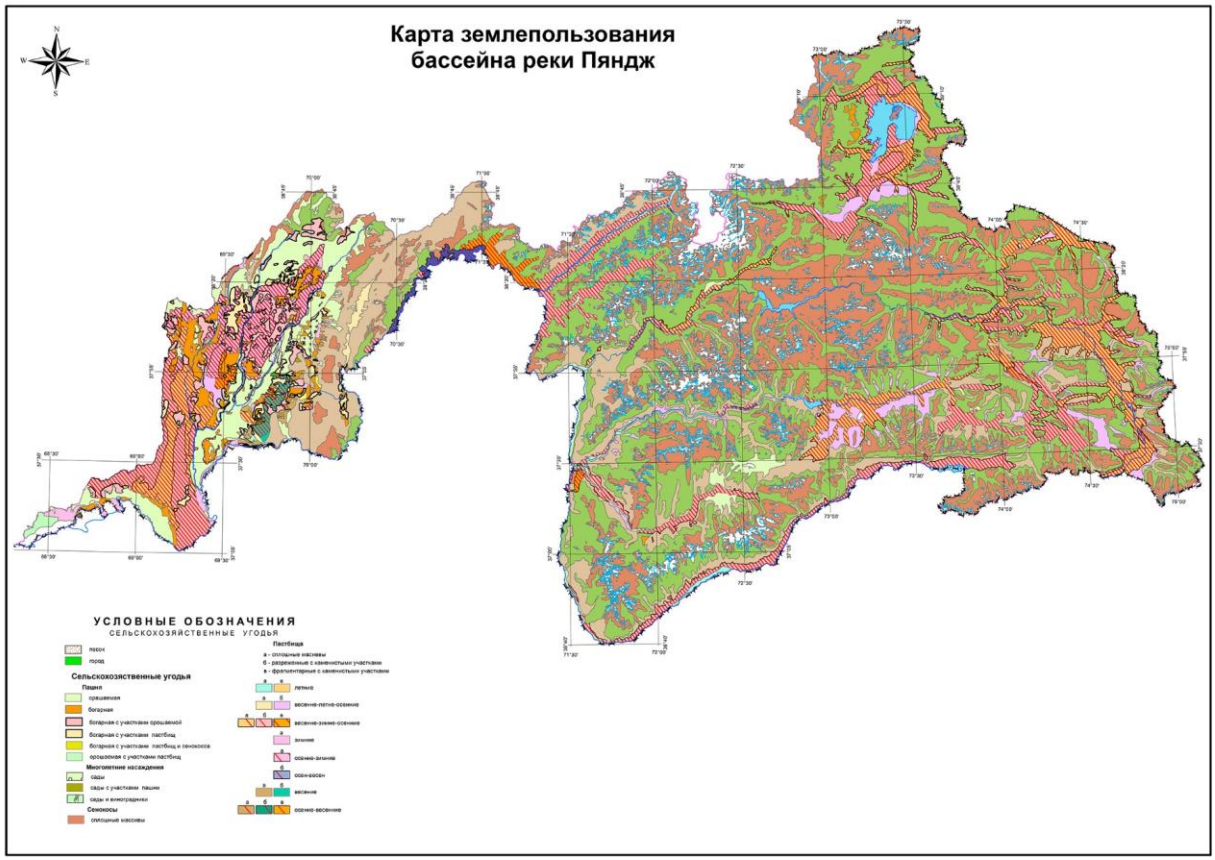
Figure 3: Season Runoff in the Pyanj River with Climate Change (ADB, 2011)



6. LAND USE AND AGRICULTURE

33. Agriculture is the dominant occupation in rural Tajikistan and PRB, and vital to the economy of rural areas. The main crops in the Basin are cotton, wheat, maize, melons and vegetables, fodder, and oilseeds – all requiring irrigation for satisfactory yields. Cotton and wheat are the most valuable crops. The raising of livestock is a very important element of agricultural activity in the basin. While irrigated crops include fodder crops, a lot of the nourishment of the animals is obtained through use of pasture lands that might be distant from their source village.

Figure 4: Land Use in Pyanj River Basin



7. WATER RESOURCES

7.1 SURFACE WATER

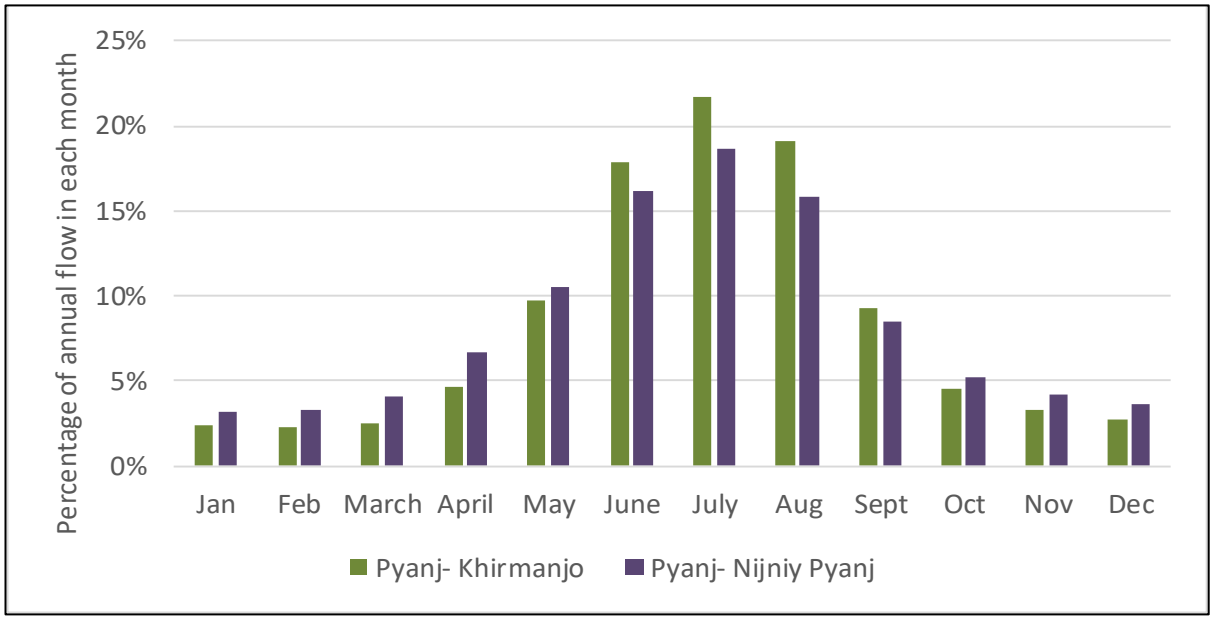
34. There are plentiful surface water resources within the PRB, particularly as water is largely needed only within the valleys of the basin where most of the surface water is located. Table 1 summarizes this information, while detailed calculations are provided in Annex 6.

Table 1: Mean Annual Runoff at Gauged Locations

River and location	Catchment Area (km^2)	Mean Annual Flow (m^3/s)	Mean Annual Runoff (mm)
Pyanj - Shidz	57,100	437	242
Pyanj- Khirmanjo	72,400	838	365
Pyanj- Nijniy Pyanj	113,000	1026	287
Kizilsu - Bobohonshaid	1,790	31.3	552
Yahsu - Karboztonak	1,440	36.4	798
Yahsu - Vose	2,650	28.4	339
Kizilsu - Samanchi	6,200	78.4	399
Obikhumbhou - Ustie	709	19.4	883
Vanj Bichkharv	2,060	51.4	787
Vomardara - Rushan	87.1	2.14	777
Bartang - Murgab	10,500	16.5	49.7
Bartang - Barchadiv	16,700	45.2	85.5
Bartang-Shuchand	24,700	131	167
Yazgulem - Motravn	1,940	36.8	599
Gunt Khorog	13,700	105	242

35. For the main Pyanj River, the month-to-month mean flows are indicated in Figure 5.

Figure 5: Annual Distribution of Flow of Pyanj River



7.2 GROUNDWATER

36. Tajikistan is rich in groundwater- fresh, mineral medicinal, industrial, and thermal. The predicted groundwater resources are 51.2 million m^3/day; and the explored operational reserves of only fresh groundwater of the valley part of the republic amount to 7.6 million m^3/day.

7.3 WATER SUPPLY SYSTEMS

7.3.1 Irrigation and Drainage

37. Irrigated agriculture is the largest water consumer in PRB. The need for irrigation is long-established, since agriculture relying on rainfall is unreliable and of low productivity.

38. Management of I&D network to the farm level is the responsibility of ALRI. At the field level, WUAs are being developed to assume responsibility for management of the on-farm systems, the distribution of water to field outlets, and collection of dues for water supply.

39. The total irrigated area in PRB is 170,142 ha and is divided into 2,452 schemes. Out of these, 2,013 have an area of up to 5 ha and 439 – areas ranging from 5 to 10 ha. The total length of the canals is 7,266 km, of which 206 km are lined. These canals are equipped with 543 structures on the main network and 742 field delivery points, and outlets with 1,206 gauging stations. In addition, there are 6,077 km of operational on-farm canals, of which 104 km are lined.

40. Sources of water for irrigation are the river systems with little groundwater used. River water quality is generally very suitable for irrigation but has a high sediment load. In general, there is plenty of water available for irrigation use, but little land suitable and economic under present conditions for profitable agriculture.

7.3.2 Pumping Stations

41. Water for about 40% of the irrigated areas within PRB, is supplied by 73 pumping stations in the basin, including: (i) Lower Pyanj WRZ, state owned – 22, non-state owned – 2; (ii) Kulyab WRZ, state owned – 46, non-state owned – 5; and (iii) Badakhshan WRZ, state owned – 10, non-state owned – 16.

7.3.3 Drainage Network

42. The total length of the drainage network in the basin is 2,393.4 km, of which inter-farm – 663.7 km (28%) and intra-farm – 1,729.7 km (72%). The total drained area is 51,391 ha with a drainage network density of 20.2 m/ha. The entire drainage volume is discharged into the Kyzyl-Su, Yakh-Su, Kulyabdarya, Toir-Su rivers.

7.3.4 Reservoirs

43. The use of artificial and natural reservoirs in the basin and their maintenance in good technical condition are of increasing importance. Currently, the basin has two reservoirs formed by blockages: Sarez Lake on the Bartang River, Yashil-Kul on the Gunt River. There are two small reservoirs use for irrigation with a volume of 20 to 30 million m^3 – Muminobod and Selbur.

44. The number of waterworks with large reservoirs is projected to increase significantly in order to utilize the hydropower potential of the basin. The potential dam sites, planned for implementation in the next 15-20 years, and the existing ones are presented in the table below. Some dam sites are being developed, for example, the Lower Pyanj and the Sarez Lake.

Table 2: Potential Dam Sites in the Pyanj River Basin

Name and location	Water level (m)	Backwater (m)	Total volume (km^3)	Net volume (km^3)	Reservoir area (km^2)	Comments
Lower Pyanj	0.0	0.0	0.0	0.0	0.0	redesigned
Dashti-Jum	1,055.0	300.0	17.6	10.2	135.0	potential
Granite Gate	1,570.0	215.0	1.3	0.03	0.0	potential
Rushan	2,060.0	295.0	5.5	4.1	71.0	potential

7.3.5 Irrigated Land

45. The PRB irrigated systems are located mainly in the Kulyab and Lower Pyanj water resource zones, where irrigated areas amounted to 170,142 ha in 2018. Despite the development of new lands, the average area of available irrigated land has noticeably decreased by 2018. The most critical is the situation in the Kulyab and Badakhshan zones, where the irrigated land was 0.07-0.08 ha/person in 2018 – see Table 3.

Table 3: Irrigated Land per Capita (2018)

Water resource zone	Irrigated area (ha)	Population (2018)	Irrigated area (ha/person)
Lower Pyanj	43,054	246,500	0.17
Kulyab	86,218	1,170,800	0.07
Badakhshan	18,609	223,500	0.08
Total PRB	147,881	1,640,900	0.09

46. Taking into account projected population growth in PRB, and to maintain the average irrigated land per person (0.09 ha/person) by 2030, it is necessary to develop additional 20,000-20,500 ha and increase the total irrigation area to 169,000 ha. Nevertheless, even with the new irrigated lands, there would be a decrease in irrigated area per capita from 0.09 to 0.07 ha.

47. Considering that the total amount of water resources in the basin, taking into account all surface and underground water as well as reuse of drainage water, the required withdrawals appear to be much less that the available water resources in the basin.

48. Based on the assessment of the current state of irrigation systems, the following main directions for improving the technical conditions, management and operation of irrigation systems were identified:

- Reconstruction and modernization of the existing systems, augmentation of water supplies; introduction of automated water allocation and improved technologies;
- Improvement of soil condition of irrigated lands, rehabilitation of the existing and construction of new drainage systems, precision land leveling, etc.; and
- Improvement of construction and O&M practices, optimization of land and water management and extension services.

49. Detailed descriptions and analysis to the I&D status in the basin are provided in Annex 7.

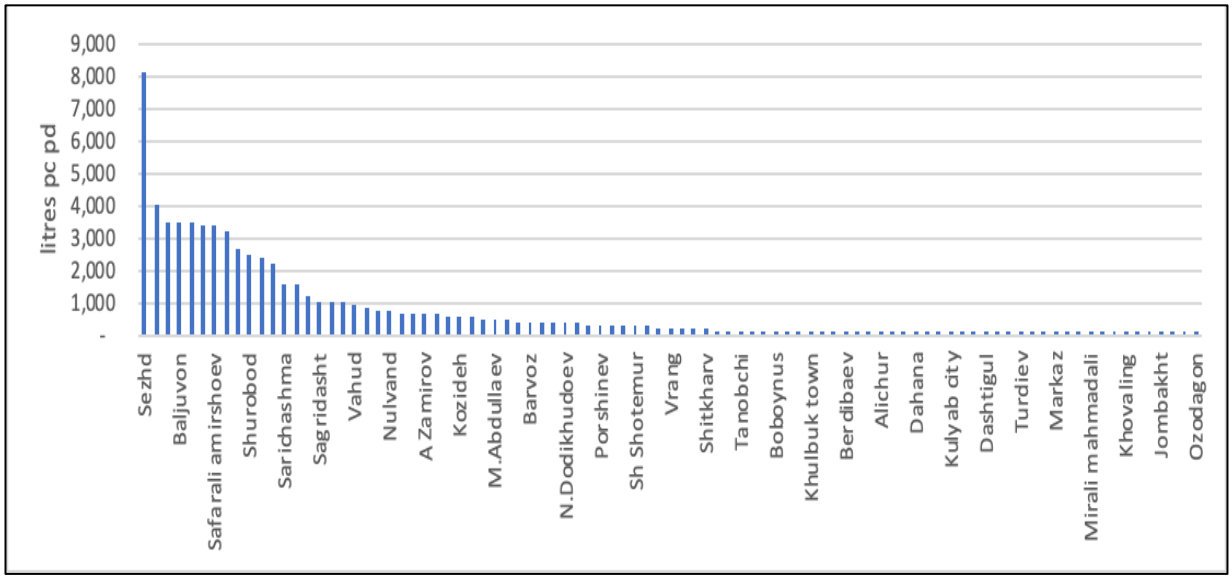
7.4 WATER SUPPLY AND SANITATION (WSS)

50. In terms of sustainable access to improved drinking water sources, Tajikistan is ranked 156 out of 177 countries in the world by the UN. With 57.5% access to drinking water, it ranks last among the post-Soviet countries and the CIS.

51. The Ministry of Health and Social Protection and its centers are authorized bodies for determining the quality and safety of drinking water, compliance of water with established standards defined by the Water Code of the Republic of Tajikistan, April 2020, and by the Law of the Republic of Tajikistan "Drinking water supply and wastewater disposal", July 2019.

52. Within the basin, population with some access to drinking water supply is 747,000, or 53% of the total. Access to mains sewage is confined to 106,000 persons, 16,400 households (in Zarbdor, Kulyab City and Khorog City), which is about 8% of the basin population. The volume of water taken from source is about 89 million m^3 (but data from 24 jamoats is missing). Where the amount supplied to the distribution system is also known, the losses are about 13%. The consumption per capita is variable, as over and under supply is evident.

Figure 6: Consumption per Capita per Day (liters)



53. Detailed description of WWS systems in the Basin is provided in Annex 8.

7.4.1 Other Water Abstractions

54. The use of water resources in municipal and industrial water supply is organized through municipal (city) and departmental water supply and sewerage systems, which carry out water intakes from both open water sources and groundwater. After treatment, the return water is discharged (industrial-municipal wastewater), as a rule, into open water sources. Discharge of untreated sewage is a rare exception.

55. The total water intake for technical needs of industrial enterprises from water bodies in the basin in 2017 was 2,789,912 $m^{3.}$. For the manufacturing industry of the basin, a significant share in the total water consumption is accounted for non-ferrous metallurgy – 79.7%, coal industry – 0.10%, production of building materials – 10.7%, and food industry – 8.5%.

8. BASIN WATER RESOURCES BALANCE

8.1 IRRIGATION WATER REQUIREMENTS

56. The irrigation water requirements in the basin were compiled using information from ALRI for the period 2011 to 2018. Over this time, the average irrigation water withdrawals amounted to 1,262,811,000 m^3 per year. Although there is abundance water in the basin, some 19,200 ha, or 13% of the irrigated area experienced water shortages. The main reason was the poor condition of water infrastructure – deterioration of irrigation networks and control structures, unreliable operation, and inadequate maintenance of irrigation pumping stations.

Table 4: Current Required water Withdrawals for Irrigation

Water Resources Zone	Total irrigated area (ha)	Planned water withdrawal (thousand m^3)	Actual water withdrawal (thousand m^3)	Average volume per ha (m^3)
Lower Pyanj	43,054	539,734	533,405	12,389
Kizilsy-Yakhsu	86,218	592,489	591,730	6,863
Badakhshan	18,609	138,037	137,676	7,398
Total PRB	147,881	1,270,260	126,2811	8,539

57. The approved standard irrigation water application in Tajikistan ranges from 9,500 to 10,660 m^3/ha. Thus, the total estimated irrigation water withdrawals for Basin in 2030 will amount to 1,735,599 million m^3/year, taking into account the projected irrigated development.

Table 5: Regulatory Irrigation Water Requirements until 2030

Water Resource zone	Norm (m^3/ha)	2020		2025		2030	
		Total irrigated area (ha)	Intake million m^3/year	Total irrigated area (ha)	Intake million m^3/year	Total irrigated area (ha)	Intake million m^3/year
Lower Pyanj	10,660	43,054	458,956	47,076	501,830	51,098	544,705
Kizilsy-Yakhsu	10,300	86,218	880,045	90,895	936,218	95,572	984,392
Badakhshan	9,500	18,609	176,785	20,173	191,644	21,737	206,502
Total PRB		147,881	1,515,786	158,144	1,629,692	168,407	1,735,599

Note: Application of water conservation technologies can save up to 10% of irrigation water

8.2 POTABLE WATER SUPPLY

58. The future potable water requirements in PRB were calculated on the basis of: (i) surveys and official data from the district administrations regarding the access to drinking water; (ii) forecast of population growth in accordance with the information from the Agency for Statistics; and (iii) water consumption standards for water supply and sanitation.

Table 6: Future Demand for Potable Water Supply in the Pyanj River Basin

Indicators	Indicators for 2018			Forecast for 2025			Forecast for 2030		
	Access to water (%)	Number of people with access to clean water, people	Total water consumption, mln. m^3	Forecast of population access to water,%	Number of people with access to clean water, people	Total water consumption million m3	Forecast of population access to water,%	Number of people with access to clean water, people	Total water consumption million m^3
Urban		246,0	16,164		274.0	18,004		296.3	19.464
Rural		1,143.6	29,219		1319.5	33,713		1,462.6	37.369
Total PRB	**53,4**	**1,384.5**	**45,4**	**86,7**	**1,588.1**	**51.717**	**100**	**1,752.9**	**56.833**

Source: Consultant's estimates

59. Based on the anticipated population growth for 2025–2030, the total consumption of potable water in the Basin would amount to 56.8 million m^3 per annum.

8.3 INDUSTRIAL WATER CONSUMPTION

60. In accordance with the Water Sector Reform Program (2016-2025), in 2018, with the support of the European Union, a study was conducted on "Analysis and assessment of the state of water consumption in Tajikistan's industries" for the formulation of a program for restoration and development of the water supply infrastructure for industrial enterprises and for introduction of water meters; and an interagency working group was established for this task.

61. Based on the results of the analyzes, the water consumption of all industrial enterprises in the country was estimated - water withdrawals from water bodies in 2017 amounted to only about 110,500,00 m^3. Also, industrial enterprises used over 527,000,000 m^3/year, for municipal needs and for drinking water supply to the population of nearby settlements. Accounting also for these services, the total water withdrawal by industries in Tajikistan amounted to about 638 million m^3/year.

62. The Development Strategy of the Republic of Tajikistan - 2030 envisages accelerated growth of the industry sector: 12.5% by 2020, 16% by 2025 and 20% by 2030. The projected growth will naturally result in increased overall water consumption by industries. After meeting these targets, the water demand by the industrial sector by 2030 would reach 45.5 million m^3.

8.4 HYDROPOWER[7]

63. The existing hydroelectric power plants (HPPs) in the Basin - with a total installed capacity of 44.14 thousand kW - are located mainly in the Gorno-Badakhshan WRZ. The table below shows their key features as of 2018.

Table 7: Technical Features of the Pamir Energy HPPs

Name of HPP	Name of river	Year of construction	Head (m)	Water rate (m^3/s)	Water volume (mil m^3/year)	Installed Capacity (thousand kW)	Generation (kW Hour)
Pamir-1	Gund	1994	79	40.4	1,256.6	28.0	100,854,520
Khorog	Gund	1970	59	17.5	544.3	9.0	60,700,386
Kalai-Khumb	Obi-humbov	1959	10.8	3.1	96.4	0.208	Non-operational
Tajikistan	Ak-su	1964	9	10	311.0	1.5	3,957,941
Teharv	Vanj	1995	76	0.63	19.6	0.36	2,620,870
Andarbak	Komochdara	1999	23	1.8	56.0	0.3	2,167,940
Vanj	Vanj	1968	21.5	6.35	197.5	1.2	5,328,060
Namadgud	Pyanj	1974	42	6.2	192.8	2.5	12,828,845
Savnov	Savnov (spring)	1989	95	0.1	3.1	0.08	82,679
Sponj	Khidorzhev	1992	130	0.3	9.3	0.16	639,206
Shuzhand	Bartang	1969	10.2	10.5	326.6	0.832	3,700,365
Total PRB					**3,013.2**	**44.14**	**192,880,812**

[7] Water used by hydroelectric power plants is renewable and therefore is not counted as consumption.

64. The overall hydropower potential of the Basin is estimated at about 97.6 billion kWh per year. The table below shows the power indicators of the proposed hydropower plants in the basin.

Table 8: Hydropower Potential of the Main Tributaries of Pyanj River

№	Name of tributaries	Potential Capacity (thousand kW)	Potential Generation (million kWh)	Technical Capacity (thousand kW)	Technical Generation (million kWh)	Percentage of the total capacity
I	Pyanj River	5,715	50,063	5006	4,385	88.0
1	Obi-Khumbou	172	1,507	86	753	50.0
2	Obi-Ravnou	142	1,244	71	622	50.0
3	Obi-Minou	122	1,069	61	534	50.0
4	Kizil-Su	244	2,137	122	1,068	50.0
5	Yakh-Su	339	2,967	136	1,190	40.0
	Sub-total:	6,734	58,987	5,482	48,017	82.0
II	Gund River	940	8,234	673		
1	Shakh-Dara	325	2,847	226	1,980	70.0
	Sub-total Gund	1,265	11,081	899	7,884	71.1
III	Bartang River	965	8,453.0	437	3,830	45.0
1	Yazgulem	282	2,470	127	1,111	45.0
2	Vanj	339	2,967	170	1,489	50.0
	Total PRB	**9,585**	**83,958**	**7,115**	**62,332**	**74.3**

65. Given the existing technical capabilities and financial resources, it is unrealistic to expect construction and commissioning of large new hydropower plants in the Pyanj Basin in the short- (2020–2025) and longer-term (until 2030), due to government commitment to the construction of the Rogun hydropower plant (3.6 million kW) on the Vakhsh river.

66. However, construction of small hydropower plants is likely to continue provided funding would be available. For example, at present, the construction of the small Sebzor hydroelectric station on the Shokhdara River with a capacity of 11.0 thousand kW is underway with foreign financing. Upon the commissioning of this hydropower plant, additional 173.6 million m^3 water will be required in medium term (until 2025). Taking into account the commissioning of other planned small hydropower plants by 2030 only 3,360.04 million m^3 will be required.

8.5 WATER SUPPLY AND DEMAND BY SECTOR

67. Based on the available data, the main driving forces of the basin in the following sectors will be considered: (i) agriculture, irrigation and drainage; (ii) drinking water supply and wastewater (iii) industries; (iv) fish farming; and (vi) hydropower. The table below summarizes the projected water use by these sectors.

Table 9: Water Supply and Demand Trends in the Pyanj River Basin

Water use by sectors (million m^3)	2018	2025	2030
Irrigation	1,262.8	1,629.7	1,735.6
Potable Water Supply	45.4	51.7	56.8
Industries	29.0	38.0	45.5
Fisheries	37.6	199.3	350.0
Hydropower	3,013.0	3,186.6	3,360.0
Total demand	4,387.8	5,105.3	5,547.9
Total available	32,574.0	32,574.0	32,574.0
Surplus	28,186.2	27,468.7	27,026.1

Note: Water use by hydropower is not included in the total, since it is reused downstream.

9. WATER-RELATED NATURAL HAZARDS

9.1 EXOGENOUS GEOLOGICAL PROCESSES AND PHENOMENA

68. The following types of natural hazards are identified in the project area:

- seismic hazard;
- danger of development of slope processes (landslides, landslides with landslips, etc.);
- mudflow hazard;
- flood hazard (during snowmelt, extreme precipitation, lakes outburst);
- underflood hazard; and
- erosion hazard.

69. The climatic conditions of Tajikistan play a very important role in the occurrence of natural disasters. Almost all the dangers that threaten the county are related to climate and weather conditions. The analysis of natural emergencies (depending on the formation of natural processes that caused them), recorded in database of the Information and Analytical Center of the Committee of Emergency Situations under the President of the Republic of Tajikistan for the period from 1996 to 2010, showed that meteorological events (storm wind, cold snap, heavy rainfall, including hail, droughts) directly caused about 40% of registered natural disasters.

9.2 FLOODING

70. Flooding is a major issue within the Pyanj Basin, as floods have historically caused extensive damage, and loss of life. Measures have been taken in the past to mitigate such risks, but the threat of floods continues to be a major issue. There are a number of contributary factors to the flood risk including:

- Events that can cause sudden increases in river flows, such as intense rainfall, temporary blockages in drainage systems and the like occur relatively frequently;
- A significant proportion of the population live in flood-prone areas where hillslopes are steep and high ground does not sustain economic activities;
- Increasing populations and economic activity put pressures on occupied land in areas where habitable land is in short supply (especially in the upper basin).

71. In the PRB the key risk factors include:

- Outburst floods, caused by breaches of temporary blockages to the drainage system, by landslides, glacier movement or similar;
- High flow rates in rivers caused by snowpack melting and intense rainfall;
- Erosion of river embankments during high flows, causing collapses.

72. Measures taken to protect against floods in the past have included construction of flood embankments, and river engineering to improve channel capacity. While such measures are effective after construction, they require constant monitoring and significant maintenance effort to sustain their effectiveness. After independence such maintenance could not be sustained, so levels of protection declined. There have been many subsequent projects to address key problems with flood protection systems since those times, but overall the work is still incomplete, and levels of flood protection provided are not consistent through the basin.

73. Under the TA project flood management plan has been prepared for PRB identifying measures needed to mitigate flooding risks within the basin to 2030. This is included in Annex 9 to the River Basin Management Plan.

9.3 MUDFLOWS

74. Mudflows are discharges of runoff from land with particularly high sediment content, increasing the density of the mixture of soil and water, increasing its destructive power. In areas with steep slopes, unstable soils and intense rainfall such high-density discharges can be created, and the destructive power can severely damage houses and other infrastructure, and deposit large amounts of soil and rocks once the discharge slows.

75. Many parts of the Pyanj Basin are susceptible to mudflows. Addressing the threat from mudflows can involve multiple strategies, such as:

- Increasing slope stability and reducing the risk of massive soil mobilization through appropriate planting of trees and drainage systems for vulnerable slopes in critical locations;
- Building defensive structures to protect key infrastructure – walls and embankments to divert potential mudflows and constructing alternative pathways to avoid damage if mudflows occur;
- Zoning in vulnerable locations; and
- Building stronger to be able to withstand the impact of mudflows.

76. The areas of Tajikistan with high risk from mudflows have been identified in a report prepared by OSCE in January 2019.[8] In PRB, the vulnerable areas are:

- Vanj, Yazghulom, Bartang, Gunt, Shahdara in GBAO; and
- Pyanj, Kofarnihon, Yakhsu, Tairsu and Kyzylsu in the Khatlon Region.

9.4 DROUGHT RISKS

77. Drought has impacted on the basin in the past and is a threat in the future. Problems of inadequate water availability can arise from a number of sources, but generally would be because:

- Low rainfall in the spring, coupled with low snowmelt volumes leaving spring pastures and non-irrigated crops severely short of water, and
- Low river discharges creating problems of access to irrigation water for the irrigated crops.

78. Historical droughts within the country have been identified in the 2017 FAO report[9] in the years 2001, 2003, 2008 and 2011. This report also estimates that moderate droughts (which reduce crop yields by 20%) can be expected about once in three years in the Lower Pyanj sub-basin, and once in four years in the upper sub-basin. The report also estimates that severe droughts causing might be expected once in six to eight years in the lower Pyanj sub-basin.

79. To mitigate these recurrent events, a Drought Management Plan has been prepared for the basin (see Annex 10), identifying measures needed to mitigate risks from droughts within the basin- e.g. improved forecasting systems, increased resilience to drought through seed development and crop selection, and organizational changes to provide timely relief during the drought.

[8] Natural Hazards in Tajikistan. OSCE, Dushanbe, January 2019. Available at https://www.osce.org/programme-office-in-dushanbe/408008?download=true

[9] "Drought Characteristics and Management in Central Asia and Turkey". Food and Agriculture Organization of the United Nations. Rome, 2017

10. RIVER BASIN WATER MANAGEMENT PLAN

10.1 KEY WATER ISSUES

80. The major water issues in the basin (for details see Annex 11) were identified through consultations with the local administrations and key stakeholders. Their distribution by sub-sectors is shown below.

Table 10: Summary of Important Water Issues By Sub-Sector

Sub-Sector	Number of Issues	%
Irrigation and land use	170	40.6
Municipal water supply and wastewater disposal	155	37.0
Ecology and environmental protection	39	9.3
Water-related natural disasters	30	7.1
Obstacles to fisheries development	13	3.1
Forests protection and pastures	12	2.9
Total	**419**	**100**

81. The analyses of these key water issues and consultation with stakeholders has resulted in the following overall vision for the River Basin Management Plan:

> ***Coordinated development and integrated management of the Pyanj River Basin water resources aiming to maximize the economic and social benefits in an equitable manner and ensure the sustainability of vital ecosystems.***

82. The PRBMP will also support the government commitment towards achieving key sustainable development goals (SDGs) adopted by the United Nations;[10] and will ensure monitoring and evaluation (M&E) of water resources management in the basin, and the impact of the PRBMP implementation. In consultation with stakeholders, the RBMP priorities were agreed, resulting in the following key outputs[11]:

- Output 1: Basin wide institutions for implementing the IWRM process established;
- Output 2: Equitable and reliable irrigation water supplies and drainage services delivered;
- Output 3: Improved WSS infrastructure and services provided;
- Output 4: Protection from water-related disasters enhanced; and
- Output 5: Sustainable ecosystems safeguarded.

10.2 PROGRAM OF MEASURES

83. The link between the PRBMP outputs, the proposed program of measures and related programs and investment projects constitute the development plan for the basin. The proposed measures are summarized in the table below, while detailed description of the envisaged capacity building programs, studies and investment projects are presented in section 11 of the PRBMP.

10 Especially relevant is SDG 6 – Ensure availability and sustainable management of water and sanitation for all.

[11] The outputs and the program of measures described in this report are applicable only to the Tajik part of the Pyanj River Basin. Water sector issues that are being addressed at national level in Tajikistan, and river basin planning in the Afghan portion of the basin are beyond the scope of the TA project.

Table 11: Outputs and Program of Measures

Outputs	Program of Measures
Output 1: Basin wide institutions and systems for implementation of IWRM process established	1.1. Realignment of water management institutions 1.2. Enhancing the basin GIS database 1.3. Expansion of basin hydrological monitoring network (hydro posts and piezometers) 1.4. Introduction of remote sensing technologies and hydrological modelling technologies, including climate change 1.5. Establishment of flood and drought warning and mitigation systems. 1.6. Formulation of a basin plan for sediment and watershed management
Output 2: Equitable and reliable irrigation water supplies and drainage services delivered	2.1. Strengthening of I&D System Planning 2.2. Rehabilitation and Modernization of Prioritized I&D Infrastructure
Output 3: Improved water supply and sanitation (WSS) infrastructure and services provided	***3.1.*** Planning and Prioritization of WSS Development ***3.2.*** Modernization and Expansion of Prioritized WSS Facilities ***3.3.*** Enhanced WSS Sustainability and Service Delivery
Output 4: Protection from water-related disasters enhanced	4.1 Urgent Inspection and Repair of Flood Embankments 4.2 Improved and Resilient Flood Embankments 4.3 Improved Management of Mudflows 4.4 Improved Drought Forecasting and Management
Output 5: Sustainable ecosystems safeguarded	5.1 Modernization of Existing and Construction of new Sewage Treatment Plants 5.2 Restoration of Pastures and Prevention of Further Degradation 5.3 Minimizing Pollution of Water Bodies 5.4 Restoration of Ecosystems of Protected Tugai Forests 5.5 Establishment of Protected Water Sanitary Zones 5.6 Raise Environmental Public Awareness

11. INVESTMENT PLAN

84. Each district with in PRB submitted a cost estimate for priority works considered necessary for water management infrastructure. These estimates were nearly all maintained,[12] but in order to achieve national targets for water supply (100% cover by 2030), a reasonable quality of I&D rehabilitation (a minimum expenditure of about $2,000 per ha over 40% of the irrigated area) and a realistic cost estimate for the opening and reclamation costs for new irrigation land ($5,000 and $3,500/ha respectively, compared to the district estimates of $2,000 and $1,000/ha respectively), the district estimates were augmented. To this were added cost estimates of baseline surveys, basin-wide studies (as per the Program of Measures) and Monitoring and Evaluation (M&E) costs.

85. The total investment cost proposed is $266 million in the period 2021-2030. The cost estimate is expressed in base costs and therefore excludes taxes and physical and price contingencies. The cost estimate is given in current (2019 USD) prices, as shown by Output in Table 12. In the period 2021-2023 most expenditure is at basin level, incurred in studies and refining baseline information so that future M&E is more reliable and focused. Investment in the districts is not expected until 2022, peaks in 2026 at $45 million and thereafter declines. Basin level expenditure (including M&E) is a small proportion (3%) of total investment costs.

[12] Except aquaculture, small-scale mining tailing rehabilitation (which are private costs) and government staff salary top-ups.

Table 12: Scheduled Investment Cost Estimate for PRBMP, $

Item	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
Output 1	Basin institutions and systems for IWRM established										
1.1 Realignment of water management institutions	250,000	250,000	250,000	-	-	-	-	-	-	-	750,000
1.2 Enhancing the basin GIS database	319,333	319,333	319,333	-	-	-	-	-	-	-	958,000
1.3 Expansion of basin hydrological monitoring network	160,000	160,000	160,000	150,000	150,000	-	-	-	-	-	780,000
1.4 Introduction of remote sensing technologies and hydrological modelling, including climate change	312,500	312,500	-	-	-	-	-	-	-	-	625,000
1.5 Formulation of a basin plan for sediment and watershed management	292,500	292,500	-	-	-	-	-	-	-	-	585,000
1.6 Establishment of flood and drought warning and mitigation systems	355,667	355,667	288,667	191,000	-	-	-	-	-	-	1,191,000
Output 2	Equitable and reliable irrigation water supplies and drainage services delivered										
2.1 Strengthening of I&D system planning	149,000	500,000	500,000	-	-	-	-	-	-	-	1,149,000
2.2 Rehabilitation and modernization of selected I&D infrastructure	-	16,534,034	16,534,034	16,534,034	16,534,034	33,593,469	27,998,135	25,709,181	22,741,560	22,598,750	198,777,231
Output 3	Water supply and sanitation (WSS) infrastructure and services provided										
3.1 Planning and prioritization of WSS development	244,000	436,667	241,667	241,667	-	-	-	-	-	-	709,000
3.2 Modernization and expansion of selected WSS facilities	-	2,254,114	2,254,114	3,109,644	3,814,539	4,130,142	4,044,632	3,128,489	2,334,261	1,255,472	26,325,408

Item	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
3.3 Enhanced sustainability and service delivery	-	6,099	6,099	9,004	13,016	14,243	12,671	11,108	9,765	5,280	87,286
Output 4	Protection from water-related disasters enhanced										
4.1. Urgent inspection and repair of flood embankments	25,000	25,000	25,000	3,911,997	3,911,997	7,607,736	5,445,536	3,355,224	630,011	19,167	24,956,666
4.2 Improved management of mudflows and landslides	75,000	75,000	75,000	57,600	57,600	-	-	609,033	513,333	513,333	1,975,900
4.3 Improved drought forecasting and management	75,000	75,000	75,000	-	-	-	-	-	-	-	225,000
Output 5	Sustainable ecosystems safeguarded										
5.1 Prevention of further degradation of rangelands and restoration measures	-	59,994	187,918	193,984	193,984	193,984	193,984	133,991	6,067	-	1,163,905
5.2 Minimize the threat of pollution of water bodies with solid household and industrial waste	-	-	9,067	9,067	18,867	18,867	41,317	41,317	32,250	32,250	203,000
5.3 Restoration of ecosystems of tugai forests on the right bank of the Pyanj River	-	-	143,435	143,435	143,435	143,435	143,435	143,435	-	-	860,609
5.4 Creation of water-protected sanitary zones for drinking water supply systems	-	-	-	-	-	-	-	-	-	-	239,090
5.5 Raise public awareness of environmental issues	-	100,000	100,000	100,000	100,000	100,000	-	-	-	-	500,000
Monitoring and Evaluation	139,250	194,250	139,250	194,250	1,136,250	266,250	67,250	194,250	67,250	1,335,250	3,733,500
Total, $	**2,393,250**	**21,946,156**	**21,325,490**	**24,880,089**	**26,108,130**	**46,101,974**	**37,989,808**	**33,368,876**	**26,356,438**	**25,773,943**	**266,249,595**

Note: The cost of Supporting Studies ($6.13 million) and Baseline Studies for M&E ($2.18 million) are included in the tabulation above by Output.

86. The Program of Measures identified a number of important studies to support the investment program at district level. These are listed in Table 13.

Table 13: Estimated Cost of Supporting Studies, $

PRBMP Studies	Estimated Cost, $
Output 1	
1.1 Realignment of water management institutions	750,000
1.2 Enhancing the basin GIS database	100,000
1.3 Expansion of basin hydrological monitoring network	780,000
1.4 Introduction of remote sensing technologies and hydrological modelling	625,000
1.5 Formulation of a basin plan for sediment and watershed management	585,000
1.6 Establishment of flood (and drought warning) and mitigation systems	540,000
Output 2	
2.1 Strengthening of I&D planning	1,000,000
Output 3	
3.1 Planning and prioritization of WSS development	500,000
3.3 Enhanced WSS sustainability and service delivery	225,000
Output 4	
4.1 Urgent inspection of flood embankments	75,000
4.2 Improved management of mudflows and landslides	225,000
4.3 Improved drought forecasting and management	225,000
Output 5	
5.5 Raise public awareness of environmental issues, including water	500,000
Total	**6,130,00**

11.1 FUNDING THE PRBMP

87. The full cost estimate for the PRBMP is $266.3 million to be disbursed (indicatively) during the period 2021-2030. This is a very large sum (in the region of $160 per capita of the basin population, or $2,200 per river basin km^2). Furthermore, it may be expected that the investment costs in other river basins in Tajikistan will also be large, raising questions about the availability of funding, capacity to disburse, and, eventually, maintain additional infrastructure.

88. Firstly, by dividing the program into fungible activities (sectors in which potential donors may have an interest in supporting), some prospects for progress may be discerned. Firstly, the PRBMP core project (Output 1, Output 5, baseline studies and M&E) is estimated to be $15 million (6% of the cost estimate) with a maximum estimated annual disbursement of $2 m. This is a manageable sum, which can be identified as a fungible project.

89. Secondly, several important fungible activities are actually taking place or expected to take place within ongoing and prospective projects. The active and committed portfolio of ADB in the period 2020-2022 ($769 million) includes about $70 million for agriculture, natural resources, and rural development (9%) and $41 million allocated to water and other urban infrastructure and services (5%). It may be within ADB's strategic planning framework to take the PRBMP core funding ($15 million), investment costs for flood, landslide and mudflow management ($25 million) and urban WSS ($8 million) into its loan portfolio, since ADB is already a key financier within these sub-sectors.

90. Further, the on-going World Bank Rural Water Supply and Sanitation Project ($58 million) is already operational in PRB and about 15% of the project budget is directed to basin. The investment for rural WWS in the basin would be an additional $18 m, or probably less, since there might be double counting between the PRBMP cost estimate and the project budget.

91. The biggest issue is the investment required for I&D; in total nearly 50% of the cost estimate. Rehabilitation ($87 million and 33%) is the most pressing issue, and I&D modernization ($42 million and 16%) is also important. Development of new irrigation and land reclamation ($69 million and 26%) is a lower priority and could be postponed until economic viability can be demonstrated. How, and to what extent, I&D requirements can be funded and implemented is a key matter for discussion during the PRBMP updates and implementation.

92. Given the shortage of funding resources, it will be a difficult task to prioritize investment by river basin - it is expected that the National Water Strategy will guide this process.

93. It is also envisaged that MEWR will provide overall coordination on behalf of the Government for PRBMP updates and implementation by local government authorities, RBO, RBC, various government agencies, NGOs, etc. ALRI will continue to manage agriculture and water resources priorities in the basin, including I&D systems and flood protection works. Detailed implementation arrangements will be gradually formulated in consultations with these stakeholders, after securing of state and external PRBMP funding.

11.2 MONITORING OF PRBMP OUTCOMES, OUTPUTS AND MEASURES

94. A monitoring and evaluation (M&E) system for PRBMP is proposed as described in section 11 of the Plan. Baseline data will be collected in association with the studies identified in the Program of Measures. The costs of the required baseline studies are shown in Table .

Table 14: Summary of Investment, Baseline Studies and M&E Costs, $

Outputs	US $				% Baseline	% Monitoring
	Investment cost	Baseline studies	M&E	Total		
Output 1	4,889,000	-	814,500	5,703,500	14%	14%
Output 2	199,926,231	623,000	750,000	201,299,231	1%	0%
Output 3	26,753,694	823,000	1,024,000	28,968,694	6%	4%
Output 4	26,506,566	651,000	488,000	27,645,566	4%	2%
Output 5	2,883,604	83,000	657,000	3,623,604	20%	18%
Total	**260,336,095**	**2,180,000**	**3,733,500**	**266,249,595**	**2%**	**1%**