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Monographic issue

Tajikistan Disaster Risk Profile

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Letter from the editors

The Emergency and Disaster Reports is a journal edited by the Unit for Research in Emergency and Disaster of the Department of Medicine of the University of Oviedo aimed to introduce research papers, monographic reviews and technical reports related to the fields of Medicine and Public Health in the contexts of emergency and disaster. Both situations are events that can deeply affect the health, the economy, the environment and the development of the affected populations.

The topics covered by the journal include a wide range of issues related to the different dimensions of the phenomena of emergency and disaster, ranging from the study of the risk factors, patterns of frequency and distribution, characteristics, impacts, prevention, preparedness, mitigation, response, humanitarian aid, standards of intervention, operative research, recovery, rehabilitation, resilience and policies, strategies and actions to address these phenomena from a risk reduction approach. In the last thirty years has been substantial progress in the above mentioned areas in part thanks to a better scientific knowledge of the subject. The aim of the journal is to contribute to this progress facilitating the dissemination of the results of research in this field.

This monographic issue is about disaster risk profile of Tajikistan.
Tajikistan is in South-east part of Central Asia and is a former republic of the Soviet Union. It borders Afghanistan to the south, Uzbekistan to the west, Kyrgyzstan to the north, and China to the east. Tajikistan has an area of 143,100 square kilometers, of which 400 square kilometers is water.

Tajikistan is prone to many types of natural hazards, including floods, mudflows, landslides (mudslides), epidemics, drought, earthquakes, avalanches, insect infestation and windstorm. According to the World Bank, each year Tajikistan experiences around 50,000 landslides, some 5,000tremors and earthquakes, and hundreds of avalanches and debris flows.

The present monographic issue assessed the impact of the main natural disasters happened during the last 50 years (1966 – 2016) and the national disaster prevention and response strategies.

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Contents

Abbreviations

RT	Republic of Tajikistan
UNDP	United Nations Development Programme
GDP	Gross Domestic Product
RAOUES	Unified Energy System of Russia
WHO	World Health Organization
UNDAC	United Nations Disaster Assessment and Coordination
GSHAP	Global Seismic Hazard Assessment Program
GBAO	Gorno-Badakhshan Autonomous Region
IFRC	The International Federation of Red Cross and Red Crescent Societies
REACT	Rapid Emergency Assessment and Coordination Team
NGO	Non-Governmental Organization
MoES	The Ministry of Emergency Situations and Civil Defense
ISDR	The International Strategy for Disaster Reduction
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Emergency Fund
UNHCR	Office of the United Nations High Commissioner for Refugees
WFP	World Food Programme
IDNDR	International Decade for Natural Disaster Reduction
OCHA	United Nations Office for the Coordination of Humanitarian Affairs
GIS	Geographic Information System
USGS	United States Geological Survey
GSHAP	Global Seismic Hazard Map

Summery

Tajikistan is a beautiful land-locked mountainous country in Central Asia. It is rich in history and culture, and is home to thousands of glaciers and glacial lakes, small and large rivers that provide water to neighbouring Uzbekistan and Afghanistan, fertile valleys and some of the highest mountains in the world.

The Republic of Tajikistan is a country prone to natural disasters. This has negatively affected the lives and welfare of the population and has impeded the development of the country. To reduce the impact of disasters in the Republic of Tajikistan it is necessary to include disaster risk reduction activities into the development programs for the society and the country in general. This preparation will help to reduce the impact of threats, as well as reducing the social and individual vulnerability to external events. Major climatic and geological threats have had a permanent effect on the population of the country. As a result of these events, the Republic of Tajikistan needs a reliable, integrated, sustainable foundation for effective prevention, mitigation, warning and response to possible disasters. Every citizen of the Republic of Tajikistan needs to possess the knowledge and skills in this area so as to be able to contribute to effective disaster risk management at the individual level, at the household level, as well as at the regional and national levels. The perspective that disasters are uncontrollable and a temporary phenomena, which should be managed by means of short-term aid, or that their impact can be reduced through complex technical measures is being replaced by the recognition that the impact of disasters is closely related to the sustainable development of the state and society. With the development of new technologies risks associated with natural hazards are at present is increasingly viewed as controllable processes. This perceived controllability becomes possible with increased risk awareness, improved risk assessment and planning, as well as effective disaster preparedness with the application of disaster risk reduction measures. In aggregate, these measures are in their entirety viewed as “disaster risk management.” The overall goal of this is to prevent, reduce and mitigate the consequences of disaster for the country, society and individuals.

1 COUNTRY OVERVIEW

1.1 Location and geography

Tajikistan is in South-east part of Central Asia and is a former republic of the Soviet Union. It borders Afghanistan to the south, Uzbekistan to the west, Kyrgyzstan to the north, and China to the east. Tajikistan has an area of 143,100 square kilometers, of which 400 square kilometers is water. Tajikistan has an approximate population of 8.5 million people as of the end of 2015. About 93% of the country's area are mountainous, which widely vary in height from several hundred meters to 6000-7000 meters above sea level. Only 5% of Tajikistan is land area is cultivated. Tajikistan's highest point is Qullai Ismoili Somoni, and peaks at 24,589 ft. (7,495 m). The eastern mountains contain many glaciers and lakes. The Fedchenko Glacier covers 700 square kilometers, and is the largest non-polar glacier in the world. Geographically, Tajikistan is generally subdivided into five natural and geographic zones: Northern Tajikistan, Southwestern Tajikistan, Central Tajikistan, the Western Pamirs, and the Eastern Pamirs. These zones differ from each other in climatic conditions, relief, geological structure, vegetation, animal world, and anthropogenic load. Tajikistan is divided into four regions, Sughd, Khatlon, Gorno-Badakhshan, and the Republican Subordination. These regions are divided into districts and then further sub-divided into self-governing village units. There are 19 cities/towns, and 48 urban type settlements. The rivers Amu Darya and the Panj mark the border of Afghanistan and there are more than 900 rivers in Tajikistan longer than 10 km (Fig.1).

Figure 1. Map of Republic of Tajikistan

1.2 Climate

The climate of Tajikistan is continental, with considerable seasonal and daily fluctuations in temperature and humidity. The country has very complicated relief structure, with huge variations in elevation, creates unique local climates with great temperature differences. There is a great dispersion of average precipitation figures depending on the geographical location: around 70mm in the Eastern Pamir and up to 1,600mm on the south slopes of the Hissor range. The maximum amount of precipitation falls in winter and spring whereas in

summer and autumn rains are rather infrequent. The unique local types of the climate are formed due to the complicated relief and the great amplitude of altitudes. Tajikistan is remarkable for its variety and contrasting nature conditions. In summer(July/August) the temperature is 30-40 degrees above zero and in wintertime(December/January) it is 8-10 degrees below zero. The high-mountain areas of the Western Pamirs are characterized by a more severe climate. Winter temperatures in valleys are from 0°C to +2°C, high in the mountains -25 to-27°C. In summer temperature in the valleys is from +23°C to +30, +35°C, in the mountains - from +4°C to +15°C. The absolute minimum is observed in Bulunkul Lake (-63°C). For the last 50 years, the average air temperature in different geographical provinces of the country has increased by 0.2-1.3°C, which is very likely due to the global warming(Fig.2).

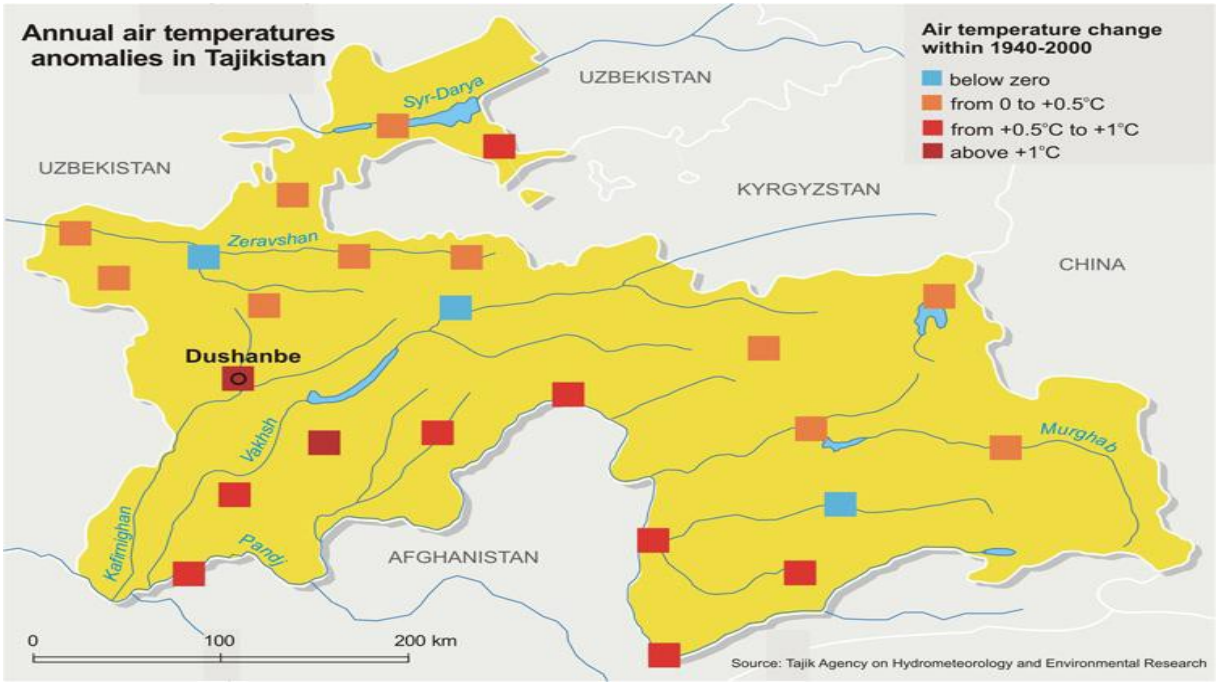

Figure 2. Annual air temperatures anomalies in Tajikistan

1.3 Economy

The majority of Tajikistan's 6 million people are poor and vulnerable. The break-up of the Soviet Union in 1990 and the ensuing civil war had a devastating impact on the welfare of the population. The armed conflict and a succession of natural disasters -- drought in 2000, food deficit in 2001, floods in 2002 and several small-scale disasters in 2003 -- have ruined lives, livelihoods and infrastructure. While relatively economically stable, Tajikistan is increasingly suffering from low economic productivity, high unemployment and extreme poverty. The country ranks 122 of 177 on the Human Development Index of the UNDP, and has one of the lowest GDPs per capita among the 15 former Soviet republics. The GDPs per capita in Tajikistan was last recorded at 917.08 US dollars in 2015. The mainstay of Tajikistan’s economy is electricity, cotton and aluminium. Tajikistan has the potential of being one of the world’s largest hydroelectricity producers, but due to the lack of investments, only 10% of its hydroelectric capacity is used. Even so, hydropower covers 50% of the country’s energy needs and 95% of its electricity consumption. For other energy sources, such as oil and gas, Tajikistan is dependent on imports.

Tajikistan has a great hydropower potential, and has focused on attracting investment for projects for internal use and electricity exports. According to the world hydraulic atlas “Hydroenergy and dams” the country has the largest per capital water resources and ranks number eight in the world based on absolute hydropower potential (300 billion KW-h/year). With adequate utilization of those resources Tajikistan could become the major energy exporter in the region. Tajikistan is home to the hydroelectric power station Nurek with the highest dam in the world (300m) with the capacity of 3,000 MW.

Cotton is a key component of the Tajik agricultural sector. Cotton is the main source of income for 75% of poor and extremely poor households. Tajikistan is the fourth largest cotton exporter in the world. However, it does not have many value-added aspects of the industry, including ginning and baling facilities and warehouses to support those parts of cotton enterprise. Yield per acre has been increasing due to the initiatives of some individual growers but is still low. The republic is rich in many deposits of natural resources: coal, oil, gas, mercury, molybdenum, tin, antimony, gold, silver, phosphorite, salt, talc, asbestos, fluorine, limestone, marble, gypsum, clay, sand-pebble materials, precious stones, etc. On the whole, nearly 400 deposits of natural resources are explored, over 70 of which are being exploited now.

Aluminium industry is the biggest aluminum smelter in Central Asia and one of the biggest in the world. There were plans to privatize the enterprise which accounts for half of the entire industrial production in the country by the year 2007. However, in May 2006, the government changed its position and cancelled the privatization process. Ambient air pollution from the smelter including toxic emissions of fluorine hydride has severely affected the densely populated Sary-Osiyo valley in Uzbekistan. Although some steps were taken in mid-1990's to address this problem there are still a number of issues in this area awaiting their resolution.

Foreign remittance flows from Tajik migrant workers abroad, mainly in Russia, have become by far the main source of income for millions of Tajikistan's people and represent additional 36.2 % of country's GDP directly reaching the poverty-stricken population. Migration from Tajikistan and the consequent remittances have been unprecedented in their magnitude and economic impact.

1.4 Health

In Tajikistan indicators such as infant and maternal mortality rates are among the highest of the former Soviet republics. In the post-Soviet era, life expectancy has decreased because of poor nutrition, polluted water supplies, and increased incidence of cholera, malaria, tuberculosis, and typhoid. The leading causes of death are cardiovascular diseases, respiratory disorders, and infectious and parasitic diseases. Because the health care system has deteriorated badly and receives insufficient funding and because sanitation and water supply systems are in declining condition, Tajikistan has a high risk of epidemic disease. Several typhoid epidemics have occurred since 1991. The limited access to health care services, in spite of growth in budget funding and foreign aid, is due to a number of factors, which can be divided into three groups: specific causes, such as the poor quality and limited availability of medical services, the spread of socially hazardous infectious, malnutrition and inadequate access to safe drinking water, which result in high infant and maternal mortality, among other things; systemic causes, which involve the slow pace of reform in the health care system, limited involvement of the private sector and inadequate prioritization in financial management of the sector; and technical causes, which go beyond the limits of the health care sector itself and require a multi-sectoral state-wide approach. Current budget appropriations are insufficient for the stable operation and development of the health care system. There is a serious imbalance in the distribution of the material base and budget funds between primary health care and hospital services, as a result of which the bulk of the funding goes to secondary health care (hospitals), while the services that are provided are expensive and out of reach for the poor.

Most indicators characterize Tajikistan as a country with low health status compared with other central and eastern European countries, and the health status of the Tajik people remains precarious. Adult life expectancy is low, with non-communicable diseases the main cause of all deaths (59%) – mainly cardiovascular disease, respiratory disease and cancer.

Communicable diseases account for a continuing burden of disease: TB has re-emerged as a major public health threat since the 1990s, and although the number of officially reported cases of HIV infection is still comparatively small, with 373 new cases reported in 2008, the Joint United Nations Programme on HIV/AIDS estimates that the true number of people living with HIV in Tajikistan at the end of 2007 was between 5000 and 23 000.

The age-standardized death rate from external causes, injury and poisoning, at 33 per 100 000 populations in 2005, is much lower than the Commonwealth of Independent States (CIS) average of 159 and

the central Asian average of 81. It is even slightly lower than the average of 35 among the 15 countries belonging to the European Union before May 2004 in the same year. One major reason for this may be a lower level of alcohol consumption than in most other countries.

Cause of death	1991	1995	2000	2003	2005	2007	2009	2010	2011	2012
Diseases of the circulatory system	185.9	218.3	187.8	201.9	215.2	219.2	206.0	208.0	217.7	209.9
Malignant neoplasm	48.7	28.7	30.9	31.7	32.1	30.5	33.7	33.2	35.3	32.4
Transport accidents	821	545	406	421	483	464	478	411	438	441
Infectious and parasitic disease	85.7	65.8	31.2	24.3	19.6	15.4	14.8	15.2	17.5	11.9
Diseases of the respiratory system	125.4	128.0	58.2	47.8	40.1	40.2	29.0	30.6	31.1	27.0
Diseases of the digestive system	18.2	22.6	19.3	18.1	20.7	22.0	19.4	19.6	19.7	20.9
TB					9.1		8.1	8.8	8.9	5.1

Table 1. Main causes of death per 100 000 populations, selected years.

The health care system is becoming increasingly dependent on unofficial private payments for medical services and on foreign aid. In recent years private payments represented 70% of total spending, budget expenditures accounted for 16% and donor aid for 14%. The qualification of medical personnel is declining and there is shortage of health workers, particularly in rural areas. This is due to poor management of human resources, the low wages paid to health care workers, and the large number of personnel leaving the field as a result. These problems are aggravated by shortage of modern medical equipment and technologies at medical institutions, as well as the poor condition of buildings and facilities. Little is being done to make use of the country's relative advantages in terms of the production of medicines. The main public funder and provider of health care services is the state, but private out-of-pocket payments contribute to revenue to a large extent. Tajikistan is among the lowest spenders on health care in the world, at just under US$ 16 (or $62 purchasing power parity) per capita per year on health care, even though health expenditure as a share of GDP increased from 5.3% to 6% during the period 2007–2011. Public expenditure as a share of GDP varied from 1% to 1.7%, and private expenditure from 3.7% to 3.9%, according to an unpublished WHO report on the national health accounts of Tajikistan.

2 OBJECTIVE

The objective of developing this profile of the Tajikistan natural disasters is to collect update information about the natural disasters happened during the last 50 years (1966 – 2016) which is mainly focusing on the following specific objectives:

A. To Identify frequency of disasters happened in the country during the last 5 decades

B. To assess the impact of disasters on the population's lives, economy and general health

C. To determine the main hazards and vulnerability factors present in the country

D. To identify disaster prevention and response strategies implemented by the authorities

E. To identify structure and characteristics of the emergency and disaster response framework in the country.

3 NATURAL HAZARDS AND VULNERABILITY

3.1 Hazards

Probably the most forceful expressions of the consequences of loss of biodiversity and environmental degradation are natural disasters. Tajikistan is prone to many types of natural hazards, including floods, mudflows, landslides (mudslides), epidemics, drought, earthquakes, avalanches, insect infestation and wind storm. According to the World Bank, each year Tajikistan experiences around 50,000 landslides, some 5,000 tremors and earthquakes, and hundreds of avalanches and debris flows. These natural disasters exacerbate poverty and hinder economic progress in the impoverished country, where more than 80 percent of the population lives below the national poverty line.

In the last ten years, nearly 3 million people, which is more than one third of the total population of Tajikistan, have suffered as a result of natural disasters: floods, landslides, earthquakes and extreme temperatures. Tajikistan also ranks highest among Central Asian republics in terms of its risk of exposure to hazards of scope beyond the country's capacity.

A UN Disaster Assessment and Coordination (UNDAC) mission to the country in March 2006 said some 85 percent of Tajikistan's area is threatened by mudflows and 32 percent of the area is situated in a high mudflow risk zone.

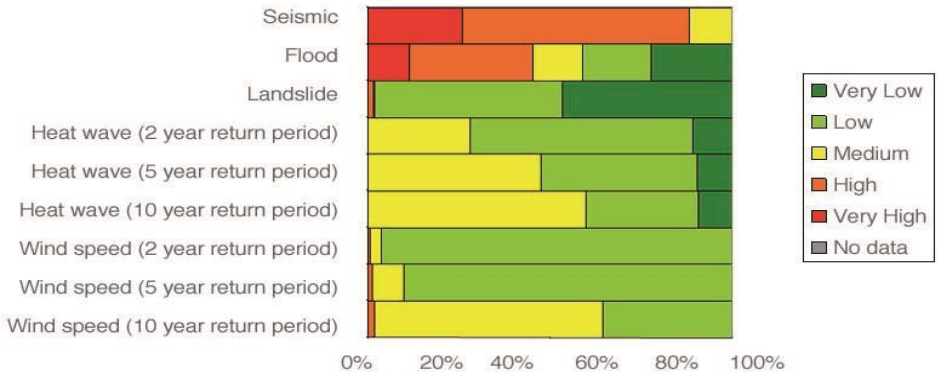

Figure 3. Proportion of population exposed to hazards, by level of intensity

3.2 Earthquakes

Earthquakes are typical for Tajikistan and represent a substantial threat in many parts of the country, specifically in urban environments like Dushanbe, where potential earthquake magnitude can be as high as 8-9 on Richter scale. The most drastic earthquakes in their consequences occurred in 1911 and 1946(Fig.4), when hundreds of people died and numerous economic objects were destroyed. Earthquake epicenters are located almost everywhere. Earthquakes are seriously dangerous, since they cover broad areas and are able to cause a considerable damage to reservoir dams, buildings and communications. According to expert estimates, 70 to 100 thousand people suffered from earthquakes in Tajikistan in the last century. According to the Global Seismic Hazard Map (GSHAP, 1999) the whole country is located in the high to very high-risk zone. Here are some examples of catastrophic and the most deadliest earthquakes in Tajikistan: Karatag earthquake in 1907, Sarez earthquake in 1911, Faizabad earthquake in 1943, Hait earthquake in 1949, Gissar earthquake in 1989. During these earthquakes, the fatalities were caused by secondary affects such as landslides, rockslides, mudflows and avalanches. In 2010 an earthquake in Vanj rayon affected over 6000 people, resulting in 1000 homeless people and an estimated economic loss in the range of US$ 1.5 million. A few moderate and strong earthquakes 5-6 of Richter scale, with considerable economic damage, were experienced in Tajikistan in 2002.

Secondary effects of earthquakes can cause major economic problems as well. An example of this is the Baipaza (still ongoing) landslide, which developed in Vakhsh river back in 2004. This landslide is causing serious problems for the operation of Baipaza and Nurek Hydro-Electric Power Stations, as well as for irrigations systems.

Another example is the Hait earthquake of 1949, which was 9-10 on Richter scale. This earthquake wiped out number of villages and killed more than 28,000 people. The Sarez earthquake of 1911, caused a major rockslide and covered the village of Usoi with all its residents. The Gissar earthquake of 1989 caused a major landslide, which covered the village of Sharora with all 274 inhabitants.

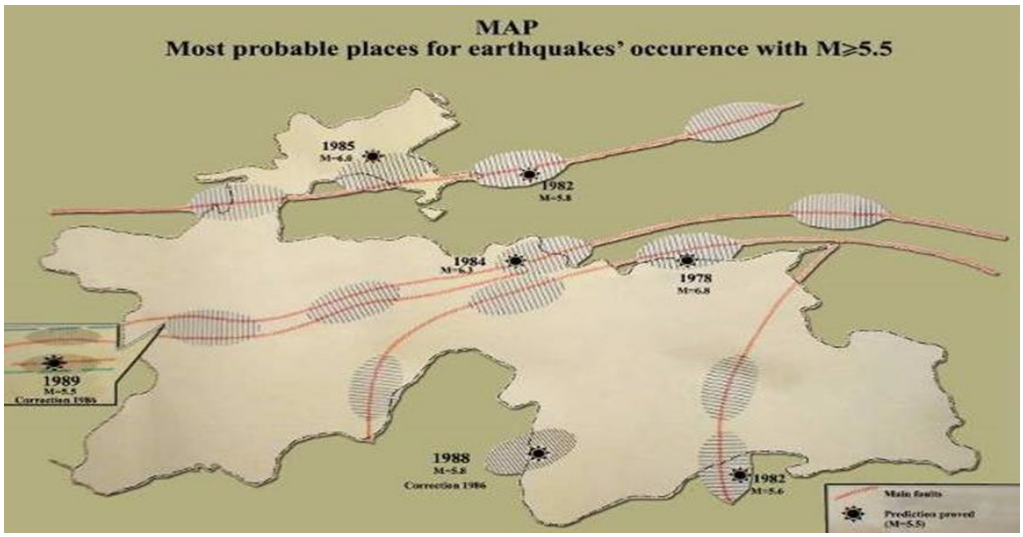

Figure 4. Most probable places for earthquakes occurrence with M>5

The overpopulation of mountain areas and the wrong selection of sites for economic activity, as well as improper use of technologies, cause the formation of man-made landslides, rock falls, and deep depressions, such as Shurab coal mines and other sites. The wrong construction and exploitation of irrigation systems resulted in Zakhmatabad, Kamcha, and Sharora landslides, which caused the huge damage and death of many people. Building settlements in potentially dangerous landslide areas caused the destruction of the villages by huge landslides. Large reservoirs, like Nurek Reservoir, contribute to the local seismic activity, reinforcing the tectonic movements. In addition to the anthropogenic impact, some exogenous factors caused by the geological structure are common in Tajikistan: the active tectonic conditions and a lot of fractures. Numerous loess rocks, that are capable to become swollen and plastic when getting wet, can also form falls.

3.3 Landslides

Landslides are common in Tajikistan due to the favorable geological, climatic, and geodynamic environments, formed due to the presence of a thick sequence of Quaternary deposits and heavy showers in a winter-spring period. The areas at elevations 700 to 2,000 masl are most exposed to the risk of landslides. Some 50 thousand landslide events, 1,5 thousand of which are threatening to settlements and industrial constructions. Seismic landslides are generally associated with earthquakes. Non-seismic landslides mostly result from man-made factors or extreme hydrometeorological conditions. Glacier landslides (surging movements) are typical for high-altitude zone. The anthropogenic impact results in the formation of irrigation landslides on the slopes of hills, crossed with irrigation cannels, as well as in river sides, terrace slopes, etc. They are common in Gissar, Yavan, and Obikiik valleys. Such landslides reduce the area of irrigated lands, destroy water management constructions, villages, and roads, and cause many deaths. Landslide hazards are also significant in Tajikistan.

The most active landslide zones are between 700 metres and 2,000 metres above mean sea level. A landslide in May 1993 killed 5 people, affected 75,357 others and caused an economic loss of $149 million, while a landslide in April 2003 killed 1 person, affected 6,000 others and incurred a reported economic loss of $41 million. As per GSHAP (1998), Tajikistan lies in a region with high to very high seismic hazard.

The tectonic activity permanently occurs in Tajikistan's area. Earthquakes also promote a formation of landslides and falls (Khait, Sarez). Annually, 3-5 underground shocks force 2-3 (Richter scale) and over a thousand weak earthquakes are reported in the republic.

3.4 Floods and mudflows

About 85% of Tajikistan's area is threatened with mudflows and 32% of the area is situated in the high mudflow risk zone. A large number of seismic and non-seismic landslides occur annually and threaten settlements and industrial constructions. Flash floods in narrow valleys are particularly destructive. Heavy rainfall and the release of water contained in watercourses dammed by landslides, glaciers and accumulation of loose debris result in extremely destructive flooding and mudflows.

A further hazard emanates from the potential of sudden drainage of alpine lakes in the southwestern Tajik Pamir mountain range. In the last 40 years several new lakes have formed in the front of retreating glacier tongues, existing lakes have grown and others have become dammed by landslide deposits or older moraines. In 2002 sudden drainage of a glacial lake in the area triggered a catastrophic debris flow. Of the 428 lakes mapped in the area, six have been rated very hazardous and 34 hazardous. A highly dissected relief, numerous loose Quaternary deposits and heavy rains are the factors causing mudflow formation. Mudflows and floods annually destroy tens of kilometers of roads and hundreds of road constructions. Nearly 3.6 thousand km of roads, over 500 bridges and other constructions, and a great number of equipment and machinery were destroyed and damaged from 1997 to 2001, due to the natural disasters, with insufficient preventing measures being taken.

Figure 5. Flood risk zone map

The complex topography of this mountainous country, its high rainfall levels and large number of glaciers mean that Tajikistan is highly exposed to flood hazards. The floods are largely caused by outbursts from mountain lakes, which store huge volumes of water behind unstable natural barriers. Tajikistan's Lake Sarez is one of the world's potentially dangerous lakes. Analysis of disaster data shows that Tajikistan is severely affected by flood disasters, with 19 such events taking place in the past two decades. The most significant

include: a flood in May 1992 which killed 1,346 people, affected 63,500 others and caused an economic loss of $300 million; Risk Assessment for Central Asia and Caucasus flood in May 1993 which killed 5 people, affected 75,357 others and incurred a reported economic loss of $150 million; a flood in April 1998 in the Ainy region which killed 51 people, affected 40,974 others and caused an economic loss of $66 million; and, more recently, a flood in July 2005 which affected 1,890 people and caused an economic loss of $50 million.

3.5 Snow avalanches

Basic conditions for the formation of avalanches are slopes with a gradient of 30-50°, snow cover more than 30 cm, and relevant meteorological conditions. The major reason of avalanches is fresh snow formation (60-70%). Many avalanches are registered in Zeravshan-Gissar and Darvaz mountains. The biggest occurrence of avalanches has been reported on the slopes with a northern exposition. Most avalanches are observed in February and March.

The biggest number of days with avalanches was indicated in 1978, when mass avalanches occurred in all highland areas. It caused traffic jams; many communication and power supply systems were damaged. In 1969, extraordinary avalanche activities were indicated in the Western Pamir. The number of days with avalanches exceeding twice the average was indicated in 1976, 1984 and 1987. In the period of 2001-2003, avalanches resulted in 10 deaths; in individual regions, the infrastructure was destroyed and other serious damage caused to the economy. Dangerous meteorological phenomena include heavy snowfall, rainfall, dust storms, hails, and other events assigned to natural disasters and causing damage to the national economy.

3.6 Epidemic

Tajikistan is also vulnerable to epidemic hazards. In December 1997, 168 people were killed and 15,618 others were affected by typhoid, while an outbreak of typhoid in 1999 killed three people and affected a further 200.

3.7 Heavy snowfall and rainfall

Intense precipitation is one of the most dangerous hydro meteorological events in terms of its consequences. The average number of days with intense precipitation in the republic is insignificant and varies from 0.1 to 6 days per year. In some areas, intense precipitation does not occur at all. In some years, for example in 1969, the number of semidiurnal intense precipitation exceeded the average value by 3.5-5.5 times. The maximum number of days with intense precipitation is accounted for mainly in spring months and in summer months in high-altitude areas. During the last 30-40 years, the number of days with intense hard precipitation tended to reduce. The change in the number of days with intense liquid precipitation is ambiguous: they increased in some areas, while decreased in others. Heavy snowfall creates snowdrifts on the roads resulting in traffic disturbance, increasing loads on the roofs of buildings, breaking fruit and adornment trees, worsening conditions for feeding animals, decreasing the visibility during plane taking off and landing and avalanches in mountain areas. Heavy rainfall, over 30 mm a day, contribute to the erosion processes, cause serious damage to the agriculture and provoke mudflow and landslide events and floods.

3.8 Dust storms

Dust storms are observed in Tajikistan for 1-4 months in a spring-summer period. They raise thousands of tonnes of soil and sand into the air, thereby considerably increasing the concentration of suspended particles in the atmosphere. A lot of farms suffer from this event, when the crop productivity decreases. Long-lasting dust storm and haze in Tajikistan was registered in 2001.

3.9 Hailstones

Hailstones frequently cause damage to agriculture. The center of most hail events is located along the Gissar range, primarily in the foothills. The number of days with hail grows as the altitude increases. At the same time, the maximum reoccurrence of hail ranges from 0.7-1 days in lowland areas to 4-8 days in high altitudes. Gissar valley is known for its large frequency of hail events, where the number of days with hailstone averages to 1.9-3.5 days per year. In the last 30-40 years, the number of days with hailstone in lowland and foothill areas has decreased. In mountainous areas, the occurrence of hail has not changed, and in some areas has increased. In 2002, hails caused damage to many farms in the Gissar Valley and other regions of Tajikistan**.**

4 TOP MAJOR DISASTERS AND IMPACTS

Tajikistan is prone to many types of natural hazards. Per the World Bank, each year Tajikistan experiences around 50,000 landslides, some 5,000 tremors and earthquakes, and hundreds of avalanches and debris flows. In the last ten years, nearly 3 million people, which is more than one third of the total population of Tajikistan, have suffered because of natural disasters. There are some top major disasters with its impacts which happened in the last 50 years on Tab.2.

Date	Disaster type	Total death	Total affected	Total damage (US$)
1985	Earthquake		8080	300million
22.01.1989	Earthquake	~1000		
13.05.1992	Landslide	243	24100	
25.05.1992	Flood	1346	63500	300000
07.05.1993	Landslide	5	75357	149000
05.07.1994	Flood		6051	
31.05.1996	Epidemic		7516	
27.05.1996	Flood		180000	
19.11.1997	Landslide	40		
13.02.1997	Epidemic	168	15618	
24.04.1998	Flood	51	40974	66000
07.07.1999	Flood	24	9392	6154
00.05.2000	Drought		3000000	57000
09.01.2002	Earthquake	3	1050	
07.08.2002	Flood	24	1713	2836
13.04.2003	Landslide	1	6000	41000
06.06.2003	Flood	6	1755	20000
13.07.2004	Flood		400000	12000
03.02.2005	Landslide	16	1853	
08.06.2005	Flood	8	3222	
23.07.2005	Flood		1890	50000
26.01.2006	Landslide	21	728	
29.07.2006	Earthquake	3	15427	22000
22.07.2007	Earthquake	11	7003	
21.04.2009	Flood	21	15000	1000
06.05.2010	Flood	73	6708	20400
01.01.2010	Epidemic	21	456	
13.05.2012	Earthquake	2	2531	
22.04.2014	Flood	20	7436	
03.04.2015	Landslide	10		
09.05.2016	Flood	4	12750	

Table 2. List of major disasters happened in the las 50 years.

The 1989 Hissar earthquake occurred at 23:02 UTC on 22 January in southern part of Hissar valley in Tajikistan. The shock had a body wave magnitude of 5.5 and a maximum felt intensity of VII (Very strong) on the Mercalli intensity scale. The epicenter was located about thirty kilometers south-west of Dushanbe. Magnitude ML=5.5; focal depth H=5-7 km. Most victims were three of the village, which were in the center of Hissar district. The National Geophysical Data Center was reported that the death toll from the event

amounted to about 600, while the National Earthquake Information Center stated there were many injured. According some to other reports the amount of total death was about 1000. This was the deadliest earthquake in 1989. The earthquake was accompanied by residual deformations of two types: liquefaction of loess soil and landslide processes caused by this event, and opening of fault on the surface. Four landslides occurred as a result. Three of them took place on the northern slope of the upland Okuli.

The earthquake demonstrated once again that the secondary consequences of earthquakes are the most dangerous in the mountainous areas. In Hissar earthquake case the catastrophe was caused by irrational land use. Similar earthquakes was occurred before in exactly the same area July 31, 1953 with ML=4, August 4, 1953 with ML=4, April 21, 1968 with ML=4.5. No such effects had been observed at that time. Starting from 1960's cotton fields were introduced in the area and channels to irrigate them were constructed. Intensive watering of cotton plantations for 20 years from irrigation channels running on the slopes had become the main cause of the tragedy.

One village of clay homes was buried under a 50ft (17m) landslide, triggered by the earth tremors. All 600 inhabitants of Sharora are believed to have died. More than 1,000 people may have been killed.

Landslide width of about two kilometers broke down at the village. Half of the houses of the village was buried under a layer of earth. Mostly blockage reaches a thickness of 18-20 meters. The same fate befell a significant part of the buildings in the Okuli Poyon and Okuli Bolo.

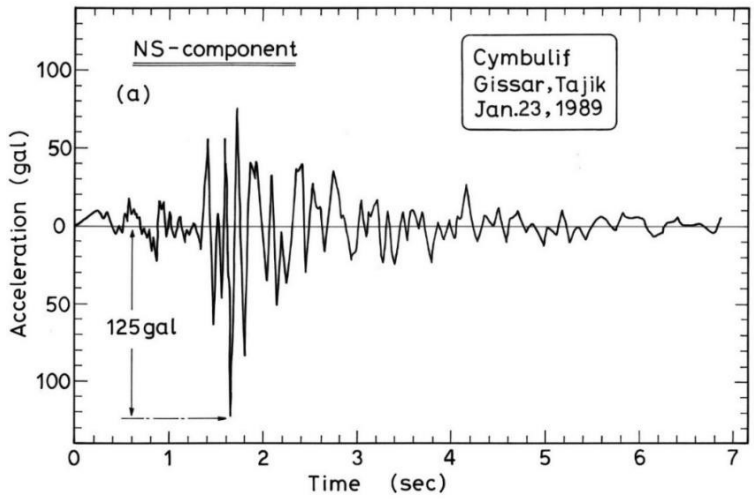

Figure 6. Strong motion record of the Hissar earthquake, distance from the epicenter about 5 km K.Ishihara

It was completely destroyed about two kilometres of road, livestock farm for 760 head of cattle, large areas of farmland. Earthquake felt the residents of many other settlements. Total area destroyed more than 3,000 private households. The village Okuli Bolo killed 67 people. The Okuli-Poyon, a third of the victims were not victims. Liquid clay lava reached here only one and a half hours after the push. People awakened by the rising din, had to leave their homes.

The farm "50 October" affected 511 families. 174 of them are homeless. There are two schools destroyed, boiler room. The village Khisor affected 355 families in the village May Day destroyed 209 homes. Sharora - the only inhabitants of the southern part of the village Sharora survivors after the earthquake January 22, 1989. The girl was saved by the fact that it was tied to the cradle(figure).

Figure 7. Only resident who survived after the earthquake.

Figure 8. Flow slide 3.5 km long on a slope 4 – 6 steep. (photo by A.R.Ischuk, 1989)

Figure 9. Landslide on the northern slope of upland Okul that buried the village of Sharora. (photo by A.R.Ischuk, 1989)

Flood April 1998. In April 1998, as a result of heavy snow-falls and rains in the mountains, the eastern and central parts of Tajikistan became a scene of avalanches, floods, and landslides with villages, dikes, canals and reservoirs being washed away. The most afflicted are the regions of Garm, Aini, Varzob, Kulab, Leninabad (Khodjent), Hisar, Tursunzada and the metropolitan areas around Dushanbe. Statistics indicate that 7,115 dwellings were damaged, with 704 of them being completely destroyed. 155 schools, 65 hospitals, and 15,000 hectares of agricultural land have been totally devastated along with hundreds of kilometers of roads, electric power and communication lines, water-supplies and sewage systems. Heavy rains continued through May and June throughout the country. At one time, 62 mm of rain fell in the city of Dushanbe during one hour.

During the height of the flood crisis in May, ACT member - Russian Orthodox Church (ACT/ROC) provided $50,000 of Rapid Response Fund assistance in targeted areas of Tajikistan, including food kits, clothing, and blankets. ACT/ROC working in partnership with ACT member - Hungarian Interchurch Aid (ACT/HIA) are now requesting ACT funding and support to provide rehabilitation and continuing relief assistance to vulnerable victims of the floods.

The most severely affected areas included the regions of Garm, Aini, Varzob, Kuliab, Leninabad (Khodjent), Ghesar, Tursunzade and the metropolitan areas surrounding Dushanbe. Since many settlements are traditionally situated at the foot of, or on mountain slopes, flood torrents and avalanches swept away whole kishlaks. Estimates of human losses varied from 76 to 127 people; with 42,000 people had lost their homes. Some 1,030 families were moved out of hazardous areas. As of May 18, according to the Tajik Government's information, 7,115 houses are affected, with 704 of them being completely destroyed. 155 schools, 65 hospitals, 147 km of bank-reinforcing facilities and 15,000 hectares of agricultural land have been totally destroyed along with hundreds of kilometers of roads, electric power and communication lines, water-supplies and sewage systems. Specific numbers of beneficiaries per region according to the type of assistance as shown in the Table 3.

Region	No.Families (Food, Hygeine, Non-Food)	No.Families (Housing Reconst)
Aini	90	12
Varzob	80	12
Lenninabad (Khodjent)	70	12
Metropolitan Dushanbe	70	12
Neighbouring Uzbekistan	80	12
Total Beneficiaries	390	60

Table 3. Number of effected families per region.

Floods and landslides of July 2004. Floods and landslides set off by the unusual heavy rains, starting on 12 July 2004 caused considerable damage to infrastructure and livelihoods throughout Tajikistan. The water supply system to the capital city, Dushanbe, was damaged and 60% of the city population was left without drinking water. The only road connecting the capital with the northern city of Khujand was disconnected. The government initially estimated the damages to amount to about US$ 12 mln. Heavy rains caused damage to infrastructure, mainly roads, bridges, water and electricity supply systems. Badly hit area was Varzob District (Fig.10 and 11). All relevant ministries and government departments had been mobilized to deal with the effects of the disaster. Some villages had to find alternative sources for drinking water as the Varzob river was muddy and polluted. IFRC/Red Crescent Society of Tajikistan established a first aid tent to service flood victims, travelers walking down from blocked parts of the road and the Khoja Obi Garm

sanatorium. The Centrospas (the specialized rescue team of MoES) were also mobilized involved in much of the rescue and recovery work.

Figure 10. Damaged bridge in Varzob Distrikt

Figure 11. Damaged road in Varzob District

During any emergency, uncoordinated assistance can be a disaster in itself. In Tajikistan, since 2000, the Ministry of Emergency Situations and Civil Defense has been leading a disaster management coordination group known as the Rapid Emergency Assessment and Coordination Team. In an even of any disaster, REACT is activated by the Ministry of Emergency Situations to organize a coordinated response. REACT is constituted by 65 different organisations: 16 Government agencies, 7 donor organisations, 9 UN agencies, 28 International NGOs, and 5 local NGOs.

Heavy snowfall – February 2005 Tajikistan was hit by heavy snowfall starting 1 February 2005, which continued for several days. In Tavildara district of Rasht Valley 2 metres of snow had fallen in the first two days. In Rasht Valley, an important area surrounded by steep slopes, over a hundred major avalanches had come down into populated areas. Hundreds of vehicles were trapped in the snow in Rasht Valley, alone (Fig.12). The heavy snow had caused roofs to collapse on hospitals, schools and private homes. In mountainous Tajikistan, key inhabitated valleys of the country were completely cut off from the rest of the country. For such areas, all roads were blocked, and all communication lines were down. Within these regions, numerous whole villages were completely isolated from each other. Helicopters could fly to the affected areas due to snowfall for several days.

Figure 12. Affected house in Rasht Valley

An avalanche in Degdonak village of Mujikharf Jamoat in Rasht valley killed 9 people and 3 were seriously injured. This avalanche buried 15 houses under the snow. In GBAO a total of 375 avalanches had been registered (Fig.13).

Figure 13. Avalanches in Degdonak

An earthquake of magnitude 4.5(Richter scale) at 5 in the morning, 29 July 2006, affected at least five settlements in Qumsangir District, Panj Jamoat, namely Dusti (the district centre), Village, Sholikori, and Zamini Now. Another quake (magnitude 5) stroked at 15.57 the same day. The epicenter of the quake was 145 km South of the capital Dushanbe, and 55 km. East of Shahrituz. 3 people was reported dead (a 6 year old boy, a 6 year girl, and a 9 year old girl), and 19 injured. Approximately 9,000 people had been directly affected by the quakes, as to the table below:

Name of settlement in Qumsangir District, Panj Jamoat	# of houses totally destroyed	# of houses partially destroyed
Dusti town	53	283
Village no. 6	129	145
Village no. 8	233	114
Zamini Now	120	13
Sholikori	4	27
Total	539 (4,312 people)	582 (4,656 people)

Table 4. Affected population by the earthquake.

Vanj Earthquake. On January 2, 2010 at around 7:15 am there was an earthquake with the magnitude of 5.3 in GBAO. The epicenter of the earthquake was close to Vanj district of GBAO. Significantly negative had the impact on 23 villages in Yazgulyam and Vanj jamoats of Vanj district and was affected 958 households. Aftershocks was increased the number of fully destroyed houses from 98 to 162, was affected 1,134 residents. Additionally Andarbak, Budun, Motravn, Vishkharv, Dashti Yazgulom and Zaich villages of Yazgulom sub-district of Vanj district had also been affected by earthquake, where houses got damaged partially. Was provided by the assessment team comprising of Local Authorities, Regional CoES and FOCUS around 921 houses (6145 people) had been impacted negatively. 98 household (622 people) was destroyed and 622 people had left without shelter and were currently been placed with other family member and neighbors. Another 921 homes (with 6215 residents) were partially affected and needed repair. The earthquake had also partially impacted other buildings in the centre of Vanj like policlinic, secondary school in Rog village, tax department building, the building of the department of culture, music school, building of Amonatbank and the government building. So far, no deaths or injures had been reported in the district. No aid to the population, inclusive of food aid to the displaced population had been provided. According to FOCUS Humanitarian Assistance, significant impact had been on five villages of Vanj Jamoat (Uskrogh, Panjshanbeobod, Gishkhun, Dashtirogh, Rokharv) and Jamak village of Yazgulom Jamoat. Additionally Andarbak, Budun, Motravn, Vishkharv, Dashti Yazgulom and Zaich villages of Yazgulom Jamoat had also been affected by earthquake, where houses was partially damaged. Distance from the epicenter to Khorog town (center of GBAO) is 80 km North, and 235 km East of the capital Dushanbe.

IFRC funds were allocated on 6 January 2010. The operation was implemented over four months and completed by 5 May 2010. Response was provided and committed Governmental had established the

Emergency Commission at the centre of the District. In addition, six operational points had been established in six Jamoats of the district to complete situation assessment and to identify needs. In addition, an assessment team had been deployed by the Government from Dushanbe, including specialists from CoES, Institute of Earthquake Engineering and Seismology, GlagGeology and Committee of Architecture and Construction to conduct further damage assessment. The Red Crescent Society staff were deployed to conduct rapid assessment. The team conducted assessment in most of the affected villages. There was stock with non-food items prepositioned in Vanj district with Red Crescent Disaster management centre warehouse for 25 families. The existing stock included: bedding sets, blankets, hygiene kits, water cans, kitchen sets, hoes and shovels. In case of additional needs, further NFI/shelter items was transported from Khorog DM centre warehouse or from Dushanbe RCST central warehouse. No additional request for assistance was made by the Government of Tajikistan so far.

5 DISASTER MANAGEMENT SYSTEM

5.1 Legal system, legal framework

There are several national laws and decrees, which govern the disaster management field in Tajikistan:

- Government of the Republic of Tajikistan Decree #400 "*On the establishment of the Committee for Emergency Situations and Civil Defense*" (17 August 1994), is the first legal provision in the field of protecting the population and territories from natural and manmade emergency situations.
- The Law of the Republic of Tajikistan "*On Civil Defense*" (November 1995) is aimed at the implementation of security tasks in wartime. This Law was reconsidered in 2004; its peculiarity was reduced to the regulation and provision of safety in peacetime.
- The Law of the Republic of Tajikistan "*On protection of population and territories from natural and manmade emergency situations*" (2004) stipulates organizational and legal provisions in protecting the people, national territories, natural wealth of Tajikistan.
- The Law "*On emergency rescue services and the status of rescuers*" defines the organizational, legal and ecological conditions for application of capacities and tools to prevent and mitigate emergency situations. It also regulates relations among the authorities, institutions and citizens, and determines rights and duties of rescuers in the country.
- The Law "*On the Fund for mitigation of emergency situations*" (27 December 1993), allocated the fund for mitigation and rehabilitation activities. The fund comes from 10 percent of depreciation amounts paid by business enterprises on the territory of Tajikistan.

5.2 Structure of disaster management

The establishment of the State Commission on Emergency Situations under the Government of the Republic of Tajikistan has become an important step in the enhancement of the system of management in emergency situations. This Commission has obtained a status of a national coordinating body in emergency situations (Figure 13).

The Ministry of Emergency Situations and Civil Defense (MoES) was established to settle issues of protection of the population and territories of the country. MoES has the following functions:

- Implement a common State policy in disaster prevention and mitigation;
- Implement programs on disaster management;
- Maintain preparedness of disaster management units, communication and warning systems, forces and tools acting in emergency situations, implementation of mitigation and rehabilitation activities, forecasting and assessment of socio-economic impact from emergency situations; - Implement international cooperation for disaster reduction efforts; - Stock piling and delivery of relief aid to the affected population.

MoES is also tasked to protect the population and national territories from hazards of military actions such as terrorist threats.

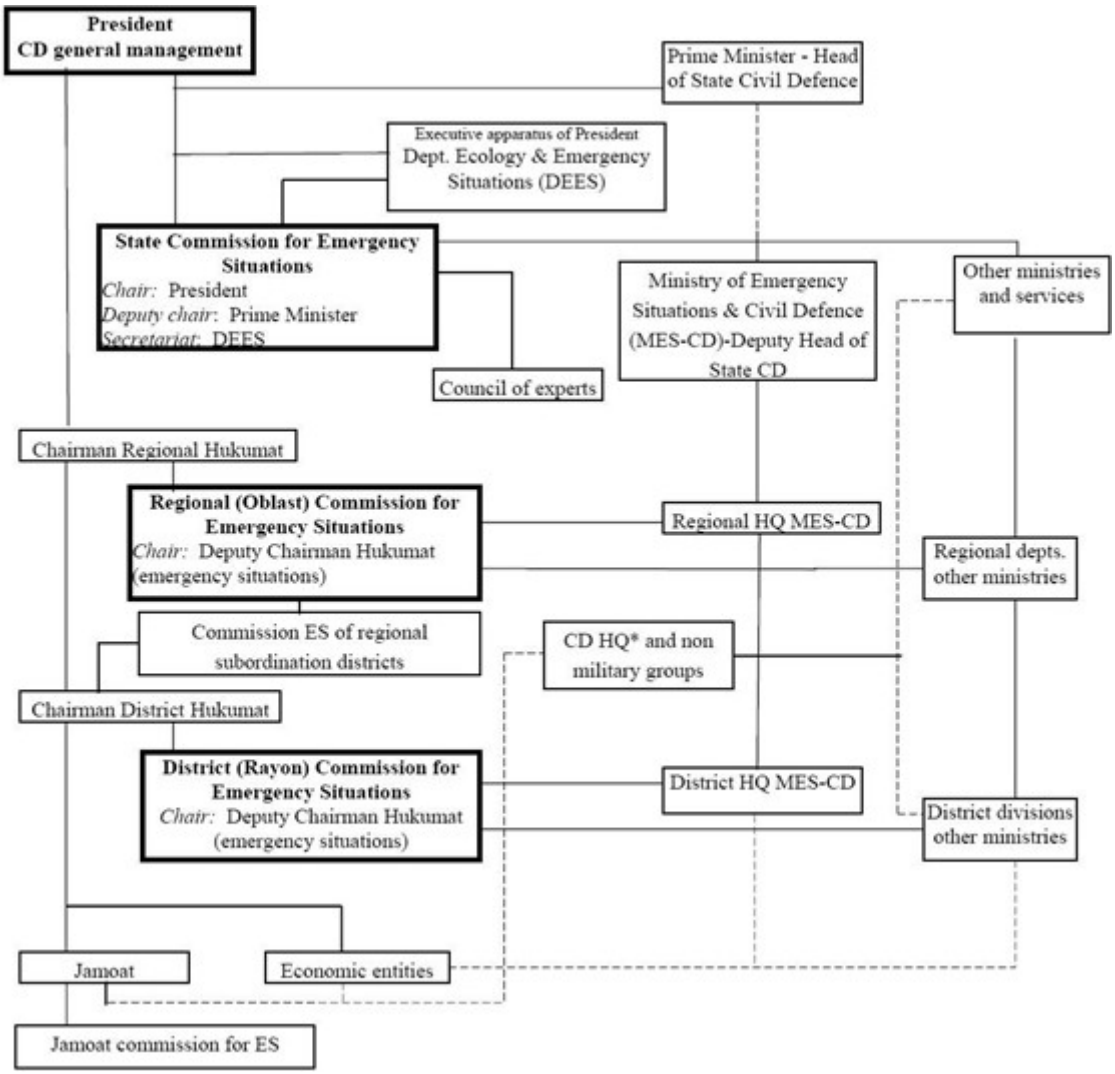

Figure 14. Structures for Disaster Preparedness and Response in Tajikistan.

5.3 Priority on disaster risk management

- ✓ Enhancement of disaster management and information maintenance
  - establishment of a more efficient structure of management;
  - gradual integration of a common system of response to emergency situations and systems of civil defense in the integrated State system
  - establishment of early warning and forecasting systems
- ✓ Building and strengthening international cooperation in the sphere of prevention and mitigation of emergency situations
  - establishment of an international system of response to emergency situations;
  - enhancement of management of international forces in areas affected by disasters;
  - development of coordinated scientific studies on disaster prevention and mitigation

6 DISASTER MANAGMENT PLAN

There is no specific Disaster Management Plan in Tajikistan yet. The Ministry of Emergency Situations and Civil Defense is working closely with the international community, in order to consolidate all the various sectors of disaster management into a Disaster Preparedness plan. Currently, disaster management is part of the Civil Defense Plan of the country.

7 BUDGET SIZE ON NATIONAL LEVEL

In order to implement various activities for disaster management, the central government, as well as the regional and district authorities, and the local communities allocate special funds from their budgets. Government allocates approximately USD 5-6 mln. annually for disaster response and recovery activities. Law of the Republic of Tajikistan "*On the Fund for mitigation of emergency situations*" (27 December 1993) mandates government to allocate a fund for mitigation and rehabilitation activities.

8 PROGRESS AND SITUATION OF THE HYOGO FRAMEWORK FOR ACTION(HFA)

The Republic of Tajikistan has undertaken the following actions in response to HFA.

With the help of the representation of ISDR in Central Asia, two consultative meetings have been held as a follow up to HFA between Central Asian Countries.

The first regional consultative meeting on disaster risk reduction in Central Asia was held in Dushanbe, Tajikistan, 1-2 of December 2004. The meeting was jointly organized by the Government of Tajikistan, UN Disaster Risk Management Project in Tajikistan and UN/ISDR Outreach Office in Central Asia. Governmental officials from Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan, and representatives from Directorate – General for Humanitarian Aid (ECHO), Swiss Development Cooperation (SDC), Asian Development Bank (ADB) and United Nations Development Programme participated.

The objectives of this regional consultative meeting were to:

- Promote regional cooperation and collaboration in the field of disaster risk reduction;
- Integrate disaster risk reduction into development planning, policies and implementation, as part of the Central Asian preparatory process for the World Conference on Disaster Reduction and the outcomes from this conference;
- Discuss measures urgently needed in order to create sustainable development planning and programmes;
- Create a regional platform for disaster risk reduction, especially integrating disaster risk reduction into public policies, promotion of disaster emergency response and disaster risk reduction at the community level and professional capacity building;
- Consult with participants from Central Asian governments; aim to set regional priorities, and to create a fundament for a regional strategy for disaster risk reduction.

The participants came up with following key points;

- Work must be harmonize, taken into consideration that major threats like earthquakes can also lead to secondary effect and create human made hazards, example leakage chemical industry can become a consequence of poor building structure.
- Hydro technological facilities (HEPS) – are a major threat. Need to improve monitoring of these facilities.
- Need for disasters database for Central Asia in order to increase prevention.
- Improved early warning and monitoring.
- Major cities in Central Asia all prone to earthquake- legislation for private construction practices, a need for sustainable urban development, common problems
- Harmonization of legislations
- Earthquake is a common threat to all the countries of Central Asia. The group will focus on two concrete actions with donors' support:

A) Legislation for disaster risk reduction should be harmonized, starting with earthquake legislations- building codes for private constructions. Tajikistan will take a leading role to draft the legislation and then share and discuss with other countries. Countries were recommended to organize two meetings to consult with national institutions for finalisation of the legislations.

B) Seismic hazard mapping should be unified for Central Asia through the joint work of technical scientific research institutions.

- Information and knowledge sharing should be harmonized and enhanced among the countries through the regional website based in Iran, and extend the competence centre on disaster risk management based in Dushanbe (education and educational materials). A data bank on disaster risk reduction should be developed.
- Donor cooperation at regional level should be harmonized in the domain of disaster risk reduction.

- Assistance should be provided in improving monitoring and early warning systems in the most vulnerable constructions (large dams and reservoirs) of Central Asia. Assistance should also include assessment, prioritisation and community awareness and training, supply and installation.

The second consultative meeting was held in Almaty, Kazakhstan 24-25 May 2005, which was a follow up to the first consultative meeting. One of the concrete outcomes of the second meeting was a joint agreement on reviewing the draft Low on Earthquakes, which will be adopted and approved by each government.

Disaster risk mitigation is a national priority. Measures on risk mitigation taken by the government of the Republic of Tajikistan.

The Government of Tajikistan under the support of regional and international organizations develops multilevel and multisectoral cooperation for risk mitigation, widely applying legal and other relevant risk reduction and preventive measures, some of which are included in the country development plans.

The central government, as well as the regional and district authorities, and the local communities allocated special funds from their budgets national for disaster prevention activities.

In August 2004, the government organized a national workshop on risk management in emergency situations, which resulted in the development of a country strategy and a set of priorities on disaster reduction. The workshop helped further enhance national policy in the field of risk management. It also accelerated the implementation of activities by legal and executive authorities, local governments, enterprises, communities and citizens of Tajikistan.

Risk management and preventive measures remain the key priorities for the Government. Currently, the Government has strategic stockpiles of food and non-food commodities, and undertakes measures on the enhancement of national and regional capacities and reserves needed for risk management.

Priority activities in the country include among others, the development of a logical legal basis, mobilization of the State prevention and mitigation forces and tools, management and coordination of the State structural units, the introduction of global risk prevention and mitigation experiences, all based on the framework of the International Decade for Disaster Risk Reduction.

Several laws were enacted as mentioned above. In addition, the State Commission on Emergency Situations was created. This Commission serves as a national coordinating body for emergency situations.

The Ministry of Emergency Situations and Civil Defense of the Republic of Tajikistan was established for the settling of issues of protection of the population and territories in natural and industrial emergency situations.

8.1 Identification, assessment and monitoring of risks in emergency situations

Currently, within the Information-Analytical Center, the Ministry develops a sustainable scientific technological infrastructure at the national and local levels. This infrastructure is needed for research, monitoring, analysis, mapping, forecasting of natural disasters, development of a relevant data base, testing of innovation, scientific and technical methodologies, distant surveys, systems of geographical data, systems of disaster modeling, forecasting of weather and climate conditional, systems of risk assessment and early warning.

To prevent flood hazards, the government is constructing a diversion tunnel along the left opposite bank of the river, which will be passing the waters of Vakhsh in case of activation of the Baipaza landslide, and perform the function of an emergency spillway.

For landslides, the implementation of the international project (LSRMP) modern early warning and monitoring systems were installed at the Usoi dam; the awareness of the residents along the riverbed was enhanced, and enable them to timely evacuate in case of the breakthrough of the lake.

Application of knowledge, innovations and education in formation of safe behavior and disaster management capacities on all levels.

Local data bases, information bulletins on advanced practices, feasible and accessible risk reduction technologies and lessons learned from policies, plans and loss reduction measures are being developed within the local networks of State authorities.

The Scientific Research Center under the Ministry on Emergency Situations and Civil Defense has developed a system of training and tutorials on disaster mitigation management for local governments, decision-makers, regional branches of the Ministry involved in disaster management, vulnerable communities, business enterprises and the common population of the country.

The Government of the Republic of Tajikistan considered the issue of inclusion of special risk reduction subjects in the educational curriculum for 2006-2007, and in the relevant educational programs within the systems of school, pre-school, secondary, special and higher education.

In addition, local authorities establish information services with the purpose to inform the population about perspective development planning in cities and districts, construction planning of new industrial and civil objects, activities on land reclamation and land use.

8.2 Reduction of the basic risk factors

The level of poverty is still high in Tajikistan, and the difficult conditions of living weaken the prevention and risk reduction capacities. Despite this, some activities were undertaken to address concerns on nuclear threats such as: studies on nuclear radiation due to the extraction of uranium deposits in the country.

Currently, the activities on physical reinforcement of the national radioactive waste disposal unit are under intent control of the International Atomic Energy Agency (IAEA). Tajikistan became a member of this organization since 2001.

In addition, the Ministry of Emergency Situations has been implementing activities to assess users of radioactive sources aimed at preventing of radioactive accidents, and inventory of radioactive sources at industrial enterprise of the country.

8.3 Enhancement of disaster preparedness for effective actions

In Tajikistan, it is recognized that the development and periodical updating of plans of preparedness to natural and industrial hazards establishes a legal bases for actions in emergency situations. However, at present the Government is sourcing support from the international community to formulate a comprehensive disaster risk management plan.

8.4 International cooperation

An efficient system of coordination, interaction and cooperation between the Government, UN agencies and international humanitarian organizations has been established in the sphere of risk reduction in emergency situations.

Currently, 13 UN agencies working in Tajikistan implementing the concept “Moving the Mountains”, which represents a common strategy of actions aimed at the achievement of positive outcomes in the sphere of access of the population to basic social services, assistance in mitigation activities, and hazards related with mountainous landscape, support of communities and households in strengthening of democratic values. The significant inputs of donors, which amounted to $380 million in 2003 and 2004, indicate the commitment of the international community.

Another significant achievement is the establishment of the REACT group in 2001. It comprises of a number of key international and national organizations that work in the sector of disaster preparedness and mitigation, and have capacities for prompt provision of skills and resources for immediate assessment of needs. This organization consists of the Ministry of Emergency Situations and Civil Defense of Tajikistan, Swiss Agency for Development and Cooperation, National Red Crescent Society of Tajikistan, Focus

Humanitarian Assistance, Global Partners, International Federation of Red Cross and Red Crescent Societies, Merilin, MSF Holland, UNICEF, UNHCR, WFP and WHO.

Project implementation with UN agencies at present aimed at developing an efficient risk reduction policy, strengthening of coordination mechanisms, application of new technologies in assessment and monitoring, which significantly enhances forecasting and decreases time limits for response, improves public awareness on the issues of risk, vulnerability and mitigation of emergencies, and enhances partnership on local, national and international levels.

9 PROJECTS ON DISASTER REDUCTION HEADED BY THE MINISTRY

There are several programmes and initiatives covering the field of disaster reduction in Tajikistan. European Commission Humanitarian Office has been running a Disaster Preparedness Programme in Central Asia since 2003. Most of the projects are implemented in Tajikistan, The projects are implemented jointly by international organizations and MoES.

The Swiss Agency for Development and Cooperation had started a Disaster Reduction Program for Central Asian countries, mainly in Tajikistan.

The UN is running a joint project with MoES called UN Disaster Risk Reduction Project. This project is co-funded by UNDP and SDC. The main goal of the project is to build the capacity of the MoES.

10 ENVIRONMENTAL ISSUES

The major environmental problems in Tajikistan, includes: natural disasters, risk of breakthrough Lake Sarez, glacial melt, land degradation, limited availability of clean drinking water, low levels of water treatment.

10.1 Land degradation

The most economically detrimental land degradation occurs in agricultural areas. Agriculture also accounts for 90% of water consumption. High water tables, erosion and salination are diminishing soil productivity and erosion affects 60% of the irrigated land. This is a major problem in a country were only 5% of the land area is arable and agriculture accounts for about quarter of GDP.

10.2 Water and sanitation

Now, water supply and sanitary in Tajikistan are neither safe, nor adequate. In the Republic of Tajikistan, public access to centralized water supply systems of is 59.2 % nationally, 94.1% for urban populations and 45.2% for rural populations. The rest of the population consumes water from other sources (springs, wells, irrigation ditches, canals, precipitation, etc.), which do not meet sanitary requirements, which in turn leads to the spread of infectious diseases transmitted by water. Of the 764 of the country's water pipes 463 pipelines do not meet sanitary requirements. The lowest access to safe drinking water (25.4%) is recorded in Kurgan-Tyube zone of Khatlon oblast. More than half (50.3%) of the population use water from open dangerous epidemiological sources. The water supply problems are compounded by irregular water supply and poor quality of power supply. Water consumption is marked by such negative factors as excessive consumption, non-payment for services rendered, inadequate metering of water, etc. Significant loss of water in the drinking water supply in the form of leakage from water supply systems (average 50–60%) are caused by worn-out communications, which is due exhilaration of contaminated groundwater. Share of non-standard samples for bacteriological parameters is 10.6%, for chemical indicators 32.2%, and 23.8% for non-centralized sources. The main causes of poor water quality are frequent accidents on water supply systems and structures, equipment failure and irregular electricity supply. The access of population to sanitation services is about 15%, with 44% in cities and 3% in villages. Over the past 20 years, the rehabilitation of sewer networks and facilities was not conducted which has reduced the effectiveness of wastewater treatment. This wastewater is, in turn, discharged without treatment into water, thereby creating a potential threat to life and health.

Problems of water and sanitation sectors:

- Not enough financing;
- Low availability of human resources and lack of capacity;
- Technical deterioration of water and sewer systems;
- Low tariff policy;
- Not perfect regulatory framework;
- Lack of precise control of water and electricity consumption;
- Unprofitable enterprises and organizations.

The improvement and access of population to sanitation services requires huge financial resources. The construction of new sewer systems as well as the rehabilitation of existing systems and improved sanitation facilities in rural type settlements is an impossible task without attracting investment.

Achievements in the field of water supply:

- The program to improve clean-drinking water for the population of RT for 2008–2020 years;
- The Law of RT "On drinking water and drinking water";

- Several regulations have been accepted;
- The authorized agency dealing with the problems water and sanitation has been established;
- A platform of dialogue partners involved in problems of water and sanitation has been established;
- The Water Users Association and community drinking water users are organized;
- The embedding of water safety plans' zones is planned to be extended.

As soon as the annual rains start in the country, in the spring and autumn, a person turning on a tap is often rewarded with a coffee-brown liquid replete with sand, worms and bugs. Such water is unusable not just for drinking and cooking with, but even for washing one's hands.

There is some hope of improvements in the future. The United Nations was declare 2005 to 2015 the International Decade for Action:" Water for Life". The title was meant in part to underline the need to provide clean drinking water across the globe. During the period of the "Water for Life" Decade for Action nearly 1 billion and 648 million US dollars from different sources has been invested in implementation of water related projects and programs. In this period one and a half million people in the country have got access to safe drinking water.

Nevertheless, providing population with clean drinking water still remains the priority issue for the country's water sector, since regardless of significant achievements of the last decade the target to improve water supply conditions is significantly behind the schedule.

President Imomali Rahmonov in one of his speeches said that 20 million dollars have been set aside to refurbish the water supply system in Dushanbe. In late July, the World Bank allocated an additional 13 million dollars in non-repayable funding to go towards an overhaul of the water system in Dushanbe and in the north of the country.

But Petra Zeidler, a representative of the international MVV/Hydroplan consortium that has a tender to revamp Dushanbe's water supply, says much more money is needed if the job is to be done properly. "To completely reconstruct the Dushanbe water supply system would cost around 150 million dollars," Zeidler told IWPR.

The state enterprise in charge of water distribution in Dushanbe also appears to be sliding into financial ruin.

In mid-2007, the company is due to start paying back a previous loan from the World Bank. And observers warn that even if all customers pay their water bills on time, the revenue will still only be enough to cover around 30 per cent of the normal operating costs of the city's water system.

Another possible solution that has been considered by the company is to install water meters and carry out random checks to prevent wastage of water, particularly by people tending their gardens. But this route has the disadvantage that it would require extra resources.

In the meantime, problems caused by waterborne infections are only likely to be made worse by the introduction on August 1 of a new fee system for medical treatment in Tajik hospitals. While a formal list of prices has not yet been made available, a day's treatment in hospital now costs around 30 dollars.

The number of cases of intestinal illnesses with a fatal outcome will grow every day as a result. People in most districts are poor and can't pay this kind of money for treatment.

10.3 Lake Sarez – Time Bomb

There are more than two thousand lakes on the territory of Tajikistan and the Sarez Lake is one of the most beautiful lakes. It is situated in the middle of the high mountains land Pamir.

The 1911 Sarez earthquake occurred in the central Pamir Mountains in the Rushon District of eastern Tajikistan. It had an estimated magnitude of 7.4. An enormous landslide caused by an earthquake in the Pamir Mountain range of Tajikistan blocked the Murgab river and formed Usoy Dam, the tallest dam in the world, created Sarez Lake(Fig.14). The river soon formed a lake approximately 60 km in length, containing close to 17 cubic kilometers of water.

Figure 15. Lake Sarez.

The Usoy village with the whole population has been totally buried under the rock debris. Behind the mass stones has formed a lake which has been named after name of the village Sarez, which went under water with raising level of the lake. Today the total area of the lake is 80 sq.km, its length is 60 km. It is one of the deepest lakes –its depth is more than 500m and total pool is about 17 km3. The Usoy dam is the highest among both natural and artificial dams of the world. The Usoy landslide dam has a total volume estimated at approximately 2 km3 and it is located at an altitude of 3200 meters with a height of over 550 meters. Until recently, very little information about the lake and its precarious situation had passed beyond the borders of Tajikistan and the territory of the former Soviet Union. The appallingly beautiful lake is fraught with danger. Geologists have been warning about the Sarez threat since Soviet times. Now it's urgent. Due to climate change the clock on the Sarez time bomb runs faster every year. During the 1990s the water level was rising eight inches a year. Now it's one or two yards. Scientists say the dam is going to burst. Whether a quake dislodges a rockslide that creates a wave that crests the dam, or melting glaciers brings the water to the top, computer models predict a devastating inland tsunami sooner rather than later. Seventeen cubic kilometers of water will be instantly released. A wall of water 800 feet high will cascade down a series of river valleys in four countries. The lake's stability is questionable, considering local seismic activity and the fact that Sarez is located in one of the most earthquake-prone regions in the world. According to scientists, if a strong earthquake occur near the lake, the dangerous 'right bank', a partially collapsed body of earth and rock with a mass of roughly 3 cubic kilometres(Fig 16), might fall into the lake 17 km3 of water. By breaking of the dam can flood the bordering territory of Tajikistan, Afghanistan, Uzbekistan and Turkmenistan with 5 billion population and all plants, animals and industrial objects. The big flood will probably be the worst natural disaster in history. Yet no one is lifting a finger to save the lives of one to five million people.

Another threat is the result of the filtrating water, which created cavities inside the dam, which might destabilize Usoi's walls. The 3 km3 detached rock mass at the edge of the lake could fall into its waters any time, creating a huge wave, adding additional pressure to the dam which would most probably collapse.

Although many believe that Usoi dam is balanced enough to resist erosion, it is unkwnown whether it can withstand a big earthquake. The area has been monitored since 2004 for surging water levels and other geographic events. Some proclaim that because of the limited funding and the remoteness of the area, this level of monitorization is not sufficient.

The Lake Sarez problem was first brought to the attention of the IDNDR Secretariat during a meeting of the Interstate Council for Emergency Situations of the Commonwealth of Independent States (CIS) held in Chisinau, Moldova in May, 1997. During this meeting, countries of the CIS called upon the IDNDR Secretariat to lead an effort to raise international awareness of this problem and develop a programme to reduce this threat. The Government of the Republic of Tajikistan also raised the issue of Lake Sarez during the visit of the Under-Secretary General for Humanitarian Affairs, Mr. Sergio Vieira de Mello in 1998. As a follow-up to these discussions, the IDNDR Secretariat began preparations for a Risk Assessment Mission to Lake Sarez. An interagency mission took place from 2-18 June 1999 and consisted of renowned international and national experts in the assessment of risk and impacts of natural phenomena in mountain environments. This document summarizes the observations and recommendations of this interagency mission, thereby shedding light on the problem and proposing specific activities to address the issue.

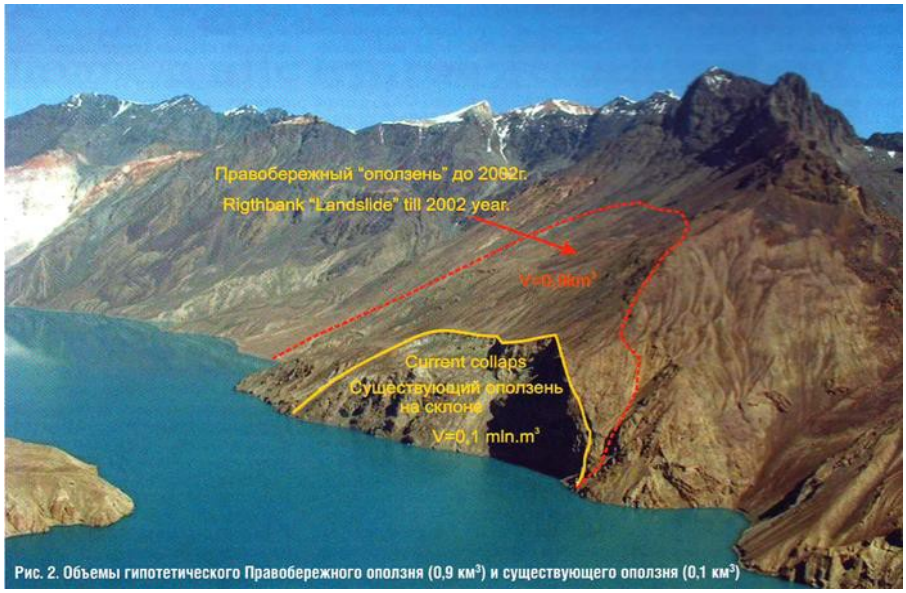

Figure 16. Right Bank and volumes of the hypothetical landslide and the existing landslide.

A complete or even partial collapse of the Usoy landslide dam, and the cataclysmic impact which many believe such an event might cause, are very unlikely. However, the threat of collapse of the right bank, although smaller than previously believed, remains an unfortunate reality. Even a medium sized surge wave overtopping the dam could affect the entire population of 7,800 people living in the Bartang valley and could possibly extend beyond the city of Rushan and affect the first three major towns along the Panj river where an additional 25,000 people live. Therefore, one of the overriding conclusions is that Lake Sarez, and the Usoy landslide dam, are indeed worthy of the international community's urgent attention. The risk is real and, as this report will show, an integrated strategy of the international community to reduce this threat is necessary. It is anticipated that through its preliminary observations and recommendations, the mission will become a catalyst for a coordinated, interagency programme of action for Lake Sarez.

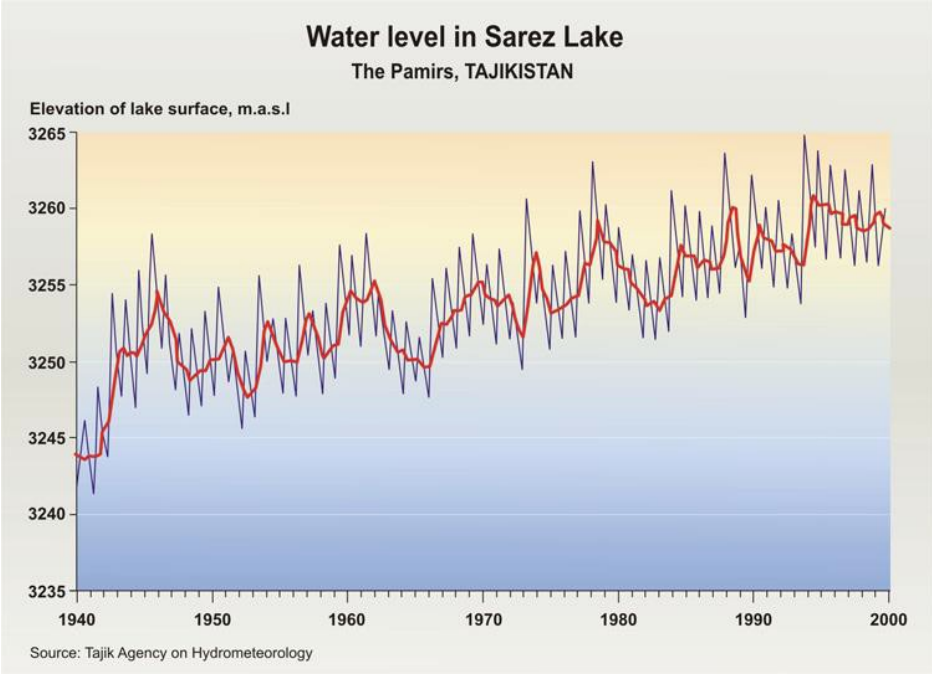

Figure 17. Water level in Sarez Lake.

The mission sent to Tajikistan was coordinated by the IDNDR Secretariat and constituted a true interagency effort. The World Bank, the Joint UNEP/OCHA Environment Unit, OCHA, the German Geological Survey, Focus Humanitarian Assistance USA and the IDNDR Secretariat provided the international experts taking part in the mission. The Government of the Republic of Tajikistan provided Tajik experts for the mission with years of experience working on Lake Sarez related issues. The implementation of the mission was made possible through funding provided by the US Agency for International Development (USAID), the World Bank, OCHA Tajikistan and the Government of the Republic of Tajikistan. In addition, President Emomali issued a decree requiring all branches of government to facilitate the work of the mission team. Furthermore, substantive contributions to the mission were made by the US Geological Survey through the provision of maps and preliminary GIS data for the region. Data collected by Dr. Alford during an earlier mission to Lake Sarez and the region in 1998 provided valuable information for the UN mission.

The objective of this effort was to undertake an international expert reconnaissance and evaluation mission to the region in order to assess the vulnerability of the Usoy dam, the likelihood of its collapse, and the projected impact of this potential disaster in human, economic and environmental terms - with a view to raising the international community's awareness of the problem. The mission was also charged with identifying strategies to mitigate the hazard, and with recommending, in a final report, specific short-, medium- and long-term risk reduction strategies. The impact assessment components of the mission are an important part of this effort as they determine the urgency and scope of the risk in question.

In order to achieve these goals, the IDNDR Secretariat organized a mission of international experts to visit the region in eastern Tajikistan. The team was divided into several subteams to examine the following issues:

- The stability of the Usoy landslide dam and the dangerous right bank with particular consideration to water filtration through the dam (causing possible internal erosion or "piping".)
- The socio-economic impact of a potential flood on downstream inhabitants and possible mitigation activities.
- The environmental impact of the potential disaster on a local, national and regional scale.
- The need to replace or improve the monitoring and early warning systems at the lake and downstream.
- The accessibility of the relevant areas, including the lake, as a primary concern for any future structural work on the dam or mitigation work in the valleys.

The team also collected GPS data of the Bartang and portions of the Panj valleys in order to refine the GIS system for Lake Sarez being implemented by the USGS.

Mission Observations and Findings

The findings of the mission have been broken down into three main sections:

1 Hazard Risk Assessment
2 Impact Risk Assessment
3 Disaster Mitigation

As the mission had the task of gathering a vast amount of information in a very limited time, many of these findings are preliminary observations. Where additional study is considered necessary, specific proposals are included in the mission's recommendations.

At present the right bank of the lake is kept under constant observation from a camp located directly opposite the unstable slope. Some new extensometers have been installed at open cracks in the superficial deposits in August 1998. The instruments are read once a year and have hitherto showed slow movements of the order of 1-2 cm/year. Former readings between 1985 and 1990 had reported maximum displacements of 10 cm/year.

Usoy dam:

- The morphology of the valley prior to the 1911 landslide was characterized by a considerable narrowing which later buttressed the downstream side of the dam. In this way, the dam was confined effectively by the formation of a wedge-like supporting face.
- The enormous proportions of the 1911 landslide only become clear after climbing on the dam. Large scale structural modifications/works, such as creating channels through the dam to evacuate water from the lake, are clearly not feasible.
- The northern and southern parts of the dam consist of very large blocks of rock (at the surface). The middle part contains much more fine material and (at the surface) is devoid of huge blocks.
- Huge pieces of relatively undisturbed rock fragments were observed in the central downstream side of the dam pointing to a solid core of only slightly loosened rock mass.
- The right part of the dam has a considerably smaller free-board (only 50 meters above the lake level) than the rest of the dam. The predominantly blocky material there, however, is expected to be highly resistant to erosion from a potential over-topping surge wave.
- At the northernmost part of the dam, active landsliding occurs in the form of rock avalanches, debris flows and mud flows from the source area of the former huge landslide. Currently, almost all of the paths of these flows descend into the lake.
- No indications for over-topping of the dam have been found. The reported surge wave after an earthquake in 1968 and consequent landsliding into the lake could not be confirmed by visual observations of the dam.
- The erosion of the canyon from the water leakage at the downstream side of the dam at present is restricted to fine-grained flood plain sediments deposited by a seasonal tributary river from the north. The erosion of this material does not influence the stability of the dam. The incision of the canyon into the dam material further downstream along the dam does not seem to be very deep.
- The areas where the water leaks out of the dam in a slow flow show no signs of active erosion. The water seems to be totally free of sediments although no measurements were made. Piping effects are therefore very unlikely.
- The springs where the leakage emanates from the dam are all located roughly at the same level, which is 130-140 m below the level of the lake. This points to an impermeable lower part of the dam body between this level and the pre-1911 valley bottom.

Therefore, due to many of these factors and considering the dam's huge volume of mainly blocky material (with high internal friction factors) and the flat slopes up and downstream, the overall stability of the dam is considered to be high.

Right bank:

The visual observations from a one-day field visit (up to 3900 m) revealed the presence of at least four different types of mass movements:

- Regular (nearly daily) rockfalls at the steep cliffs along the shore line. The volumes vary from stone size to several thousand cubic meters of rock mass.
- Rock- and debris sliding from the steep slopes along the shore line.
- Slow but continous sliding of the colluvial debris of the slopes. This is caused by rockfall at the top of the slopes, a process leading to overburdening of the load on the lower colluvial debris.
- A process called mountain splitting caused by stress release in the rock of the valley flanks after glaciers retreated from the valleys. The deformations caused by this phenomena are still in evidence but extremely slow.

Clear evidence of a deep-seated sliding surface in the rock mass could not be found. On the other hand there are numerous indications of relatively shallow slope movements from the shape of the open cracks. The maximum thickness of the colluvial soils should be between 40 and 60 m according to former borehole and geophysical investigations.

Impact Risk Assessment

A disaster risk assessment requires a projection of the scale, speed and trajectory of the potential hazard - the flood/mudflow wave in the case of Lake Sarez. These projections or models in themselves must be based on an estimate of the risk and the probabilities such a risk might pose. Although this mission found that a total breach of the Usoy dam is very unlikely, the scale of a potential overtopping cannot be accurately estimated. Further study is needed. Therefore, until such studies are made, we cannot afford to underestimate the potential impact that an overtopping of the Usoi dam might cause.

Socio-economic impact assessment

According to field investigations recently performed by Focus Humanitarian Assistance USA, roughly 7,800 people live in the Bartang valley and an approximate total of 25,000 people live in the first three major towns along the Panj river. Although not yet confirmed, these larger towns are considered vulnerable to a medium-to-large scale potential flood disaster. These figures do not cover any of the villages along the Afghan side of the river Panj and thus are only a preliminary investigation of the number of people immediately at risk.

By FOCUS has provided a much better data base than existed before. Nearly twice the number of villages, kishlaks, are located in the Bartang valley than had been previously identified. Good data on nutritional status and overall food self-sufficiency of the inhabitants in Gorno-Badakshan, together with much local data, had been entered onto a GIS being prepared by the USGS.

Apart from the short time spent in Khorog town work was restricted to one day along the Panj valley downstream to Shipad, one day in the Bartang valley, and general observations during the drive out along the Panj gorge. Only a very small sample of interviews (10) could be completed. These took the form of standard questions with the aid of interpreters, followed by questions relating to attitudes and possible responses to Lake Sarez and related disaster scenarios for outburst flooding.

Environmental impact assessment

Lake Sarez and the Bartang and Kudara rivers are situated in typical dry alpine areas. In order to assess the direct impacts of a Lake Sarez outburst flood, it is necessary to examine landforms in the valleys immediately downstream from the lake. Local experts have conducted some geomorphologic studies in the valleys, which include studies on the slope instabilities related to tectonic activities. The impacts of the flood on geomorphology of the downstream valleys, however, have not been assessed thus far.

While a precise impact assessment can only be completed once flood models have been carried out, the subteam found the following important aspects that

Settlements would be destroyed entirely and the erosion of the toe of rock walls could leave the entire valley system unstable, bringing yet more rockfalls and debris flows in unpredictable places. Agricultural land would be destroyed and the surface covered with the associated debris of the flow. In broad terms, entire valley areas could possibly be rendered uninhabitable for generations.

Most fauna and flora, as well as most human settlements, are found either on the alluvial fans/cones or on the younger river terraces formed about 3,000-5,000 years ago. Only two settlements are located on the glacial moraines. The alluvial fans/cones and younger terraces have formed near the valley floor. These depositional landforms, serving as homes for most fauna, flora, and human settlements could be easily washed away.

Downstream transport of the deposits would also lead to high suspended sediment loads, which could damage fish populations in the lower reaches, as found elsewhere in the Himalaya following glacial lake outburst floods.

Revegetation would be possible only after the stabilization of the new landforms. Geomorphologic response would start immediately after the flood. However, the development of the landforms, such as alluvial fans/cones and river terraces, may require hundreds to thousands of years to form, effectively rendering this valley uninhabitable.

Immediate locality

Two of the three Zapovednik Nature Reserves in the country are in the direct flood path of a worst case catastrophe. The Dashtidzhum mountain forest reserve on the bank of the Panj River occupies 53,400 ha. It includes pistachio, juniper and maple forests, and provides habitats for key faunal species such as the Markhor Capra falconeri, Snow Leopard, Brown Bear and Persian Otter. The low-lying areas of this reserve would be affected by a major flood. The Turan Tiger reserve contains the largest tugai forests in Central Asia. At 49,786 ha, this reserve was the main habitat of the Turan Tiger, which was last seen in the country in 1954. It remains the key habitat of several Red Data Book . There appear to be no factories, power stations or waste facilities on the upper reaches of the Bartang and Panj rivers that could present a significant pollution threat and fertiliser use is reported to be low.

Broader regional implications

Until more precise flood models can be created, it is important to consider the potential regional implications of a major flood. Termez, in Uzbekistan, is the nearest major city that could be flooded in the worst case scenario. Farther downstream across the five nations that would affected by the worst case flood scenario, it is very likely that significant pollution would result from chemical stores, factories, power stations and waste facilities. This could possibly affect the cotton-irrigation systems of the Aral Sea Basin as well as drinking water.

Disaster mitigation

On www.sarez-lake.ru(Personal site of Leonid Papyrine) site describes the project of bringing Lake Sarez to guaranteed safe condition and the construction of Pamir HPP system, which provides for: an initial decrease the level of Lake Sarez and construction of protective levees and dams. Elimination of all landslides and damaged areas. The construction of four power plants and the Pamir Energy Ring. The total capacity of 4 Pamir hydropower plant in the summer - 400 MW -1300 MW in winter. (Now the total capacity of the two Pamir HPP 21 MW and it is planned to increase by 14 MW, for a total of 35 MW). Power of the proposed power system is sufficient for lighting and heating of all the settlements, all electricity supply companies GBAO and supply of the electricity for export. The total cost of the project - 7 billion USD. The cost of survey work - $ 700 million.

By some other experts: The simplest and cheapest way of reducing the hazard of Lake Sarez - lowering the lake level by enhancing the filtration of water through the dam on 40-50 meters. The project cost of $ 30-35 million

Conclusions

Total collapse of the Usoy dam seems highly unlikely. The right bank partially-collapsed landslide is regarded as the most likely catalyst of a possible surge wave and overtopping of the dam. This area is a complex structure and additional study will be required to determine its stability. However, given the various

speeds at which the different bodies of the right bank are moving, it seems unlikely that a landslide on the order of magnitude previously considered (2-3 cubic km of rock mass) would fall into the lake at one time. The effects of such a landslide would depend on many factors, including the speed with which the mass displaces the water of the lake. All these conclusions point to the need for additional, longer-term studies of these various elements. Nevertheless, the experts believe that a right bank landslide into the lake could occur as a result of a strong earthquake. This could result in an overtopping of the dam at its lowest point by a surge wave measuring 80-100 meters (i.e., 30-50 meters above the top of the dam). The water volumes released during such an event and the size of the ensuing debris flow flooding into the Bartang and Panj valleys must be carefully calculated.

The older inhabitants are less concerned about the threat of Lake Sarez than the younger ones, especially those with small children - thus the older people are much less likely to respond to an early warning system. As is most often the case, those living closer to the lake (especially in the Bartang valley) are much more sensitive to the potential dangers than those living further away. It would seem that government and Non-Governmental Organization discussions of the Lake Sarez problem in recent years have increased fear of the lake hazard.

The level of education of the people of the Bartang is remarkably high. Thus, given the alertness, understanding, and willingness to respond, there appear to be excellent prospects for introduction of an early warning system. The sense of belonging to their "homeland" is very high; the people in general want to stay in their mountain valleys. Despite this, they all agree that they cannot become self-sufficient because of the severe shortage of cultivable land and they depend upon humanitarian aid, just as outside food was provided during the Soviet period. The overall nutritional status is very low. Similarly, the level of unemployment in Gorno-Badhakshan as a whole is very high (90%), although this statement needs to be balanced against the fact that the rural families all have access to some land, however insufficient.

From Rushan downstream in the Panj valley, it is significant that alternative village sites have already been selected in preparation for a move to higher ground once funds are provided (US $5,000 per house) and more reliable simulation models have become available. Another interesting finding is that the entire village of Basid (in Bartang valley) organized itself and effected a total, if temporary, evacuation last year in response to rockfalls and mudflows caused by heavy rains.

A major debris flow would completely destroy all habitats up to the level of the flow; it would impact farther up the mountain by changing slope stability patterns. Re-colonization of damaged areas would take many years and habitats and species assemblages would change in unpredictable ways. The endangered species, and especially those endemic species at risk, are irreplaceable and therefore, the highest level of protection must be given to them. This is a responsibility not only for Tajikistan under their commitments in the UN Convention on Biological Diversity; it is also an international issue given the unique nature of the region.

Disaster Mitigation

The understanding of the Lake Sarez threat clearly justifies that a high priority be given to the installation of a monitoring and early warning system. The installation of such a system is feasible, but complimentary training of the villagers and regional emergency management staff. This work should be undertaken as soon as possible.

Assessment of accessibility

Lake Sarez is located in one of the most remote areas of the world. Any structural work to be performed on the Usoy landslide dam would require heavy machinery and a significant number of personnel. The road along the Bartang valley represents an important artery to the villages along the river and would be the principle means of access to the people in the valley and for the installation of an early warning system. Hence, suitable access is an important component of the overall feasibility study for future work to be performed in the region.

An access road to Lake Sarez would require a paved surface, structurally adequate bridges, radius of curvature not less than 25 m, and slopes not exceeding 9 percent. Such an endeavor would require structural works (bridges, culverts, retaining walls, etc.) in order to construct a road in the difficult mountainous terrain.

The problem of the accessibility to the Usoy landslide dam is not only a local problem, but is indicative of the general condition of transport routes throughout Tajikistan. The condition of roads in Tajikistan is generally very poor. Roads are inadequate and most of the vehicles are obsolete. The Gorno-Badhakshan region, where Lake Sarez is located, can be reached from the capital Dushanbe by means of two possible routes.

The first of these, via Osh, Kyrgyzstan, to the north and east of the Pamirs and then down to the south to Khorog via Murgab, is a very high and difficult route, closed for some months in winter. It represents the primary access road to Gorno-Badhakshan for most goods entering the region. The alternative road, presently under construction, reaches the city of Kuliab and then, following the Panj river, which delineates the border with Afghanistan, reaches the city of Khorog. This route, due to its elementary design, and to the rough construction criteria, is even more unreliable and inaccessible to heavy traffic.

Conventional wisdom suggests that the easiest way to reach the Usoy dam is from downstream through the Bartang valley or the Kudara valley. The accessibility from both these valleys is very difficult. The geomorphological conditions are critical and the existing roads are absolutely inadequate. The required works to build an adequate road along this route would impact substantially both the environment and the local population. In addition, the enormous investment that this option would require strongly discourages consideration of the construction of a road suitable for heavy traffic along these valleys.

Most likely, the key to access with heavy construction equipment to the dam crest, and the only alternative to transport by helicopter, is along a route which, departing from the city of Murgab on the course Khorog-Osh-Karakorum, follows the Murgab river downstream and reaches the upper side of the Sarez Lake. Construction equipment could then be transported by ferry along the full length of the lake to the dam crest. The topography of the valley of the Murgab River between Murgab and Lake Sarez is at present uncertain and a careful investigation of this alternative is highly recommended.

The accessibility of the Bartang valley, however, is a problem which cannot be ignored. The installation of communication apparatus connected with the early warning system requires the possibility of safely traveling the existing road in every season, both for operation and for maintenance. The current road has the appearance of a single-lane track: steep, bumpy, with numerous tight and dangerous curves. The road is positioned over landslides, steep rocky hills or across torrents and alluvial fans. Improving the general geometric characteristics of the road to make it safe and suitable for light vehicles requires an investment, which, in the best of cases, can be estimated at between US$300,000 and US$600,000 per kilometer. In addition, an improved road built according to common construction procedures would impact gravely the environment and the people of the valley.

The quality, performance and economics of the road can be greatly enhanced if engineered using proper planning, design, construction and maintenance strategies. Every effort should be made to develop structural designs that are consistent with local construction capabilities. Construction standards can be achieved through labor-intensive technologies such as construction of retaining walls consisting of steel-meshed gabions, paved fords, grouted rubble paved waterways. Involvement of local population in construction of the road would probably lie below the lower bound of the estimated construction costs (say, below 0.3 Million US$/km). Such basic refurbishment works would, at the same time, improve the rural economy of the valley. In addition an accessible road makes contacts between villages easier, which will be induced by the introduction of communication systems, including sanitary assistance. Basic development activities (irrigation, rural electrification, radio communication, etc.) are being promoted by Non-Governmental Organizations (notably Focus Humanitarian Assistance) in the Bartang valley. Improving the road to meet the above-mentioned, basic standards, would render such development efforts more reliable and sustainable.

10.4 Glacial melt

Due to specific orography and climatic conditions, Tajikistan is considered the main glacial centre of Central Asia. Glaciers are the wealth of Tajikistan, they are not only retaining water, but also regulating river flows and climate. Glaciers of Tajikistan occupy about 6% of the territory of the country and play an important role in forming Amudarya River, the biggest water "artery" of the Central Asia and Aral Sea Basin(Fig.18). Glaciers and permafrost are the main source of water replenishing the Aral Sea river basins. Every year the melting of snow and glaciers contribute several cub.km of fresh water to the main river basins of the country. Glaciers occupy more than 8.4 thousand sq.km, which is about 6% of the total country area. The bulk of ice cover is observed in the Pamir mountains. The largest valley glacier of the region is the Fedchenko Glacier. Its length exceeds 70 km, width - 2 km, and maximum ice thickness - 1 km. The volume of glacier itself with tributaries is 140 cub.km. It originates on 6200 masl with its terminus stretching for 2910 masl. It is estimated that Tajikistan enumerates with 8 thousand of glaciers with 7 out of them having the length of 20 km. Rivers of Tajikistan are the main sources of water replenishing the Aral Sea. They provide neighboring areas with water for irrigation and power generation. There are several largest river basins in the republic: Syrdarya (Northern Tajikistan), Zeravshan (Central Tajikistan), Pyandj (SouthWestern Tajikistan and Pamir), closed basin of the lakes of the Eastern Pamir. The largest rivers are Pyanj, Vakhsh, Syrdarya, Zeravshan, Kafirnigan, Bartang. Most of the rivers in Tajikistan are of mountainous origin. There are 947 rivers in Tajikistan with the length more 10 km. Total river length is 28,500 km. The annual surface runoff reaches 30-45 l/sec/ sq.km in highlands, whilst in lowland deserts and high mountain regions it amounts to 1 l/sec/sq.km. The annual river flow is about 53 cub.km. Water is critically important for agriculture and hydropower production – the economic sectors that drive Tajikistan's economy and are highly dependent on water.

Climate warming led to widespread glacier retreat. The largest glacier, Fedchenko, has regressed for nearly 1 km in 20th century, reduced by 11 sq.km in area, and by 2 cubic km in volume; almost all of its right-side tributaries have been separated and became independent glaciers. At the present time, the lower part of the glacier is cracked and covered with glacial lakes for 6-8 km. Many other glaciers of the country are also regressing and reducing in volume everywhere.

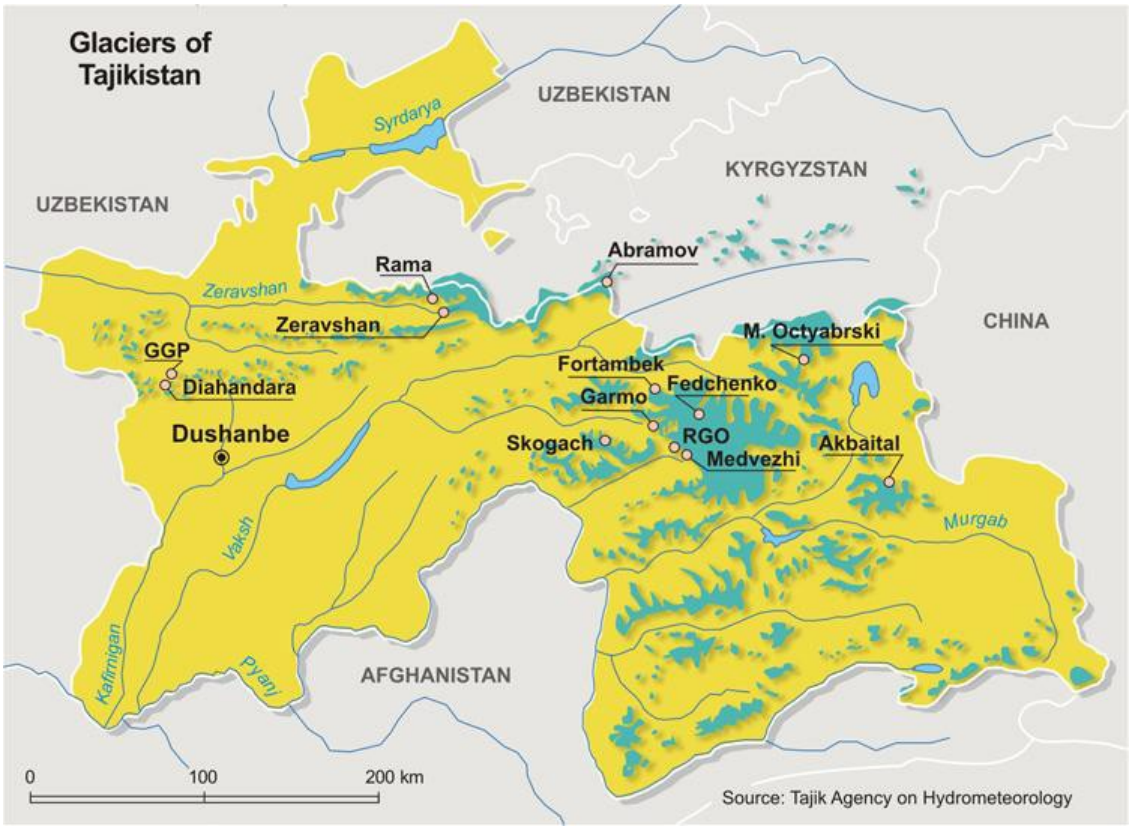

Figure 18. Glaciers of Tajikistan.

Warming trends in high-altitude areas of Tajikistan, namely in the Pamirs and Zeravshan Mountains, correspond to the regional and global warming patterns and trigger observable changes in the climate sensitive environments such as glaciers.

Alarming examples of the glacier retreat due to climate warming include:

Fedchenko glacier in the Pamir, Tajikistan, is one of the largest mountain glaciers in the world, with a total length of 72km. The elevation ranges from 2900m at the terminus to 5400m in the highest basins, while the highest peak in the drainage basin, the Peak Revolution or Koh-i Abu Ali Sino, reaches 6940ma.s.l. Fedchenko is by far the largest glacier in the Pamir, consisting of several small tributary basins in the accumulation zone and a valley-glacier-type tongue, which is fully covered by supraglacial debris for the last 7km.

Pamirs's Fedchenko Glacier, is currently retreating at rates 10-16 m per year, and its total retreat in the past 100 years have accumulated more 1 km(Fig.19). Almost all Fedchenko Glacier's tributaries have became separated from its main body. Its surface in the lower part thinned by 50 m in the past 25 years and now covered by multiple glacial lakes and debris(Fig.20).

Figure 19. Subsidence of Fedchenko Glacier surface in the past 100 years.

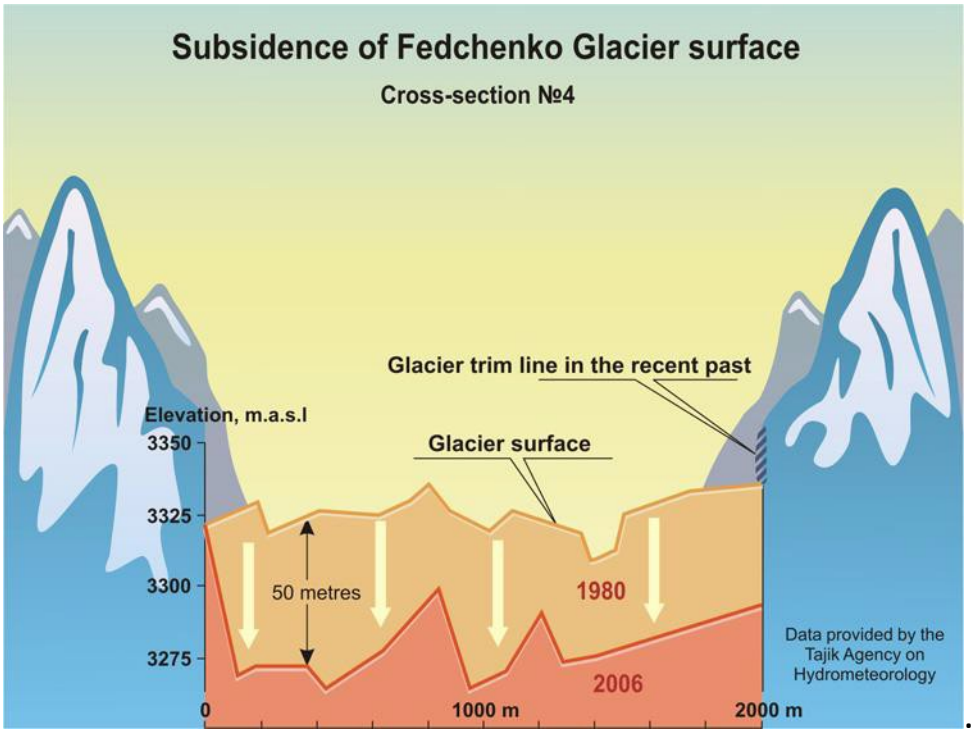

Figure 20. Subsidence of Fedchenko Glacier surface in the past 25 years.

Garmo Glacier is significantly covered by debris and moraines and is melting most intensively in parallel breaking into the blocks. At times the speed of glacier's retreat was 100 m a year. Since the first observation in 1932 to 2007 the glacier retreated for more than 7 km, which makes it the most significant retreat among the large glaciers of Central Asia over the same period of time.

Significant retreat of many other glaciers is observed. By the end of 20th century, Saukdara glacier in the Pamirs and Zeravshan glacier in central Tajikistan shrank by 2 km. Hundreds of small glaciers, such as Diahandara glacier (area less 1 sq.km) totally disappeared – only dust and moraine indicate their former existence. At high elevations 4,000 metres and above, where climate is cold and severe, glacier retreat is less pronounced and for some glaciers degradation rates make 1-2 m per year.

If the current rates of glacier retreat retain or intensify, estimates that by 2050s glacier area of Tajikistan could reduce by 15-20% and many smaller glaciers will totally melt away. Climate warming is causing the retreat of glaciers and generation of large amounts of unconsolidated debris and glacial lakes which present the high risk for downstream communities in case of floods. Moreover, melting of glaciers is affecting the hydrology of many important rivers, such as Zeravshan, Vakhsh, Pyanj, Kafirnigan, Obihingou. Considering Tajikistan's mountains and glaciers as water towers of Central Asia (<50% of freshwater resources are formed here), impacts of climate change and glacier degradation in the long term could shift and reduce water supply, affect the agricultural and energy security and sustainable development of the Amu Darya river basin.

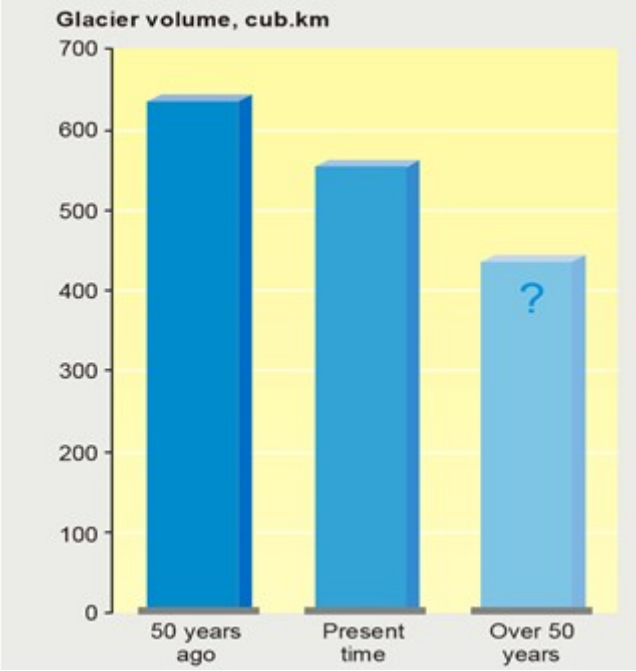

Figure 21. Glacier volume in the last 50 years.

Climate change models have linked sea level rise to glacier melting. The Fifth Assessment Report of the Intergovernmental Panel on Climate Change predicts a global sea level rise by 28-98 cm across different emission scenarios. Thermal expansion of the ocean water, loss of continental ice from ice sheets and mountain glaciers, terrestrial water storage are the main components of sea level rise (IPCC, 2013). The mountain glacier model used in the IPCC report is driven by the glacial observation data among other data. Therefore, the sea level rise predictions could be improved if we have a better understanding of the responses of glacier parameters to the increasing temperatures in various parts of the world. Therefore, an accurate estimation of mass balance of mountain glaciers is necessary for the climate change models.

The warming rates in the high altitude areas of Tajikistan, particularly Pamir, Zeravshan and Pamir-Alai correspond to the regional and global trends and cause significant changes of glaciers, one of the most vulnerable ecosystems. The impact assessment showed that during the whole period of instrumental observations (since 1930s), the glaciations area of Tajikistan decreased by around 1/3.

Changes in surface air temperature. The increase of air temperature in the plain regions of Tajikistan constituted, on the average, 0.1-0.2ºC in a decade. The biggest increase for 65 year period is noted in Dangara (1.2ºC) and Dushanbe (1.0ºC), for the rest of the territory it constitutes 0.5-0.8ºC, in Khujand it is 0.3 ºC. Analysis of surface air temperature changes per each month reveals a trend to warming during the cold season of the year, especially in November-December, reaching 1-3ºC. The trend to temperature fall was observed at all high altitudes in February, March, May, June and October.

During glaciological observations in 2005 it became evident that Medvezhiy, surging glacier, retreated from Abdukagor river by 70-80 meters; its surface sank greatly, and large gaps appeared around its two protrudent ice cliffs meaning that more ice melts than comes in from the top accumulation zone of the glacier, i.e. meaning that the glacier “reduced”.

11 CONCLUSION

Tajikistan is especially vulnerable – it is not only disaster prone but also has limited financial resources and physical resilience. Steep valleys with few trees and towering mountains leave towns and villages extremely prone to the effects of gravity, making regular earthquakes more devastating, and propelling constant landslides, mudflows, floods and avalanches. Disasters and environmental degradation are widespread, and a strong relation exists between environmental conditions and poverty. Disasters lead to social, economic and environmental losses.

Inadequate resources – human, financial, technical, and administrative – at disposal of the relevant agencies for implementing the national and institutional plans and actions for enhancing disaster preparedness, awareness, risk assessments, reduction of underlying risk factors, enforcing the minimal environmental, demographic, developmental and other norms and standards, etc.

The lack of resources also reflects in the inadequate funding of DRR in the annual national budget; besides, the reserve funds and the other resources are constantly spent on disaster mitigation and response activities, due to the many recurring disasters.

At the same time the Republic of Tajikistan possesses many opportunities for promoting the DRR as a priority in its development and in the range of current activities. The country has supported and signed many regional and international treaties and agreements, had established the structures and systems to address disaster mitigation and response. The rules, laws, norms and standards have been determined, and the responsibilities have been assigned. Hopefully, the adoption of the National Strategy for Disaster Management will provide the required momentum for activating the systems and triggering the mechanisms that will start generating decisions, monitor their implementation and effect, and will apply the new strategy and the related acts creatively and efficiently. Another great opportunity is that the Government of Tajikistan expresses strong commitment to the principles of the DRR, outlined in the Hyogo Framework for Action. The Government is considering a number of issues related to DRR, including the mode of composition and functioning of the State Commission for ES, and forming the National Platform for DRR, with recommendations of the UN/ISDR.

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