COMPENDIUM ON WATER-RELATED HAZARDS AND EXTREME WEATHER EVENTS IN CENTRAL ASIA AND NEIGHBOURING COUNTRIES

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References to dollars ($) denote United States dollars unless otherwise noted.

The term “Central Asia” in this publication refers collectively to a select group of countries that are members of the United Nations Special Programme for the Economies of Central Asia (SPECA): Afghanistan, Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan. Turkmenistan, which is a member of SPECA, was not included in this report due to lack of data.

The term “subregion” in this publication refers to the specific geographical area of the countries under study and should not be confused with official regions (e.g., the Asia-Pacific region) or subregions (e.g. North and Central Asia) as defined by the United Nations.

The term “neighbouring countries” in this publication refers collectively to China, India, Mongolia, Pakistan and the Russian Federation. These countries were selected because they participate in the Central Asia DRR Knowledge Network for Flood Risk Reduction, which is an online network for the sharing of information and knowledge that will improve disaster risk reduction and management in the subregion.

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Executive Summary

Water-related disasters and extreme weather events are occurring with increasing frequency in Central Asia and in the countries that surround it. Floods, landslides / mudflows, droughts and earthquakes, which frequently affect the region, cause enormous economic and social damage and often lead to massive loss of human life. Extreme weather events, such as long periods of abnormally high rainfall and glacial melting, are increasingly becoming the most common cause of floods and associated water-related hazards.

From 1990-2011, floods accounted for 48 per cent of the total number of disasters events that were recorded by the Centre for Research on the Epidemiology of Disasters (CRED); earthquakes accounted for 22 per cent of the total number of disaster events, but killed more people. Even though droughts did not occur as frequently as floods and earthquakes, they affected nearly 60 per cent of the total number of people impacted by disasters and substantially impacted agricultural production and associated food security in the region.

In the mountainous areas of Central Asia, the climate is predominately continental; extremely arid conditions prevail and vegetation is sparse. The lack of abundant vegetation increases the risk of water-related hazards, such as mudflows. Central Asia is dotted with glaciers. When extreme weather events, such as abnormally high rainfall, are combined with water from melting snow and glaciers, the situation becomes dangerous. As glaciers melt and recede, barrier lakes form beneath them. When these lakes are breached, they send huge flows of water and debris downstream and cause damage — particularly in terms of property and lives — in the low-lying river valleys. The subregion is also prone to earthquakes, which frequently cause barrier lakes to burst and catastrophic floods / mudflows.

Extreme weather events, such as a drought, are common in Central Asia. When a drought event occurs over a long period of time, it can cause substantial damage to ecosystems, agricultural production and economic systems. In the wake of global warming and climate change, it is expected that Central Asia, and its neighbouring countries, will see an increase in both the frequency and intensity of extreme weather events in the future.

In Central Asia, many water-related disasters transcend national boundaries, making them difficult to predict, control and manage. Countries in the subregion have different systems for monitoring water-related hazards and extreme weather events, often with dissimilar types of technical equipment. Access to sources of critical and timely data is limited. In several countries the density of the observation network is below the standard requirements for operational analysis. Uzbekistan, Tajikistan and Kyrgyzstan do have special services for dealing with national emergencies, but not all of the countries in the subregion have modern flood monitoring and early-warning systems.

In more technologically advanced countries, such as China, India and Japan, flood monitoring and early warning systems are based on real-time satellite data and employ up-to-date communications technologies. The data are processed in specialized centres and subsequently sent to Government agencies. Most of the countries in Central Asia do not have the capability to accurately predict or manage disasters, especially those that transcend national borders. A regional monitoring and early-warning system that can exchange strategic information, combined with the use of real-time satellite data, is, therefore, urgently needed.

At the international level, there is a large body of useful information on how best to monitor, manage and respond to water-related hazards and extreme weather events. Making that information available to the appropriate governmental agencies in Central Asia would help to facilitate the formation of a regional monitoring and early-warning system. Over the course of the past decade, several initiatives and programmes related to disaster risk management have been introduced in Central Asia, but no regional monitoring and early-warning system exists.

In order to mitigate the negative impacts of water-related disasters and extreme weather events, it is imperative that Central Asian countries cooperate to create a regional network that can collect and disseminate accurate and timely hydro-meteorological and socio-economic data. Such a network must have access to and utilize modern information and communication technologies, including space-based, and should include a number of automated monitoring stations with the ability to transfer real-time data to data processing centres. On this point, a framework for cooperation that could support a regional cooperative mechanism in the subregion, such as the United Nations Special Programme for the Economies of Central Asia (SPECA), has been proposed.

Chapter I. Overview of floods and water-related hazards and extreme weather events in Central Asia

Floods and associated hazards

Central Asia is frequently impacted by floods, which cause direct and indirect damage. Direct damage involves damage to property, structures and living biota (plants and animals, including humans); indirect damage involves the disruption of physical (e.g. transportation) and economic activities (e.g. factory closures). The extent of the damage caused by a flood depends on the depth and duration of flooding, velocity of flow, the size of the inundated area, seasonal factors, type of soils, topography, presence and type of vegetation, population density, the degree of economic activity, the presence of hydro-technical facilities (e.g. canal locks and weirs) and the level of disaster preparedness.

In Central Asia, floods are typically caused by a combination of heavy snow melt, heavy rains and abrupt warming events in the high mountain areas. Floods often bring with them catastrophic mudflows. Table 1 shows the number of flood events that took place in Central Asian countries from 2000-2009.

Table 1. Flood events in Central Asian countries (2000-2009)

Country	Number
Afghanistan	45
Azerbaijan	3
Kazakhstan	4
Kyrgyzstan	2
Tajikistan	12
Uzbekistan	4

Source: CRED (2012).

Note: Turkmenistan was not included because of lack of data.

Dam or levee failures, while infrequent, can cause flash floods. When a dam or levee breaks, a large quantity of water is suddenly let loose downstream, often destroying everything in its path. In some cases, the force of the water is so great that it can move boulders, tear out trees, destroy buildings and obliterate bridges. Walls of water can reach heights of 3-6 m, and they generally carry a huge amount of debris with them.

Floods can also unleash mudflows, which are rapid movements of large masses of mud formed from loose soil and water. Mudflows are common in Central Asia, especially in the mountainous zones. These water-related disasters cause substantial damage to natural resources and man-made structures. A mudflow can reach a velocity of up to 80 km per hour. In the piedmont areas of Central Asia, the most destructive mudflows occur in spring when snow and ice melt and rainfall increases. A mudflow can cause tremendous socio-economic damage, destroying crop seedlings, irrigation canals, watersheds, bridges, houses, shops, highways and railways — virtually anything that is in its path. Mudflows are especially severe in the mountain ranges that surround the Fergana and Issyk-Kul lake basins; the northern parts of Tien Shan and Djungar Ala-Tau; the mountains of the western Tien Shan and Karatau ridge; the river basins of Zeravshan, Kashkadarja and Surkhandarja; the mountainous areas of Badakhshan; the Turkmenistan mountains; the mountainous regions of the Kazakh part of Altai; and the central and southern areas of Tien Shan.

About 2,000 mudflow-prone river channels have been identified in Central Asia. “Over the last century of observations, roughly 8,000 mudflow events took place”. Mudflows are triggered by physical, geographical, geological and hydro-meteorological factors. In Central Asia, heavy rainfall is the primary trigger of a mudflow (intensive snowmelt rarely causes a mudflow). In the spring of 1969, for example, a series of storms dropped an unusually high amount of rain in Central Asia, causing catastrophic mudflows in Tajikistan and Uzbekistan.

In Central Asia, 15 mudflow-prone areas have been identified, and three stand out as being areas where mudflows frequently take place: the Fergana valley, south-western Uzbekistan (particularly the Surkhandarja, Kashkadarja and

Zeravshan river basins) and the river basins of Turkmenistan. The mudflows that take place in the aforementioned areas originate in the mountains that surround the Fergana valley, in Kyrgyzstan. Major damage from these mudflows, however, occurs in the low-lying regions of Uzbekistan.

Floods, and associated mudflows, can also occur when glacial lakes are breached. Central Asia is dotted with numerous glaciers, which are valuable storehouses of fresh water. Climate change is causing these glaciers to melt and recede. As they retreat, the water they release flows downhill and becomes trapped behind various natural dams, such as moraine or ice dams, forming glacial lakes. Due to the instability of these dams, the potential of a sudden outburst / breach is extremely high.

Sub-glacial lakes, which are lakes that are embedded inside the cavity of a glacier, are also a source of floods / mudflows. These lakes are typically not large but when breached can give rise to an intense flood / mudflow event. Sub-glacial lakes are sometimes the source of rivers in Central Asia (e.g. Aksai River).

The phenomenon known as the "ice break flood" is related to the ice-formation process on the Amudarya River, which is one of the largest rivers in Central Asia. Ice conditions on the Amudarya River are, in most cases, in the process of freezing or outbreak, because the edge is moving up or down the stream. Usually, the freezing-up on the Amudarya River is characterized by a number of cross pieces of different lengths. The distance between the cross pieces changes, depending on the air temperature. A cross piece is a natural dam that holds back a portion of water, which is sometimes substantial. If one of the upper cross pieces breaks, water and ice are released and move down to the lower one. This phenomenon is called an "ice break flood".

Climate change is accelerating the degradation of glaciers in northern Tien Shan. The volume of the cavities in the glacial moraine complexes increases because of the heat flow of melting glaciers, occurring in underground drainage channels. Studies of the temperature and turbidity of the runoff from melting glaciers show that an underground reservoir exists with a volume of over 500,000 m^3. If it reaches a critical stage, it could break and lead to debris flows with volumes exceeding the capacity of the Medeo mudflow reservoir and, consequently, the destruction of large parts Almaty city. The same danger threatens other human settlements on the alluvial fans of northern slope of Trans-Ili Ala-Tau.

Figure 1. A typical glacial lake in the Zaravshan River basin

(Tajikistan and Uzbekistan)

Photograph by I. Dergacheva

Droughts

Central Asia is particularly prone to drought. The damage caused by a drought can be overwhelming. In the absence of an effective disaster-risk response network, responding to food shortages and implementing measures to assist the victims may come about too late. Such a situation was observed during the severe drought that afflicted the countries of Central Asia (and the Caucasus) in 2000/2001, after which Governments and donor agencies expressed their desire to improve the management of drought and mitigate its effects.

Countries in Central Asia and the Caucasus are highly susceptible to meteorological and hydrological drought. The frequency and intensity of drought varies considerably. In most arid regions, severe and widespread drought occurs only once or twice within a ten-year period. In some Central Asian countries, drought brings damage to one or more territories each year. After a lengthy meteorological drought, water availability can be reduced by 20-45 per cent. Many small mountain streams are characterized by large changes in flow level; that

cannot be said of the big rivers, partly due to the regulation of their levels of reservoirs or other water-partitioning structures.

If predictions about climate change are accurate, susceptibility to drought in Central Asia will grow in the 21st century. Some areas will see an increase in rainfall; other areas will see a decrease in rainfall. It is expected that the onset of droughts and other natural phenomena will become more frequent and intense. High temperatures will increase the amount of evaporation, leading to a decrease in the amount of water and a reduction of the water levels, while the demand for water is likely to increase.

Although poverty in the region has decreased since 1990, countless communities remain vulnerable to drought. In many countries of the region, drought-prone areas are among the most deprived areas. Poor water quality and unreliable delivery to households and families makes it difficult to survive periods of insufficient water supply.

Table 2. Drought events in Central Asian countries (2000-2009)

Country	Number
Afghanistan	3
Azerbaijan	1
Tajikistan	2
Uzbekistan	1

Source: CRED (2012).

Many climate change studies note the growing number of extreme weather events in the region. Researchers have noted that an "unbalancing" of climatic factors has changed the weather. As described in national reports on climate change

Due to a lack of reliable data, the models for atmosphere-ocean changes are limited in their portrayal of precipitation in Asia. The Intergovernmental Panel on Climate Change (IPCC) predicts a 1.3 per cent increase in annual rainfall by 20-50 (6.9 per cent in winter), although the level of summer rainfall will decrease by 2.3 per cent. By 2080 the volume of annual and summer precipitation will be 1.3 per cent and 4.0 per cent respectively, less than the average in 1961-1990. The global rise in evapotranspiration will lead to worsening conditions of water stress in many low-lying lands. The continued desiccation of the Aral Sea will only aggravate this process in Central Asia.

Global warming is expected to increase the number of storms and seasonal cycles of displacement. According to the data provided by scientists from the National Oceanic and Atmospheric Administration (NOAA), and the International Research Institute for Climate Prediction, the occurrence of severe droughts, like those that occurred in 2000-2001 in Central and South-West Asia, is possibly related to changes in rainfall, temperature and winds in large parts of the Indian and Pacific oceans. An increase in temperature, in accordance with prevailing trends that took place during the period 1961-1999, was also significant. Anomalies in the levels of the rivers will be compounded from year to year, and the next few decades will be characterized by cycles of years with droughts and floods, as observed in 2000-2001 and 2002-2003, respectively. Due to reduced snow reserves, snowmelt will decrease by 15-30 per cent; water entering rivers in the form of rain will increase by 12-35 per cent. The water level in rivers receiving water from snowmelt will increase, due to increased