Water, Climate, and Development Issues in the Amudarya Basin

Informal Planning Meeting

18–19 June 2002
The Franklin Institute
Philadelphia, Pennsylvania, USA

WORKSHOP REPORT

1 August 2002

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***The National Center for Atmospheric Research is sponsored by the National Science Foundation.**

This is a report of the National Center for Atmospheric Research (NCAR), which is supported by the National Science Foundation. Funds were received for this project from the Office of Global Programs, National Oceanic and Atmospheric Administration. The views expressed herein are those of the authors and do not necessarily reflect the views of NCAR, UCAR, the National Science Foundation, NOAA, or any of their subagencies.

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Please cite this publication as follows:

Glantz, M.H. (ed.), 2002: *Water, Climate, and Development Issues in the Amudarya Basin*. Report of Informal Planning Meeting held 18–19 June 2002 in Philadelphia, Pennsylvania. Boulder, CO: Environmental and Societal Impacts Group, NCAR.

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Executive Summary

Climate, Water, and Development Issues in the Amudarya Basin

An informal planning meeting was held June 18–19 in Philadelphia to discuss climate and trans-border water and equity issues in Central Asia in general, and, more specifically, in the Amudarya (river) basin. Realizing that there are hundreds of workshops and reports on water-related issues in the Aral Sea basin, the participants sought to identify new, as well as chronic, areas in need of attention.

A wide range of topics touched on climate, water, political, and development issues. Although the meeting was centered on the Amudarya basin, discussions included the roles of other countries – China, Pakistan, Iran, and especially Afghanistan – in addition to the five Central Asian Republics.

A key premise for the meeting was to discuss the consequences of the likelihood of demands by Afghanistan for its fair share of Amudarya water, now that the Taliban regime has been replaced by a more democratic regime. Even though the supply of water from the Amudarya could be sufficient for all the inhabitants of the basin, under the current situation water is scarce, especially in the downstream regions in Uzbekistan and Turkmenistan, which cannot afford to lose any more water to diversions than has already occurred since independence.

Equity concerns were voiced about the continually deteriorating plight of the Karakalpak people who inhabit the lower reaches near the Aral Sea. They are the end users of very polluted water, land, and air in the disaster zone near the Sea. The multi-year regional meteorological drought, food shortages, and news about the declining extent of glaciers in the Pamirs (an indicator of long-term climate change in the region) has led to an attitude change in Central Asian governments concerning climate issues. They are increasingly aware of their growing vulnerability to climate variability, extremes, and change. As a result, there appears to be growing interest in Uzbekistan and from some Russian political figures for water transfer from Siberian rivers to arid Central Asia.

Several activities proposed related directly to water resources, climate considerations, capacity building, equity issues, and regional cooperation and development:

- A central point of concern is the widely acknowledged inefficiency in the use of water in Central Asia's three major rivers (the Amudarya, the Syrdarya, ***and*** the Karakum Canal, among the longest manmade canals in the world). Improved efficiency in agriculture, a reallocation of water among sectors using water more efficiently, such as industries and services, as well as a shift from food self-sufficiency to food security should precede attempts to bring water supplies from other sources outside the basin.

- Central Asia is caught between the blades of a proverbial pair of scissors: growing populations, and a possible dwindling supply of water in the region. Climate projections (scenarios) must be made in tandem with demographic projections (scenarios) over the next few decades.

- There is an urgent and strong need for capacity building in the areas of water resources management and climate studies and forecasting for Afghanistan specifically, and for the other states in the Amudarya basin in general. This will involve considerable coordinated support from donor nations.

- There is a need to identify all of the climate- and water-related national and regional early warning systems in the Central Asian Republics and Afghanistan. This includes a restoration on a regional basin of the climate and climate-related monitoring networks. It is important, if not crucial, to consider how best to combine them and make them more effective.

- There is a need for transparency with respect to streamflow withdrawals, usage, and efficiency of use ratings by Amudarya basin states, as well as Aral basin states, and overall climate monitoring (glacial melt, climate change, etc).

- The inhabitants of Karakalpakstan are in dire need of international assistance with regard to health, access to clean water, employment (re-education and training).

- Donor organizations need to consider how best to coordinate their activities in "Greater Central Asia." Donor countries need to deliver on their pledges for assistance in a timely fashion.

Abstract

Before 1960, the Aral Sea was the fourth-largest inland body of water on Earth. Today, it is on the edge of extinction. The Sea is fed by Central Asia's two major rivers, the Amudarya and the Syrdarya, with a flow, respectively, of about 70 and 35 cu km per year on average. The Amudarya is formed by the Pyanj River (Afghanistan) and the Vaksh River (Tajikistan). The Syrdarya is formed in the Tien Shan mountains and flows through Kyrgyzstan, Uzbekistan and Kazakhstan, making its way toward the Aral Sea. By the 1970s, the Syrdarya failed to reach the Sea, and in the late 1980s the mighty Amudarya also failed to reach the Sea. In the early 1990s some river water reached the Sea, but by then the Sea had split into two parts, the Small Aral (fed by the Syrdarya) and the Big Aral (fed by the Amudarya). In 1954, construction began on the Karakum Canal in order to bring Amudarya water to oases in the desert of the Karakum. Estimates vary widely on the amount of water diverted by the Canal to Turkmenistan and ranges, according to some estimates, between 8 to 12 cu km per year. The Canal, essentially one of Central Asia's longest rivers (manmade) at about 1,450 km in length, has become a source of contention among the Central Asian Republics, especially between Turkmenistan (with a population of about 5 million) and Uzbekistan (population about 27 million). A debate has centered on per-capita water consumption in these two countries. A recent report estimated that water from the Amudarya was divided annually in the following way: Uzbekistan 29.6 cu. km, Turkmenistan 22 cu. km, Tajikistan 9.5 cu. km, and Afghanistan 2 cu. km (news@mon.bbc.co.uk, 22 June 2002).

Today, the Aral story is quite well known to environmental groups within and outside the region, and it has been brought to worldwide attention as the result of a 1990 *National Geographic Magazine* article. The rivers' waters still flow out of the Pamir Mountains and the Hindu Kush toward the Aral Seas (Big and Small). Its watercourse serves as an international border between Tajikistan and Afghanistan and between Uzbekistan and Afghanistan. The Amudarya crisscrosses Turkmenistan and, for the most part, traverses the length of Uzbekistan and its subregion known as Karakalpakstan. Although an upstream riparian country, Afghanistan has been at war for a couple of decades and in-country conflict remains. As a result, it has had little opportunity to lay claim to its legitimate share of Amudarya water. With an end to the Russo-Afghan war, an end to the Taliban regime, and with international involvement to bring a semblance of peace and stability to the country in the conflict-laden post-Taliban period, the new Afghan government will surely lay claim to a significant share of Amudarya water as it reconstructs the nation's agricultural sector.

In the 1970s and 1980s, the Soviet government considered and began to plan for a major diversion of water from the country's northward-flowing rivers in Siberia toward the country's arid south and into the Aral Basin. The diversion plan, labeled "Sibaral," was shelved by the Soviet government under Gorbachev in

the mid-1980s, primarily as a result of opposition based on environmental concerns. With Afghanistan and donor agencies developing ways to reconstruct its agricultural systems in the northern part of the country, in addition to recurrent, prolonged drought, cumulative rainfall deficit, concern about global warming, receding glaciers, and high birth rates, policy makers in Central Asia, as well as some in the Russian Federation (e.g., Moscow's Mayor Luzhkov), have once again begun to consider Siberian water transfers as their ultimate salvation. Because of the central importance of this major river system, the Amudarya, to the well-being and economic prospects in the basin of the countries and their citizens dependent on it, the Amudarya Basin was chosen as the focus of attention in this two-day planning meeting. The Syrdarya is not a primary topic for this meeting, but is also a river of major importance in Central Asia.

Introduction

This Informal Planning Meeting (IPM) was held at The Franklin Institute and has been supported by NOAA's Office of Global Programs (OGP) and by the Environmental and Societal Impacts Group (ESIG) at the National Center for Atmospheric Research (NCAR). The overriding objective of this activity has been to enhance understanding about "climate, water and equity" interactions, with a special focus on a major river basin in Central Asia — the Amudarya. As a result, consideration by participants in this meeting on water, climate, climate-related development issues in Central Asia's Amudarya (river) basin centered on, as well as exposed, several concerns about equity (defined here as fairness) within as well as among countries in the region.

The IPM's participants and organizers were well aware of the fact that there have been numerous meetings, reports, articles and books (academic as well as popular) on a wide range of socioeconomic and political problems and prospects devoted to the Central Asian region, as well as to specific republics in the region. In addition, during the last part of the 1990s, an increasing number of articles and (later) books and websites have appeared devoted to Afghanistan; some of those have directly linked influences in Afghanistan to the Central Asian Republics of the Former Soviet Union (e.g., McCauley, 2002). Today, water-related discussions about economic development prospects for the five Central Asian Republics (Turkmenistan, Uzbekistan, Tajikistan, Kazakhstan, and Kyrgyzstan) include serious references to Afghanistan as a riparian country of the Amudarya. From a regional climate-water-development point of view specifically focused on the Amudarya basin, Afghanistan will eventually play a larger but as-yet-uncertain role.

In this report, we do not present a bibliography of the many studies, reports, and articles that refer indirectly as well as directly to the Aral Sea, Central Asia, water resources in the region, geopolitics, and Afghanistan. Many of these also relate to history, politics, and economics of the region. Suffice it to say that a search on the Internet will identify many of them. They address a wide range of issues, many of which are related to climate and to water. We attempt to identify some of the major chronic underlying issues that affect progress toward water sustainability, economic development, social well-being and equity in the region.

The workshop was dedicated to the memories of Alvin Z. Rubinstein (left), Political Science professor and Sovietologist at the University of Pennsylvania, and Viktor A. Kovda (right), Soil Science professor at Moscow State University.

At the outset, Glantz noted that climate is viewed by some observers as a hazard, by others as a resource, and by still others as a constraint on human activities and, therefore, on economic development prospects. In Central Asia, regional climate conditions have been characterized for different locations and at different times as having manifested each of these three perspectives of climate.

Climate encompasses meteorological factors such as precipitation, temperature, relative humidity, wind speed and direction, sea level pressure, and so forth, averaged over an extended period of time. Drought, for example, can be viewed as a meteorological, agricultural or hydrological event, with a meteorological drought being defined in terms of a certain percentage reduction in precipitation over a certain period of time. For example, 75% of seasonal or annual precipitation could be defined as a meteorological drought. However, such average information can be misleading to those in the agriculture sector, because there is a good chance that the rain that does fall is timely in terms of the moisture needs of a particular crop. Therefore, there may have been no agricultural drought. Hydrologic drought refers to a reduction by a designated percentage of stream flow over a given period of time. In fact, there are many definitions of drought (e.g., Wilhite and Glantz, 1985). Drought has plagued Central Asia for 3 years, beginning in 1999.

Climate statistics can be divided according to a time factor: climate variability on a seasonal to inter-annual time scale, climate fluctuations on the decades scale, climate change, extreme meteorological events, and seasonality. The reason that seasonality has been highlighted is that people in most parts of the world and in most economic sectors are dependent on what they perceive to be the natural flow (or rhythm) of the seasons: the growing season, the rainy season, the dry season, the hurricane or typhoon season, the hunger season, the streamflow season, etc. Irrigation, air conditioning, heating, refrigeration are examples of societal attempts to circumvent the constraints of nature imposed by the changing of the seasons.

Presentations, Formal and Informal

A wide range of issues was raised for discussion during the meeting. A recurrent topic throughout the 2-day meeting, among the many issues raised, was that of the regional desire for the transfer of water from northward-flowing Siberian rivers to arid Central Asia. While it was supported by a few participants, it was challenged on various political, social, and environmental grounds by several others. Another recurrent theme for discussion centered on the health and inequitable water distribution plight of the inhabitants in the designated Aral disaster zone in general, and in Karakalpakstan specifically. Some of the participants provided papers or made brief presentations to the group to stimulate discussion of the topics listed in the agenda (see Appendix).

Muller (and co-author Johan Gely, 2002) focused attention on the institutional problems related to water resources among the Central Asian Republics of the Former Soviet

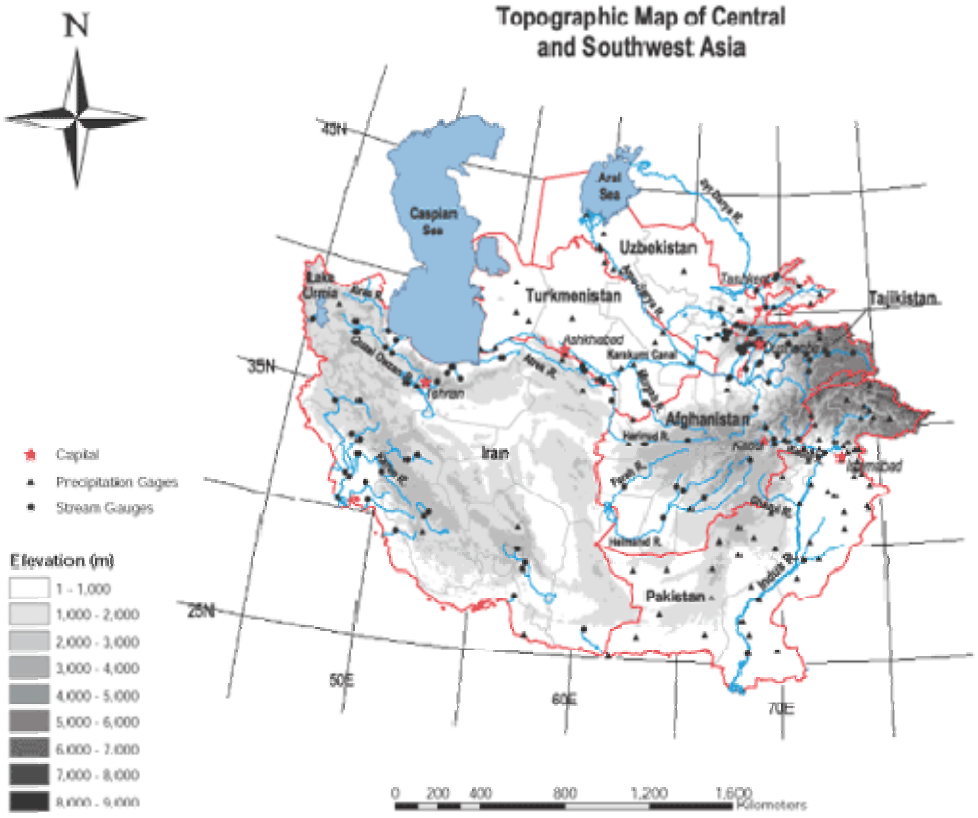
Union. After a decade of independence, the different countries have exhibited varying levels of change and success (or not) in the way they approach water-related problems. Where donors had hoped for regional cooperation, national positions seem to rule, with some limited achievements at the regional level, noting that "for understandable historical and political reasons, perception of a regional water system is seen in a much narrower view by national governments than usually by foreign donors … Dozens of international water conferences had in the last five years hardly any 'touchable' results" (p. 5). The authors concluded by calling for a "new and realistic concept on water management in Central Asia," one that includes consideration of the impacts of future Afghan water demands on the Amudarya (p. 8).

Zonn prepared a brief overview of the water resource situation in northern Afghanistan. He presented information about actual and potential irrigated land in the northern part of the country. Agriculture dominates the Afghan economy, providing a considerable portion of its national income. The sector relies on indigenous, as well as traditional, equipment such as sickles, wooden plows, primitive harrows, etc. Productivity on the irrigated land is higher than on the rainfed areas. During years of war, followed by rule by a repressive regime, existing irrigation networks in the country were destroyed. Zonn noted that there are three categories of rivers in northern Afghanistan, according to their present-day use of water for irrigation. In the first category, there is more land than available water even in wet years (the Hulm, Balkh, Sar-e Pol, and Shirintagao rivers). The water is totally consumed. These river basins would benefit from diversions from the Amudarya, were such diversions to be made.

In the second category, land irrigated from rivers such as the Pyanj, Kowkchen, and Konduz is still available, as are water reserves. He noted that these lands have been irrigated as a result of the construction of diversion dams, a complicated canal system, and pumping stations. The Amudarya is in the third category: its watercourse has very few potential dam sites. "In spite of its ample flow, the waters of this river are used in Afghanistan only for the irrigation of a narrow strip along the river" (p. 8). Drawing water from the Amudarya will require the latest technologies in order to overcome some difficult features of the landscape. Zonn also referred to the potential water reductions that would ensue for the middle and lower reaches of the river in Turkmenistan and Uzbekistan, once Afghanistan lays claim to up to 10 cu km of Amudarya water. It will surely be decided by the representatives and the legal interpretations associated with dividing up a fixed amount of water "fairly" among riparian claimants.

Gogolev presented a brief summary of irrigation in Central Asia, and the role of cotton production in the sharp expansion of irrigation in the desert environment. Historically, nations of Central Asia have developed a tradition of sustainable irrigation, based on limited local water resources, over the several thousand years before Russia came to the region in the 19th century. Russia started preparing virgin lands for irrigation and this process was very active over the 20th century with several slowdowns during the two World Wars. The irrigated area was 2 million ha in 1900, 3.2 million - in 1913, 4.3 million in 1933 and around 8 million ha in 1990. Initially, the crop variety on irrigated lands included cereals, forage, rice and cotton in nearly equal shares. However, in the 1930s the strong demand for cotton made this the predominant crop in the region. Cotton covered 65% of irrigated lands in 1933 and 85% in 1990. The agriculture of cotton

required high doses of mineral fertilizers (NPK - 450 kg per hectare in 1990), intensive application of defoliants and other chemicals. The high rate of irrigation expansion was achieved by implementing cheap irrigation technologies. Even in 1990 after some reconstruction, the fraction of lined canals constituted only 20% in Uzbekistan, 25% in



Kyrgyzstan, about 35% in Tajikistan and only about 15% in Turkmenistan. Almost everywhere, irrigation caused serious environmental problems. The groundwater, initially at 15-20 m depth, started to rise and in 5-20 years the groundwater was at 1-1.5 m depth, bringing up salts historically accumulated in vadose zone (the soil between the groundwater and the ground surface). While cotton requires around 500 - 900 mm of water during the growing season to produce a good yield on most soils, irrigators were applying 2000 - 3500 mm to press the salt down and provide the leaching regime in the soil. To withstand soil salinity (to lower groundwater level and remove leachate), the drainage network was built with an average drain depth 2.0 -3.0 m, a drain spacing of 200-400m with an average rate of 40 m of drain length per hectare in 1990. Next, the need appeared to utilize salty drainage water, full of fertilizers, defoliants, herbicides and other chemicals; this amount was around 45% of the water used for irrigation. Another round of earthworks and construction has been undertaken to build a network of drainage collectors that transferred drainage water to dead depressions in the desert as with Sarykamysh. However, in many places, drainage water has simply been returned to Amudarya or irrigation canals, which resulted in further contamination of these watercourses. As a result of all these controversial activities, some irrigation lands have been reclaimed, however, in 1990, the fraction of salinized soils remained at 49% in Uzbekistan, 12% in Kyrgyzstan, 18% in Tajikistan and 88% in Turkmenistan.

Orlovsky and Orlovsky provided an overview of the climate-water-land use and degradation situation in Turkmenistan, with references to the Karakum Canal and to the concept of the yet-to-be-created "Golden Lake." They concluded that the deterioration of irrigated lands and of ecological conditions adjacent to oases can be better explained by the irrational use of water resources in the Aral Basin in general and the Karakum Canal specifically than by the lack of water. They note that by reducing the existing inefficient and wasteful system of water use, more than 5 to 6 cu km of water can be saved, even in drought years. They raised concern about water quality, noting that "the negative ecological consequences of returning drainage water from the fields to the rivers and desert depressions will be aggravated in the future by ambitious plans of the Turkmen government. They concluded by saying that "it is necessary to consider the decrease of water supply in the future, because of the possible increase of water intake by neighboring states" (p. 17).

Although not participants in the workshop, Hannan and O'Hara (1998) published an informative article about the management problems for operating and maintaining the Karakum Canal. The 1400 km-long canal deserves special attention because Turkmenistan diverts a relatively large share of water, given the size of its population (about 5 million), from the Amudarya. Although there is an agreement between Uzbekistan and Turkmenistan that limits Turkmenistan's withdrawal to about 13 cu km per year, compliance is in no way assured or enforced. More than half the population is dependent on canal water for agriculture, a large portion of which is still centered on cotton production. It is almost totally dependent on this water for the development of its agricultural activities. The canal is unlined and these authors and others report that an estimated 50% of the water in the canal is lost to evaporation, seepage and waterlogging. The buildup of sediment in the canal is recognized as a major problem by all observers, but funds for continual dredging and overall canal maintenance are inadequate. Turkmenistan will require more water in the future but will it be able to take it from the Amudarya? These authors concluded that "the Karakum Canal is in crisis. Every aspect of the system...contributes to problems in its operation and maintenance, a situation that has been exacerbated by the economic and social upheavals that have arisen since independence" (p. 226).

Shadimetov outlined briefly the problems of sustainable development in the Amudarya basin, focusing on the Central Asian Republics with references to Afghanistan. He noted that the "water deficit originated and continues to be aggravated because of the large-scale development of new irrigated areas in the region, conditioned by the rapid and significant growth of the population." He challenged the belief of many representatives of various organizations that "the problem of water deficits in the Aral basin does not exist, and that all the troubles the population in the region face are caused exclusively by "unreasonable economic activities" related to water use. He noted that "the shortcomings of economic activity in the region certainly exist, but they are not the primary reason for the sea drying out." He also referred to the past and future water needs of Afghanistan, reinforcing his main argument: the need for water transfers from Siberian rivers (the Ob and the Irytysh rivers). He summed up by reinforcing the following points: (1) it is necessary to create a special program on the economy of water in Central Asia, with participation of all states of this region and with the support of international organizations (e.g., the United Nations, GEF); (2) improve water resources management in Central Asia and Afghanistan; and (3) develop the conceptual aspects of a coordinated policy on the distribution of water resources in Central Asia.

He suggested that even with the best results of these programs, it is impossible to provide the populations and national economies of this region with adequate water. Recent drought and climatic changes, and forecasts of climatic and ecological developments in the Central Asian region, urgently highlight the necessity of the diversion of a part of the Siberian rivers' flow to Central Asia. It is necessary to undertake this "Siberia-Central Asia" project. Only in this way is it possible to solve the fundamental problems of water deficiency, a stabilization of the social, economic, and ecological situations, the prevention of possible conflicts, and the avoidance of mass ecological migration (ecological refugees), which may lead to unpredictable consequences in the region.

Barlow and Cullen presented a review of the atmospheric and topographic influences on climate in general and the multi-year drought specifically in Central and Southwest Asia. This review is presented in the section below on "The Climate Perspective in Greater Central Asia."

Ye gave the participants an overview of China's interest and growing involvement in Central Asia with the development of the Shanghai Cooperation Organization (SCO). He noted that the organization is made up of China, Russia, Kazakhstan, Kyrgyzstan and Tajikistan and was originally called the "Shanghai Five." They first met in Shanghai in 1996 for the purpose of stabilizing and, to some extent, demilitarizing the more than 7,000 km long shared borders through mutual reduction of armed forces. As border tensions diminished, better coordination in combating the "three evil forces," i.e., religious extremism, ethnic separatism, and international terrorism has become the top priority in the group's agenda. Uzbekistan joined the group in 2001 and the group name was changed to the Shanghai Cooperation Organization. As appointed by Chinese President Jiang Zemin, the organization increases effective cooperation of the member states in political, economic, scientific, technological, cultural, and educational fields. It also seeks to ensure peace, security and stability in the region and to push forward the process of establishing a democratic, just, and rational international political and economic order in this region.

In China's long history, there has been an invisible line (some say wall) based on demographic and natural land features that divides the country into west and east. For example, there is a high population density in the east and a low density in the west; ethnic Chinese inhabit the east and ethnic minorities the west; relative affluence differs between east and west, favoring the east; upper reaches of major water resources are in the west while major in-country downstream users are in the east, and so forth. With the rapid drive toward economic development in eastern China in the past two decades, the gaps between the east and the west on economics, politics, raw materials, levels of development, and ethnicity, have grown. To close these gaps, in 1999, China embarked on a large-scale, multi-billion-dollar and multi-year economic development plan for its western region (which covers 12 provinces, autonomous regions and municipalities). One of the main targets for development is in the Xinjiang Uygur Autonomous Region (e.g., Glantz et al., 2001).

By virtue of its geographic location, Xinjiang is in a very important strategic position for China's national security. It occupies one-sixth of China's national territory, and has a 5400 km border with eight Central Asian countries. There are strong historical, religious, and cultural connections between the ethnic minorities such as the Uighurs and

Kazakhs. After the collapse of the Soviet Union, threats from the religious separatists and terrorists became a major factor in Xinjiang. Therefore, to stabilize the situation in Xinjiang, strong cooperation between China and neighboring Central Asian countries is being fostered by way of a broad range of cooperative activities in military and politic realms, and also in science, technology, education and economy.

O'Lear spoke about four different characteristics of transborder resources and how they might contribute to conflict or cooperation and applied them to the Amudarya water situation. She noted that a growing literature on resources and conflict suggests that several factors can shape whether resources contribute either to conflict or cooperation. One such factor is whether *a resource is diffuse or concentrated* (Auty, 2001). A second characteristic of resources that can influence how they might contribute to conflict is their *"lootability"* (Le Billon, 2001). The *meaning of borders* is also an important consideration when considering the role of transborder resources in conflict or cooperation situations. How and by whom a border was established, if it was imposed or mutually agreed upon, the strength of cultural ties across the border and connectivity across the border in terms of transportation, communication, and shared treaties are all factors of border areas that are important features of inter-state relations related to resources. A fourth factor is *the perceived potential for shared benefits*. For example, the European Coal and Steel Community (ECSC), created in 1951, encouraged the collaborative development of resources for mutual benefit as well as for peace-keeping among several Western European states.

Each of these four factors relates to Central Asian water resources such as the Amudarya river basin. Water is both diffuse and concentrated. Although the Amudarya watershed is diffuse, it is concentrated in terms of control differentiation between upstream and downstream users. The issue here is to discern what kind of benefits or incentives might there be for upstream users to conserve and maintain this water source?

Second, water may be "lootable" in that it can be diverted and that monitoring of water allocation may not be in place. In the case of Central Asia, it will be important to consider the possibility of context-sensitive approaches to overcome free-rider and "tragedy of the commons" situations so that water supplies are distributed in a manner perceived as fair by the users.

Political borders of Central Asian Republics were established during the Soviet era, but it is important to understand what kind of cultural borders may exist in these border areas. It is important to remember that there are different borders in the region such as cultural, religious and ethnic.

Finally, each state participating in water negotiations in the Amudarya river basin may have to surrender a degree of authority to obtain benefits of cooperation. Collaboration of experts in each state must be facilitated, perhaps by an outside agency or state, to encourage data sharing and responsiveness to feedback mechanisms. It will be important to tie incentives to the economy and to quality of life in each state or region, and to encourage equitable water distribution beyond the control of an elite few. The issue of climate change could be a useful starting point for bringing Afghanistan, which borders on the Amudarya, into the Central Asian sphere and into negotiations with potential for peaceful distribution of this resource.

Wegerich provided the following perspective on the water relationship between upstream and downstream users of the Amudarya streamflow: "To analyze the problems of scarcity, the Amudarya has to be viewed in three parts: upstream, midstream, and downstream. In each of these parts, water scarcity differed." He noted that "because of their position in a basin system, downstream users are directly affected by the water use of the upstream users. They are vulnerable to misuse and are dependent on institutions that represent their interest. … In this case, institutions are organizations that are responsible for equal and efficient use of water between the water users." He provided two papers to conference participants entitled *Natural drought or human-made water scarcity in Uzbekistan?* and *Coping with the Disintegration of a River-Basin Water Resource Management System: Multi-Dimensional Issues in Central Asia.*

Sinnott drew attention to and reminded participants about various socio-economic and political constraints on political cooperation in the region. He drew attention to the process of "ruralization" in several of the Central Asian Republics in the 1990s.

Abawi expressed a view supported by all participants, when he called for a shift in focus and emphasis toward effective and equitable management of existing water resources and away from a dependence on the development of new sources of water for the countries in the region, as has been the usual response to water shortages.

Glantz and Zonn presented their perspective on 10 existing myths (or misconceptions) about contemporary environmental and social conditions in the Aral Sea basin. They were meant to stimulate discussion. These myths are listed as follows:

1. The Aral Sea crisis is a global problem.
2. Technology is the answer.
3. Construction of the Karakum Canal was a bad idea.
4. Siberian river diversion to Central Asia is a dead issue.
5. Regional governments placed a high priority on saving the Aral Sea.
6. The Aral crisis is of recent origin.
7. Cotton is THE problem.
8. People care about the plight of the Karakalpak people.
9. Afghanistan, Iran and China have no role to play in the future of the Aral basin.
10. Central Asia is a cohesive region.

Akbar Tursunzod, not present at the meeting, kindly sent two papers to the participants about problems of regional cooperation and water/energy distribution in Central Asia. They were titled as follows: *Problems of Regional Cooperation and Water Distribution in Central Asia* and *Water Shortage in Central Asia: Is There a Way Out Now?*

Afghanistan: Setting as of the Year 2000

"Economy - overview: from www.cia.gov/cia/publications/factbook/geos/af.html Afghanistan is an extremely poor, landlocked country, highly dependent on farming and livestock raising (sheep and goats). Economic considerations have played second fiddle to political and military upheavals during two decades of war, including the nearly 10-year Soviet military occupation (which ended 15 February 1989). During that conflict one-third of the population fled the country, with Pakistan and Iran sheltering a combined

peak of more than 6 million refugees. In early 2000, 2 million Afghan refugees remained in Pakistan and about 1.4 million in Iran. Gross domestic product has fallen substantially over the past 20 years because of the loss of labor and capital and the disruption of trade and transport; severe drought added to the nation's difficulties in 1998-2000. The majority of the population continues to suffer from insufficient food, clothing, housing, and medical care. Inflation remains a serious problem throughout the country. International aid can deal with only a fraction of the humanitarian problem, let alone promote economic development. In 1999-2000, internal civil strife continued, hampering both domestic economic policies and international aid efforts. Numerical data are likely to be either unavailable or unreliable. Afghanistan was by far the largest producer of opium poppies in 2000, and narcotics trafficking is a major source of revenue."

Some Aspects of the Afghanistan Environment

- About 17% of the area of the Aral Sea Basin is in Afghanistan
- Upwards of 90% of the population is dependent on agriculture for its livelihood.
- Two-thirds of the landscape of Afghanistan is occupied by mountainous terrains with little or no vegetation, typical of an arid country.
- Half of the remaining parts of the country's landscape are deserts, which are hostile environments. The rest are farmlands and pastures.
- It is estimated that thirty percent of the farmlands and pastures have been lost either by abandonment or degradation.
- Many forested areas and farmlands were burned and degraded by the use of heavy war technology and chemicals.
- The presence of more than ten million land mines in the country, which makes it the world's most deadly mine field, is the worst environmental nightmare that has been created as a result of constant war.
- Transboundary air pollution is another concern. It receive enormous amounts of pollutants originating from the Aral sedimentary basin, Iran, Turkmenistan, and Uzbekistan's industrial parks.

Discussion throughout the meeting frequently shifted between references to the entire country of Afghanistan and references just to northern Afghanistan. This suggests that there may be a need to think about Afghanistan in terms of regions or sections according to planned phases of reconstruction and development. This suggests focusing first on the *relatively* pacified areas such as the northern part of the country. This part is within the Aral Basin and, as known, is closely tied to the ethnic groups in neighboring countries. Reinforcing this idea, which might understandably be favored by Uzbekistan, Tajikistan and Turkmenistan, one participant remarked that: "only those in northern Afghanistan drink Amudarya water," meaning that in planning the future use of Amudarya water only those areas in the basin should be considered for a share of water. However, what might seem to make sense from a long-term economic development planning point of view may not make political sense from the perspective of the national Afghan government or from the perspective of other governments in what one might call, for lack of a better term, the Greater Central Asian region.

Is there a need to redefine what is encompassed by the term "Central Asia"? In the late 1980s, the five Central Asian republics that were once a part of the Soviet Union were referred to as the Central Asia Republics (CARs) and Kazakhstan. In the early 1990s, the term Central Asia was expanded to include Kazakhstan. Today, we refer to the five CARs and Afghanistan. Is Afghanistan a part of Central Asia or is it in Southwest Asia along with Iran and Pakistan? Can western China in general and Xinjiang Province in particular be included in a Greater Central Asia? How would the region best be delineated: by topography (i.e., by river basin), by former political status (i.e., having been part of the FSU), or by current regional or global political realities that would identify functional as well as geographic involvement in the region?

The Climate Perspective in Greater Central Asia

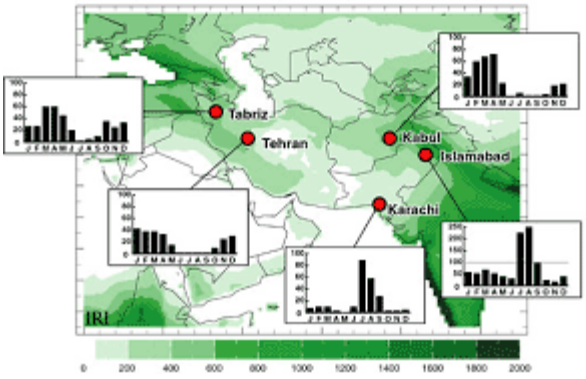
There is an increasingly popular environmental notion that merits repeating here: "We all live downstream." That refers to the likelihood that each of us and each country is dependent on someone or something that has influence of some sort on its future well-being. This notion is easy to visualize when referring to the quantity and quality of streamflow in a watercourse or to air pollution's downwind effects on society and environment. Even the air polluters are downwind of some other polluting source, the message being that we must be sensitive and care about potential adverse downwind and downstream impacts of our activities. This of course raises the precautionary principle's "do no harm."

In the greater Central Asian context, Afghanistan, Tajikistan, Kyrgyzstan and China (the sources of the Amudarya and the Syrdarya) are upstream as far as the Aral Sea basin is concerned. But they too are downstream to carry the notion further. Their rivers that contribute water to the inhabitants of the region are downstream of the climate system. Variations in the climate on a seasonal and interannual basis have disrupted settlements for centuries, and they continue to do so as shown in the recent multi-year drought. A climate change as suggested by various national and international reports would bring about permanent, most likely adverse, changes in the region's water supply. It is time to bring climate into the discussion when we raise the notion "that we all live downstream" in order to draw attention away from an overfocus on the short term water problems and increase attention on the long term to enhance planning for the future.

Barlow and Cullen (2002) have written the following overview:

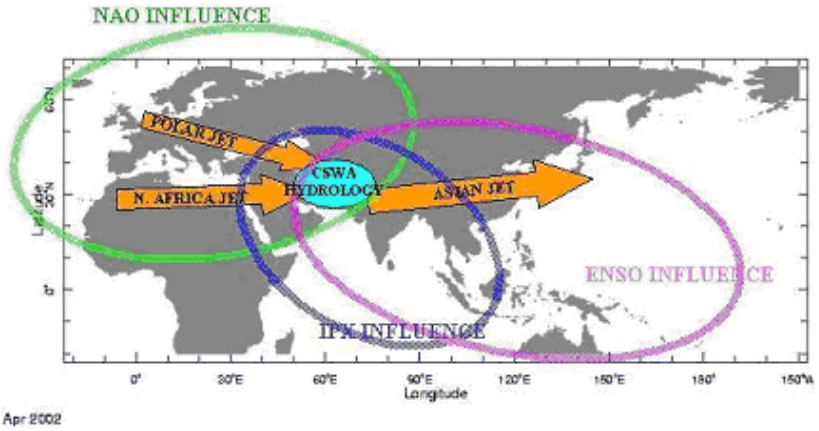
> The climate of Central and Southwest Asia ranges from steppe to desert, with large areas of the region receiving little to no precipitation. The distribution of annual precipitation is shown in this figure, with the annual cycle given for representative stations. In Iran and Afghanistan, the precipitation primarily falls from winter storms moving eastward from the Mediterranean, with the high mountains of the region intercepting most of the water and the interior high plains left with large stretches of barren desert. Precipitation in wintertime generally occurs between November and April, with the peak between January and March. Much of the precipitation falls as snow in the higher elevations, and the timing and amount of snowmelt is an important factor in the irrigated agriculture prevalent in the region. In eastern Pakistan, the primary rainfall season is

summer, associated with the northernmost advance of the Asian monsoon, which results in a summer time maximum in precipitation in the northern mountain regions of Pakistan but generally suppresses rainfall over Iran and Afghanistan. Dust storms occur throughout the year in the desert high plains. Such storms are prevalent through much of the region in summer, often associated with what has been referred to as the "wind of 120 days," the highly persistent winds of the warm season which blow from north to south.



As of Spring 2002, Central and Southwest (CSW) Asia comprise the largest region of persistent severe drought in the world, with devastating societal and environmental consequences. Recent research has suggested the possibility for seasonal predictability in the region, through an apparent relationship between the development of the drought and climate variability related to the El Niño - Southern Oscillation (ENSO). Other studies have documented links between the region and large-scale climate variability: ENSO links have been documented in Iran, and a North Atlantic Oscillation (NAO) influence has been noted for the Tien Shan mountains in Central Asia. Preliminary analysis of station data for precipitation over the last 140 years (Kaplan et al.'s analysis of the global historical climatology network (GHCN) station data) suggests notable interannual variations in regional precipitation (Kaplan et al., 2001). However, data availability in this region creates challenges in interpretation of results.

The large-scale influences on climate in the region can generally be depicted as shown in the following diagram:

A  NOAA-

supported regional Climate Outlook Forum (COF) for this region, structured along the lines of previous COFs that have been convened in other parts of the globe, will be held early in 2003 at a location yet to be determined. The countries to be represented are also yet to be determined. However, the Central Asian COF will surely include representatives of the 5 Central Asian Republics and Afghanistan. Other potential participants may be drawn from Pakistan and Iran, among others. A big question mark exists, however. In such a regional (Central Asian or Greater Central Asian) COF, who would participate from Afghanistan? We know that there already exists (to varying degrees) climate and climate-related human capacity in Turkmenistan, Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan. Perhaps it would be useful to have in advance of the regional COF a smaller national outlook forum that involves only representatives from various climate-related socio-economic sectors in Afghanistan, an Afghan COF. This would enable those who plan to organize such a regional forum to identify the appropriate participants from Afghanistan to the larger COF. Recently, the Permanent Representative of Afghanistan visited the World Meteorological Organization and the meteorological services of France and the UK in order to identify support for rebuilding his country's national meteorological service. Apparently, there is no functioning meteorological service and it needs to be rebuilt literally from the ground up. A WMO-sponsored technical support team will visit the country to identify needs and priorities. A small COF focused on Afghanistan would help the Afghans immensely at this point in time.

Water Law, Regulations, and Institutions in the Aral Basin

Sergei Vinogradov and Vance Langford (2001) published an excellent up-to-date review of political and legal issues related to transboundary water resources in the Aral Sea Basin with a focus on the five Central Asian Republics. Their article provides insights into the legal aspects of transboundary water issues in the region, alluding to Afghanistan and noting, for example, that "Other geopolitical considerations, particularly with respect to Afghanistan require further attention" (p. 359) and that "not only do the five Central Asian republics have major economic and human interests at stake, but Afghanistan, China, Iran and Russia also have direct interests in the regional environment and transboundary water resources" (p. 345). The following abstract (p. 345) prepared by the authors summarizes their informative paper:

> This paper examines the complex problems facing the Central Asian republics in the Aral Sea Basin. Confronted with unsustainable economic practices, environmental degradation and serious social problems, the Aral Sea Basin states seek to develop an effective legal and institutional framework for the cooperative management of scarce water resources. Up to date information on the environmental, economic and human conditions in the Aral Sea Basin provides the context for an analysis of efforts to manage transboundary water resources in the Soviet period and among the independent republics. The most recent draft agreements and initiatives among the Aral Sea Basin states are reviewed from the perspective of legal and institutional effectiveness, with reference to the principles of international water law. Finally, recent attempts to meet the needs of all riparians through trade in natural resources are viewed as a promising development. This strategy could provide solutions based on a

more holistic approach to natural resources, while recognizing the historical, geopolitical, and natural characteristics of the region.

Groundwater as a Resource in Central Asia

The role of groundwater in the pandemonium of the region's environmental problems has been briefly described above by Mr. Gogolev. These problems pertain to the upper layer of groundwater. In all countries and many regions of Central Asia, groundwater constitutes a resource of fresh water that is comparable or exceeds surface waters. Fresh water is stored in the sand and gravel aquifers protected by clay layers from the contaminated and salty groundwaters of the upper part of geologic profile. This renewable resource can be effectively utilized with groundwater wells which may, particularly, work as artesian wells in the lower parts of mountain slopes and mountain valleys. In Soviet times, groundwater resources were explored for the purpose of irrigation. Although they proved to be abundant, the primary focus was placed on the use of surface water.

Given the current pre- and already- catastrophic water and environmental situation, Soviet politicians could be praised for that decision. Groundwater resources were reserved and now can be used in dry years for public water supply in many areas. This resource may have special importance in case of confirmed further climate aridization in the region. A related question is what will be the impact of climate change on the groundwater resources, which are mostly renewable under current climate conditions.

The "Other" River Basin - The Syrdarya

There are two major rivers in Central Asia (three, if you count the Karakum Canal), the Amudarya and the Syrdarya. The Syrdarya River basin runs through the territory of Kyrgyzstan, Uzbekistan, Tajikistan and Kazakhstan before it makes its way to the little Aral Sea, the northern part of the Aral Sea. While its flow is not as large as that of the Amudarya, its waters are equally as precious, overused, polluted and in demand, generating its own set of political problems among its subset of riparian states. For example, upstream-downstream conflicts are similar to those in the Amudarya; Kyrgyzstan needs energy in winter and downstream states need water for irrigation in the summer. Political and economic disagreements have emerged between, for example, Kyrgyzstan and Uzbekistan and Kyrgyzstan and Kazakhstan over equitable exchanges of water needs downstream and energy needs upstream. Agreement has recently been reached for the 2002 and first part of 2003 between Uzbekistan and Kyrgyzstan, according to Aibek Moldogaziev, visiting scholar to the Central Asia and Caucasus Institute at Johns Hopkins University. According to Moldogaziev (2002), "there are no guarantees that in this coming winter the Uzbek side will not cut off natural gas deliveries again and that the Kyrgyz side will begin to discharge the water from its reservoirs to get more electricity during winter time. As a result, Uzbekistan and Kazakhstan will not get enough water for their needs." The important point to note is that the Central Asian Republics, collectively speaking, are dependent on the flow of two major rivers (plus the Karakum Canal) for their long-term survival. Upstream-midstream-downstream issues will strongly influence the way these states interact, through cooperation, litigation or conflict.

Wegerich provided a paper to the participants that focused on resource management isues in the Syrdarya Basin. The abstract of that paper is as follows:

> *Coping with Disintegration of a River-Basin Management System: Multi-Dimensional Issues in Central Asia* (Kai Wegerich, wegerich@yahoo.com)
>
> In 2001, the Central Asian states celebrated ten years of political independence. The foregrounding of political independence allowed a backgrounding of historical and geographical interdependence. Prior to 1991, during the Soviet era, Central Asia was unified: national boundaries were only administrational. The Soviet system focused on the geographical boundaries of Central Asia and managed the environmental resources according to these boundaries. The Central Asian countries were tied together through the management of different resources such as water, energy, and food products. Even though after independence the interdependence on resources continued, the national strategies began to focus on the sovereignty of the new nation states. This strategy led to a deterioration of the resource linkages, which destabilized upstream and downstream states and their economies.
>
> Prior to independence, water was managed as a common pool resource. After independence, the old water allocations to the individual countries were confirmed through contracts. However, prior to independence, water, energy, and food products were linked, this linkage broke down and caused conflicts between upstream and downstream water users. In addition, because of the Soviet focus on natural boundaries, water management structures (such as dams and reservoirs) are located in the territory of the upstream countries. However, the beneficiaries of these structures are the downstream countries. The contracts between the riparian states focused on water allocations, but they did not incorporate the water management structures. In recent years, new conflicts are rising about the operation and maintenance costs of these management structures, which are currently the responsibility of the upstream states.
>
> The example of the Syrdarya basin shows that the focus on agreements over water allocations alone has not led to stability and security. In the case of the riparian states of the Syrdarya, a more complex solidarity incorporating water, energy, and agriculture is needed. The scope would be similar to that of the Soviet period. But the style would have to be different. The new integration would have to be based on the principle of economic efficiency and environmental stability. ***Water cannot be separated from other sectors. It is part of a larger framework of interdependence.*** In addition, the recent disputes over operation and management of the dams and reservoirs emphasize the need to ulitize a joint "riparian" approach for cost sharing.
>
> Hence, along theSyrdarya, water treaties have to incorporate energy treaties as well as treaties on agricultural production and operation and

maintenance costs. Only an issue linkage can create stability for the whole basin.

Water Resources Outside the Basin

The major potential source of additional water to the region is in Siberia. A Siberian river diversion project had been proposed several times from the 1960s to the 1980s. Various Soviet scientists opposed it on environmental grounds. Planning for it was finally terminated by Gorbachev in the mid-1980s. Many observers considered This decision to have been the death knell for the project. However, following three consecutive years of severe drought and cumulative rainfall deficit in Central Asia, the idea to transfer water from northward flowing Siberian rivers to Central Asia reappeared and has gained some support, emanating not only from Central Asian leaders but from within Russia as well. Insarova (2002) has written that "the project would involve channeling six percent of the flow of the Ob to Central Asia along a new canal, running through Kazakhstan to Karakalpakstan, in Uzbekistan, where the water shortage is most severe." One argument made in support of the diversion is that it would take water from a flood-prone region and transfer it to areas that are perennially arid. This would convert a climate hazard in one place (Siberia) to a climate resource in another (Central Asia). The idea is to transfer about 27 cu km per year to Central Asia, or 37 cu km per year if Afghanistan takes a larger share than at present of Amudarya water. Of course, Uzbekistan and perhaps some of the other Central Asian states would prefer even larger water transfers, but are settling on an amount that might be feasible to potential donors.

There is still no assurance that agreement would be reached to undertake such a water transfer over a 2500 km pipeline. Yet, the possibility does raise other issues: If water were to be transferred, for what purposes would it be used: irrigation or municipal and rural water supply? If transferred, how would the transfer be engineered? If the same wasteful practices are pursued as were used in the region under the FSU, then it would be better not to undertake the transfer (better not to repeat the same mistakes). An important consideration is whether the new geopolitical situation in Greater Central Asia changes the prospects for support for such river diversions.

The resurrection for discussion of the Siberian river diversion scheme suggests that governments and development specialists tend to focus primarily on natural constraints for development in the region (several of which are climate-related) and technological fixes to overcome or remove them. In this case the constraints are the limitations imposed by the apparent dwindling supply of water to each of the countries in the region. Is there a need at the same time for more focus on restraints on water-related human activities in the region? As Abawi suggested earlier, is it more important at this point in time to focus attention on improving the management of existing water resources of the Amudarya and less so on seeking new water resources from outside the basin?

Questions were raised about the water transfer proposal. Would the same engineering methods be used in this water transfer that have been used in Central Asia in the past, that is, unlined canals that allow for water seepage into the soils and the resultant waterlogging of land within several kilometers on both sides of the canal? What would the water be used for, domestic consumption or irrigated agriculture for food or cash crop production? Should water be transferred before water efficiency is improved in the

region? Who would finance the development of the scheme? Would such a transfer generate new instabilities and political relationships in greater Central Asia? How would the water being transferred be paid for? Would the transferred water be used to address inequities in current distribution within and among Central Asian countries?

SWOC and Greater Central Asia

The United Nations Development Programme (UNDP) uses a SWOC (strengths, weaknesses, opportunities and constraints) methodology to assess human activities and their impacts on the environment. SWOC methodology, of course, is only one approach to identify what institutions and processes work well in any given situation. Different assessments rely on a variety of methods.

Format for SWOC analysis:
For improving the water situation in Central Asia and Afghanistan

Region	Strengths	Weaknesses	Opportunities	Constraints	Remarks
Aral Sea					
Central Asian Basin States					
Afghanistan					
Amudarya Basin					
Karakalpakstan					

In this case, some participants attempted to use of the SWOC notion in an anecdotal unsystematic way to assess climate- and water-related activities in the Amudarya Basin, hoping that it might expose some missed opportunities or constraints. The SWOC chart for greater Central Asia is in the appendix of this report.

The recent multi-year drought in Central and Southwest Asia (i.e., Greater Central Asia) has made the fear of the impacts of climate change in the region a real concern, as opposed to just an academic or speculative exercise. This prolonged drought rivals the magnitude of such episodes earlier in the century and is exacerbated by the relatively rapid disappearance (by 40% in recent decades) of the glaciers in the Pamir mountains, glaciers that feed the flow of the Amudarya. These climate factors have caused governments in the region, especially Uzbekistan, to project their likely water needs and demographic changes decades into the future. The IPCC (Intergovernmental Panel on Climate Change) reports provide researchers and policy makers with a glimpse of potential problems that might lie ahead with a global warming of 1-2° Celsius a few decades from now. More specifically, the 1998 IPCC Working Group II report on vulnerability to climate change (Watson et al., 1998) contained a section on climate change impacts on ecosystems, water resources, food and fiber, and health. These

topics are of interest to this workshop. The report contains a "Summary for Policymakers," which follows, focused on Arid Western Asia (Middle East and Arid Asia).

Global Warming, Population Increases, and Water

In an arid environment, even small population increases can have adverse impacts on the environment and place extreme pressure on the region's limited natural resource base. In such areas, rainfall is known to be highly variable in time (especially year to year and decade to decade) and in space. In arid areas, precipitation is skewed to dryness, with a few above-average events being balanced out by a larger number of below-average conditions. Often in such areas there is a tendency to expand human activities following a few years of good precipitation and streamflow into what would normally be viewed as harsh environments. Those expansions are usually later constrained, if not rolled back with negative environmental consequences, when there has been a diminution of climate-related resources, regardless of natural or anthropogenic cause. Thus, what is a resource in the short term can generate precarious situations in the mid- to long term. The above comments take into account only climate variability, climate fluctuations, and extreme climate episodes. They do not take account of the likely prospect of global warming of the Earth's atmosphere and the impact of global warming on the behavior and characteristics of these climate conditions.

Considerable international attention and research has in the 1990s been focused on growing scientific concern that the Earth's climate is warming up and that it may be due in part to human activities (fossil fuel burning, tropical deforestation, land-use practices and chemical emissions of various kinds). Central Asian republics have been actively engaged in climate change assessments for their region.

> This region includes the predominantly arid and semi-arid areas of the Middle East and central Asia. The region extends from Turkey in the west to Kazakhstan in the east, and from Yemen in the south to Kazakhstan in the north. The eastern part of the region has a large area dominated by mountains.
>
> *Ecosystems:* Vegetation models project little change in most arid or desert vegetation types under climate change projections i.e., most lands that are deserts are expected to remain deserts. Greater changes in the composition and distribution of vegetation types of semi-arid areas for example, grasslands, rangelands and woodlands are anticipated. Small increases in precipitation are projected, but these increases are likely to be countered by increased temperature and evaporation. Improved water use efficiency by some plants under elevated CO2 conditions may lead to some improvement in plant productivity and changes in ecosystem composition. Grasslands, livestock and water resources are likely to be the most vulnerable to climate change in this region because they are located mostly in marginal areas. Appropriate land-use management, including urban planning, could reduce some of the pressures on land degradation.
>
> *Hydrology and Water Resources:* Water shortage, already a problem in

> many countries of this arid region, is unlikely to be reduced, and may be exacerbated, by climate change. Changes in cropping practices and improved irrigation practices could significantly improve the efficiency of water use in some countries. Glacial melt is projected to increase under climate change, leading to increased flows in some river systems for a few decades, followed by a reduction in flow as the glaciers disappear.
>
> *Food and Fiber Production:* Land degradation problems and limited water supplies restrict present agricultural productivity and threaten the food security of some countries. There are few projections of the impacts of climate change on food and fiber production for the region…. The studies, however, are too few to draw strong conclusions regarding agriculture across the entire region. Many of the options available to combat existing problems would contribute to reducing the anticipated impacts of climate change. Food and fiber production, concentrated on more intensively managed land, could lead to greater reliability in food production and reduce the detrimental impacts of extreme climatic events. Countries of the former Soviet Union are undergoing major economic changes, particularly in agricultural systems and management. This transition is likely to provide opportunities to change crop types and introduce more efficient irrigation, providing significant win-win options for conservation of resources to offset the projected impacts of climate change.
>
> *Human Health:* Heat stress, affecting human comfort levels, and possible spread in vector-borne diseases are likely to result from changes in climate. Decreases in water availability and food production would lead to indirect impacts on human health. Malaria is an endemic climate-related health problem in various parts of greater Central Asia.
>
> *Conclusions:* Water is an important limiting factor for ecosystems, food and fiber production, human settlements and human health in this arid region of the world. Climate change is anticipated to alter the hydrological cycle and is unlikely to relieve the limitations placed by water scarcity upon the region. …Win-win opportunities exist which offer the potential to reduce current pressures on resources and human welfare in the region and also offer the potential to reduce their vulnerability to adverse impacts from climate change.

In addition, the 1998 IPCC report noted the following comments (p. 242): "Water from glacial melt is an important contribution to the flow of some river systems, and changes in seasonality and amount from this source are likely to occur as a result of climate change"; "Populations in many countries of the region are vulnerable because they depend on water supplies from outside their political boundaries."
In the Amudarya Basin, one can identify several kinds and levels of change (i.e., degradation) in water quantity and in soil, water, and air quality. A question arose as to whether identifying hotspots and flashpoints in the region might help to better identify for national leaders early warning of worsening regional environmental changes, providing them with enough lead time to take appropriate action if they choose to do so.

Flashpoints and Hotspots

"Flashpoints" is one of a range of changes along a continuum, which can be represented graphically as a pyramid. The base of the pyramid represents land transformation, that is, land that is being converted from its natural state to one of use by society. This could include, as examples, the development of an irrigated plot of land in an arid area. No harm is done to the environment in general, because the scale of human intrusion is low.

The next level up the pyramid represents areas at risk or areas of concern (AOCs), regions in which human activities (or climate change of some duration) have adversely affected the ecosystem to the point of endangering its survival or generating a major ecological shift. For example, irrigating an arid or semiarid area improperly (e.g., poor drainage) can lead to the salinization of soils or waterlogging. Considerable care must be taken to avoid such outcomes. As the number of irrigated farms increase in a given area, the productivity and long-term sustainability of the irrigation practices begins to be questioned. Indicators have to be identified so that human use of arid ecosystems that support it can be sustained over long periods of time.

Hotspots are situations in which human activities interacting with environmental processes have reached destructive levels. While many of those activities continue to be carried out, they do so with less efficiency and effectiveness and with increasingly destructive impacts on the environment. Up until now, the indicators used (whatever ones were chosen by the monitoring agents) serve as an early warning system of sorts, allowing ample time for decision makers to take steps to mitigate or avoid additional problems that might stem from the interaction between human activities and environmental processes in relatively fragile arid areas. The transition into flashpoints is different, however.

Flashpoints encompasses the range on the continuum in which decision and policy makers are placed in a truly crisis decision-making mode. They have a short time to act before a catastrophe of some sort occurs, the stakes of inaction are high, and the threat to a valued good is perceived to be high as well. Identifying climate-related flashpoints can be useful for decision makers to accelerate their decision-making processes to avert transitioning into the next stage, the firepoint, where there are likely to be critical and irreversible changes in the region of concern. The time to act is short, and the potential costs for decisions are perceived to be high. Flashpoints serve as the last early warning that decision makers will get before the likelihood of irreversible, unwanted change in environment or in society.

Flashpoints can be identified based on existing environmental degradation in different types of ecosystems, political conflict, ecological fragility, societal vulnerability, or situations that are in unstable equilibrium. Climate-related flashpoints refer to climate anomalies or climate or weather extremes that can disrupt human activities, environmental processes and the processes that involve the interaction between society and the environment. (For more information, see the Flashpoints Informal Planning Meeting website at www.esig.ucar.edu/flash)

Defining Sustainable Development

According to the International Institute for Sustainable Development (IISD) (sdgateway.net/introsd/definitions.htm),

> Sustainable development means different things to different people, but the most frequently quoted definition is from the report *Our Common Future* (Bruntland, 1987): "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."
>
> Sustainable development focuses on improving the quality of life for all of the Earth's citizens without increasing the use of natural resources beyond the capacity of the environment to supply them indefinitely. It requires an understanding that inaction has consequences and that we must find innovative ways to change institutional structures and influence individual behavior. It is about taking action, changing policy and practice at all levels, from the individual to the international.
>
> Sustainable development is not a new idea. Many cultures over the course of human history have recognized the need for harmony between the environment, society and economy. What is new is an articulation of these ideas in the context of a global industrial and information society.

A participant from Central Asia suggested a definition based on the region: "the term 'sustainable development' under conditions of Central Asia means the ability of respective states and their governments to provide fellow citizens with primary items of need such as access to food, drinking water, health services, and secondary education (from the ages of 7 to 17). It also means the ability of respective countries to maintain the ability and protect the available resources of the state to meet demands of the growing population for the above-mentioned items in coming years (with 20 years as a planning time frame)." The level of achievement toward sustainable development varies greatly from country to country in the region. True achievement can be accomplished only through joint actions taken on a regional basis.

One can then, using this definition or, for that matter, any one of the numerous definitions of the concept, evaluate the overall situation as well as specific human activities in the Amudarya basin or more generally in Central Asia, in order to identify which practices and activities are and have been sustainable in the long term as opposed to those that have not been sustainable. One attempt to undertake such an assessment can be found in *Creeping Environmental Problems and Sustainable Development in the Aral Sea Basin* (Glantz, 1999).

What, then, are the foreseeable prospects for sustainable development in the Greater Central Asia area? It would be quite useful for researchers, funding agencies, NGOs and national and international policy makers to apply the "Areas of Concern (AOCs)-hotspots-flashpoints-firepoints" idea to Central Asian water, climate, and socioeconomic and political issues. This would help to develop a Central Asian "hotspots" map such as the one that has been developed by the US-Canadian International Joint Commission (IJC) for the North American Great Lakes region.

The following three theorems are from the work of the economist Kenneth Boulding (1971). These theorems are based on the writings of Malthus in the late 1700s.

The Dismal Theorem
"If the only ultimate check on the growth of population is misery, then the population will grow until it is miserable enough to stop its growth."

The Utterly Dismal Theorem
"Any technical improvement can only relieve misery for a while, for so long as misery is the only check on population, the [technical] improvement will enable population to grow, and will soon enable more people to live in misery than before. The final result of technical] improvements, therefore, is to increase the equilibrium population which is to increase the total sum of human misery."

The Moderately Cheerful Form of the Dismal Theorem
"Fortunately, it is not too difficult to restate the Dismal Theorem in a moderately cheerful form, which states that if something else, other then misery and starvation, can be found which will keep a prosperous population in check, the population does not have to grow until it is miserable and starves, and it can be stably prosperous." Boulding continues, "Until we know more, the Cheerful Theorem remains a question mark. Misery we know will do the trick. This is the only surefire automatic method of bringing population to an equilibrium. Other things may do it."

Karakalpakstan and Water, Health, and Demographic Changes

Karakalpakstan is an autonomous region within the Republic of Uzbekistan. The Karakalpak people are ethnically different from Uzbeks. The Karakalpak population is estimated at about 1.5 million. They inhabit the lower reaches of the Amudarya and the southern and western part of the area surrounding the receding Aral Sea. Because Karakalpakstan is at the tail end of the Amudarya, it received all of the pollution that has been accumulated in the river on its way to the sea. The commercial fishing industry in Karakalpakstan disappeared, as the sea receded and especially as it became increasingly polluted. The health statistics (morbidity and mortality data) for the population collectively reflects the poor and still deteriorating health of the people downstream. With the river's waters being fully exploited in the upper and middle reaches of the Amudarya, little water makes its way to its once-productive deltaic area. Thus, the Karakalpak have been suffering for much more than a decade and that suffering has intensified in recent years.

The multi-year drought in the region that began in 1999 made a very bad situation even worse for the inhabitants in the lower reaches of the river, i.e., those living in "the disaster zone" near the sea. As a result, in 2001 cotton production in Karakalpakstan was only about 25% of the norm and rice production was only 0.25% of the norm. Also in the past 12 years since the breakup of the Soviet Union, an estimated 273,000 people or 20% of the population had to leave Karakalpakstan for Kazakhstan and Russia, among other locations.

Water Scarcity in the Lower Amudarya (These paragraphs were prepared by Kai Wegerich)

In the year 2000 and 2001, Central Asia was hit by a drought. While the Deputy Agriculture Minister of Uzbekistan called the first drought the "worst in 95 years" (Deputy Agriculture Minister Abdurakim Dzhalahov in www.CNN.com, 2000), the second drought was even more devastating. Reports indicate that the water scarcity in Uzbekistan and Turkmenistan was worse in the downstream regions of the Amudarya Basin, Khorezm (Uzbekistan), Dashoguz (Turkmenistan) and the Republic of Karakalpakstan (Uzbekistan).

Consequences of water scarcity

The consequences of the downstream water scarcity were devastating. Data collected from flow measuring stations show that of the three downstream regions Karakalpakstan, which is the furthest downstream, suffered the most. Hence, in the following description of the consequences Karakalpakstan is the focus.

Large roadside billboard in Nukus, Karakalpakstan lamenting the death of the Aral Sea. 1995, photographed by M.H. Glantz

At a workshop on climate change in Central Asia, the president of ECOSAN stated that officially 100,000 people in Karakalpakstan were unemployed as a direct result of the drought. However, there is also hidden unemployment. Because of the lack of water, collective farms were unable to plant. The farmers on these farms are still officially employed, even though the collective farms are not producing. In addition, the drought not only affected agricultural production, but also reduced the available water for rural households, which depend on water from the irrigation system. In the downstream districts of Karakalpakstan, irrigation water allocated to villages is barely enough for human consumption.

Consequently, in these villages the water allocated to livestock had to be cut completely. As a result of the water scarcity, people have left the farms for better opportunities in other regions. OCHA states that the drought has "led to limited population movements from the most affected

areas to other parts of Uzbekistan, as well as across international borders to Kazakhstan and the Russian federation." (OCHA No .2, 2001). Romanova (2001) claimed that, "entire villages began leaving northern Karakalpakstan."

There have been conflicts between upstream and downstream districts in Karakalpakstan, as well as the three downstream regions. The disputes are taken seriously. During the drought, government officials protected upstream pumping stations within Karakalpakstan to ensure water sharing between upstream and downstream users. In addition, the water stress has negative effects on the environment. During the time of water scarcity in the lower Amudarya basin, all available water is used, leaving no water for the environment. This is not only the case for the Aral Sea, but also for smaller lakes such as the Sudoch'e lake in Karakalpakstan. These lakes have been used after the desiccation of the Aral Sea as a substitute resource for migrating birds.

Upstream versus downstream

If one takes the water storage of reservoirs in the Amudarya Basin as an indicator of the reduced water availability, then it becomes evident that the water scarcity differed between upstream and downstream.

The Amudarya has two water reservoirs, the Nurek reservoir upstream in Tajikistan and the Tuyamuyun reservoir downstream in Uzbekistan. The Nurek reservoir stored in the end of May, June and July 2000: 6611, 7081 and 8048 mcm, respectively, and in May, June, and July 2001; 6309; 7854 and 9678 mcm, respectively. The average for the last five years was 6817, 7779 and 9418 mcm for the same months. Hence in 2000 the drought reduced the stored water in the Nurek reservoir only by approximately 10 percent, and in 2001 the available water was more than average.

On the other hand, the Tuyamuyun reservoir was at a level of 2570, 1921, and 1914 mcm in May, June and July 2000, and in the same months in the year 2001 at a level of 1872, 1912, and 1779 mcm, respectively. The average water storage for the three months was at 3865, 3688 and 3854 mcm. According to the figures of Tuyamuyun, the water level was in the year 2000 approximately down to 50 percent, and in the year 2001 down to 40 percent of the average level. The data from Nurek and Tuyamuyun show that the extreme water shortages downstream have not been caused by the drought alone. One reason for the downstream water scarcity is based on weak river management institutions.

Weak river management institutions

Prior to independence, a river basin organization (the BVO) was created to control the flow of the Amudarya and the water distribution among the

different riparian states and their provinces. After independence, the riparian states agreed to continue with the Soviet water allocations and to keep the BVO. However, since independence the institutional arrangements have been constrained by weak political commitment and cooperation. This is due to the fact that the BVO is "not recognized by national legislatures and therefore lack legitimacy and authority" (O'Hara quoted in Horsman, 2001). This is confirmed by Renger, who states that "the national water ministries are very reluctant in handing over diversion schemes to the BVOs. They often intervene in water distribution and operation of the water scheme." (Renger, 1998, p.12). The lack of authority undermines water basin management approaches and equal and efficient water distribution among the riparian users. Even though the BVO allocates water to the different riparian provinces equally, the lack of authority has as a consequence that water diversion at each intake varies little from year to year. Hence, during the drought the upper riparian regions in Uzbekistan and Turkmenistan used more water to compensate for their own water shortages. Consequently, the upstream regions were less affected in their water use by the drought, and the water shortages of the drought have been moved downstream. The drought shows that equal water distribution among the riparian users is only possible when the institutional framework is strengthened.

The Aral Sea

"Should we forget about the Aral Sea, because it will not be rehabilitated" is a question that was posed by a participant. In retrospect, it is interesting to note that the Aral Sea itself had not been selected a central topic for discussion at the meeting, even though it is a part of the Amudarya basin that has been the most visible to observers around the globe since the mid-1980s. The decline in the level of the sea has been symbolized by the photos of the rusting fishing vessels stranded on the dried sea bed. The other notable fact that identifies the plight of the sea and the communities in Karakalpakstan dependent on it is the fact the fishing port of Muynak is now more than 150 km from the present location of the Aral shoreline. At a heads of Central Asian States meeting in Nukus (Karakalpakstan, Uzbekistan) in 1995, plays and poems were presented to the participants that were already lamenting the disappearance of the sea. Culturally speaking, the people in Central Asia were beginning to acculturate the loss of the sea, once the fourth-largest inland sea on Earth. Zonn has prepared a bibliography on The Aral Sea (Zonn, 2002).

Afghanistan and Recent Events

The influence of the fall of the Taliban regime on Central Asia states has been significant. This issue was raised in response to a question by Peter Sinnott about which of the Central Asian states have strong alliances with others in the region. One

immediate benefit of the change of government in Afghanistan has been reduced concerns about immediate threats from Islamic fundamentalists. It appears that with the ouster of the Taliban regime, national fundamentalist movements have been weakened, as they had lost their base of operations. These republics have shown a willingness to cooperate and have recently created (December 2001) the Central Asia Cooperation Organization.

In addition, the northern part of Afghanistan is the home to Uzbek and Tajik Afghans. Thus, these neighboring countries appear to have more interest in the northern third of the country. Relatively speaking, this part of Afghanistan appears to be more pacified in the post-Taliban period than the other parts of the country, although regional political rivalries remain a threat to stability throughout the country.

Rebuilding Afghanistan requires "walking on two legs." This means the simultaneous rebuilding of the physical infrastructure and the rebuilding of the adaptive and human capacity. This is as valid for Afghanistan's national meteorological service as it is for other ministries. However, one must ask — What is the level of "absorptive capacity" in Afghanistan; that is, how much assistance can the country absorb and over what time period? What is the appropriate amount of aid to Afghanistan, given its present-day limited absorptive capacity? Afghan capacity can be built outside of Afghanistan as well as within it. What is going to be the role of the ex-patriates in rebuilding absorptive capacity?

The American-led coalition against the Taliban and its Al-Qaida ally in Afghanistan has apparently raised some political concerns among other countries bordering Central Asia (such as Iran, Russia, China, Pakistan) about long-lasting American influence (and military presence) in the region. One manifestation of this concern is the aforementioned Shanghai Cooperation Organization.

> It is understood, however, that hard-line elements in Beijing, including military officers, have raised vehement objection to an American presence in these countries, which are in China's northwestern backyard. A CNN news article reported the following: Western diplomats in Beijing said the Jiang leadership was trying to counter American influence in the region by resuscitating the Shanghai Cooperation Organization (SCO). A high-level meeting of leaders of the SCO, which groups China, Russia, Kazakhstan, Tajikistan, Uzbekistan, and Kyrgyzstan, …[was] convened in St. Petersburg in June. (From asia.cnn.com/2002/WORLD/asiapcf/east/04/22/china.iran/)

Pakistan and Central Asia

In the mid-1990s, Tahir Amin (1994) wrote about the relationship among "Pakistan, Afghanistan and the Central Asian states, with far-reaching consequences" (p. 216-217). He noted that Pakistan could provide these newly independent states." He suggested that "Pakistan has embarked upon a series of modest political, economic, communications and cultural moves towards the Central Asian states, with scientific and technical training, consumer and engineering products and shorter routes to international markets (p. 217). He correctly suggested the following: "The long-term contours of Pakistan's relationship with the Central Asian states have yet to be crystallized and will

largely depend on the nature of the future regimes in Afghanistan and the Central Asian states and the political will of the leadership in these countries" (p. 217). At the end of May 2002, it was reported that the presidents of Pakistan, Afghanistan and Turkmenistan signed an agreement to construct "a $USD 2 billion gas pipeline from Turkmenistan across Afghanistan to Pakistan" for a total of 1500 km. (BBC News, 2002).

Other Issues Raised

General Issues

Although the Taliban regime has been removed from power in Afghanistan, the country is far from what could be considered "pacified." International troops are still needed to maintain security in various parts of the country, and in various regions warlords remain in power. As an example of the instability that local populations as well as foreign assistance workers must face, "the UN High Commissioner for Refugees (UNCHR) has suspended the return of internally displaced people (IDPs) in parts of northern Afghanistan due to deteriorating security conditions." There have been many reported attacks recently on ethnic minorities in the region. So, even the relatively pacified Afghan north remains unstable. From www.centralasiapost.com/p/d4/4f9028786b7b.html. In addition, the abundance of land mines in the country affects the locations as well as the pace of development in the country? What are the risks of landmine displacement as a result of the likelihood of extreme flooding? Can we learn from the experiences of other landmine-plagued countries about the impact of floods on landmines, for example in Mozambique, about how to de-mine the land while re-engaging the population in agricultural and other economic development activities?

Many people have written about Central Asia and cotton: King Cotton, cotton independence, cotton scandal, cotton rush, and a wide range of environmental aspects of cotton production (soil, water, health degradation, etc.). Reducing regional reliance on cotton production has been recognized by most observers as a beneficial idea, as well as a necessity. Regional rice cultivation, a consumer of large amounts of water, has been curtailed, especially in Karakalpakstan, partly as a result of drought-related water shortages and partly because of its excessive water requirements. How can countries in the region diversify their economic activities away from cotton and rice and toward other income-producing activities, especially those that are less water-consuming? It has proven to be easier to say than to do.

People rely on what they know when dealing with situations with which they have little familiarity. They often tend to rely on analogies, identifying for our purposes here other regions (water-scarce locations) and activities (such as irrigated agriculture) that might be comparable to those in Central Asia. The process involves identifying some characteristics that are similar to both situations and then extrapolate to issues of concern, e.g., water quantity, quality, efficient and equitable distribution, soil salinization. For example, the Amudarya river basin with its upstream-downstream problems might be compared to the Colorado River system in the arid and semiarid US West, or to the Nile River.

A participant suggested that the European Coal and Steel Community (ECSC) is a possible analogue to the situation in Central Asia. For example, downstream countries need water for irrigation in summer, while upstream countries need energy in the winter.

By creating an interdependence through an exchange of resources (i.e., taking advantage of comparative advantage), cooperation and interdependence among CARs can be fostered by exchanging water in one season for energy in another. Perhaps this applies only to Tajikistan and Uzbekistan, and Kyrgyzstan and Uzbekistan. It raises the question of whether each Central Asia Republic needs to be food-self-sufficient in terms of production, or whether each one should engage in growing products for trade with other republics in a comparative advantage relationship. Enhancing cooperation in the region reduces the potential for resource-related (in this case, water) conflict. Analogical reasoning is potentially valuable as a comparative assessment tool. However, it is necessary to show great care when using such analogies. Each comparison has its strengths and weaknesses and those must be made explicit so that limited or false analogies can be identified and discarded.

What is the role of "tradition" in fostering appropriate land and water use and as a constraint to implementing changes in land use practices? What practices and activities have been used for centuries that need to be re-evaluated in order to improve water efficiency in the region? Many traditions evolve into new traditions over time.

Identify the various climate, environment and demographic early warning systems in the Amudarya basin. Is there an early warning for equitable distribution of water? Can early warnings be undertaken on a regional as opposed to national basis?

Water Concerns

Do solutions to Central Asia's development problems depend primarily on resolving the water problem? It appears that increasing water availability by any means, such as increased water efficiency or by identifying new additional sources of regional water, is seen by political leaders as a key factor for regional development prospects. Water efficiency is difficult to achieve because of traditional use of large amounts of water deliveries under the Soviet regime.

What is Afghanistan's legal claim to water in the Amudarya? Based on which agreements or principles? Is it premature to consider Afghanistan's water needs in the near and long term? Does Afghanistan have the ability to use its allotment of water? If Russia can sell future access to its river water, can Afghanistan "sell" its legitimate share of Amudarya water to downstream users, because it is not in a position to use that water at present?

Should everyone in the region have the same amount of water? Every state? How you identify equitable sharing of water in the region will affect what one will identify as the real price of water? How can one determine the actual value of water in an equitable way? How can we get to equity as a result of developing capacity in Greater Central Asia?

Who are the water and climate decision makers in Afghanistan? While there is a newly appointed Director of the National Meteorological Service, the service itself must be rebuilt as personnel, data, machines, computers, etc. that may have existed before the Taliban but are no longer functioning. The Director is visiting agencies outside this country to solicit aid in rebuilding his meteorological service.

What is the purpose (function) of the Golden Lake in Turkmenistan? In a special report on water management in Turkmenistan, the impact of such a lake was noted: "Moreover, large-scale plans are currently being formulated to build a 2092 sq. km artificial lake in the Kara Kum area in order to enhance Turkmenistan's agricultural productivity and guarantee its water security. A thorough feasibility study has yet to be conducted, but experts warn that impending such a project could have sweeping effects on the region's already fragile environment." From .

Any real (meaningful) changes to the water situation in the Amudarya basin, now and in the future, will require the need for strong regional leadership and effective decision making in order to achieve some semblance of sustainable development in the region.

Does the analogy of a share by upstream participants (e.g., oil exporting countries) in the "downstream profits" with regard to oil have any potential value for upstream-downstream relations in the Amudarya system? According to one researcher (Rasmussen, 1997), there was strong evidence for relatively high but variable levels of profitability from downstream petroleum profits (e.g., from extraction to refining, marketing, transport and retail sales) from the 1970s through the 1990s. Even in the 1980s when upstream profits dropped the profits from downstream activities remained strong.

What is the actual water intake and condition of the Karakum Canal? By all accounts, the Canal is in need of immediate attention, as succinctly noted in the following paragraphs: "But despite the canal's importance, minimal efforts are being made to maintain what many view as the country's lifeblood. "Thy neglect it like a cancer. They don't realize the value of this, but the country's long-term survival depends on it," Wilson maintained. "Investment in this is required now. Forty percent of the water is lost immediately through the irrigation system and the canal through seepage and evaporation." Describing the country's water management policy as an "Alice in Wonderland syndrome," Wilson said the consequences could be serious. "They bury their heads in the sand, saying they have enough good land. If they salinate the soil, they think they can just take new land, and they do this every year," he said. Indeed, every year new irrigated areas are taken, leaving behind land which is salinated." From www.centralasiapost.com/p/cc/7d23485806f4.html.

What role has the misuse of water in the region had on the current condition of the Aral Sea and its deltas, on water quality, on air quality, on health effects in the disaster zone, on groundwater quality, and so forth? Identify all the actual and potential upstream-downstream conflicts and problems among countries as well as within countries in the Amudarya Basin.

What is the role of groundwater in the Central Asian region with regard to addressing water needs of urban and rural populations?

The runoff collected from indigenous water harvesting systems (takyrs) could be an important potential water source in all Central Asian States. For example, in Turkmenistan, in the average year, the total annual runoff constitutes more than 300 million cu. m. This water can be used for livestock and micro-oasis agriculture.

Climate Concerns

One question that recurred throughout the meeting was as follows: What role did the current prolonged drought have on the thinking of decision makers about climate issues in general (drought, climate change, glacial retreat, etc.)? What impact did the multi-year drought in Central Asia have on policymakers' views on the seriousness of climate change (i.e., global warming)?

The top climate issues in the Amudarya basin are as follows: drought and climatic trends (i.e., warming) and their implications.

What are the implications of climate change of a few degrees C in 2030, if there are no changes in population growth rates and demographic trends?

What kinds of changes are climate issues (drought, climate change, glacial retreat, etc.) having on political and socio-economic modus operandi in the region?

Identify the impacts on water resource issues (needs and constraints) in the Amudarya basin of concern to political leaders about global climate change and about socio-economic and political changes in Afghanistan.

Studies of glacial retreat in the Pamirs provide insights into foreseeable future water resource changes in the region.

Soviet soil scientist Viktor Kovda (1980) wrote about land aridization and drought control." He defined "land aridization" as a complex of diverse processes and trends that reduce the effective moisture content over large areas and decrease the biological productivity of the soils and plants of an ecosystem" (p. 15). Does the notion of "aridization" (as defined by Kovda) have any value to describing or understanding the cumulative rainfall deficit in Central Asia, its impacts on ecosystems and society, and how fast recovery from it might take place? This will give insights into how to deal with a cumulative rainfall deficit.

What climate data exists in the Greater Central Asian region, regardless of the form it is in? Are current climate and climate-related assessments being carried out with data that is
out of date (i.e., before 1990) or with data of low quality?

Education & Capacity Building

There is a strong need for education and training of Afghan researchers and research applications specialists and other Central Asians. Training can take place in neighboring Central Asian states and in the US (such as at the IRI or NCAR or other locations), among other locations.

Concern was voiced at the meeting about the failure of the international donor community to fulfill its pledges for assistance in a timely way, if at all. That concern was recently reinforced by NYU Afghanistan expert B. Rubin who noted that "donor pledges are not being fulfilled…[donor] governments continue…supporting popular-looking projects, while not paying for more necessary things like the current expenditures of the

Afghan government or backing for the currency" (quoted in *The Humanitarian Times*, 28 June 2002).

Review the successes and shortcomings of World Bank activities since 1992 to 2002 in the Central Asian Republics. To what extent and in what ways are the donors to Central Asia working together? To what extent are donors honoring their financial pledges of support for activities in the region?

It is necessary to identify the various ways that water is inefficiently used in the CARs. This would be done in order to avoid repeating bad lessons learned about poor or inappropriate land-use and irrigation methods from these and other arid lands. A follow up activity requires a review of whether lessons learned with regard to land and water use in the region have been applied once they have been identified. Identify adverse land-use lessons in the CARs in order to assure that the known poor land and water use practices are not repeated while reconstructing and developing activities in Afghanistan.

Identify the various climate, environment and demographic early warning systems in the Amudarya basin. An early warning should be developed for monitoring the equitable distribution of water between as well as within countries. Can early warnings be undertaken on a regional as opposed to national basis? Strengthen the role of non-governmental organizations in early warning of river flow and river pollution along the Amudarya.

It is necessary to establish the network in Central Asia (including Afghanistan) for monitoring salt-laden dust storms in the Aral region, which affect the crop and pastures productivity, and system on early drought warning. The realistic assessment of the quality and quantity of irrigated lands in Amudarya and Aral Basin has to be done.

Concluding Comments:

It seems that the water-climate-environment-demographic situation in Central Asia in many ways resembles a hydra-headed crisis. This notion refers to situations in which the resolution of one problem usually generates other new problems, which are equally as difficult to resolve. For example, seeking a single solution to the region's water situation, such as, say, allowing for the transfer of Siberian river water to water-stressed Central Asia, might sharply increase the water supply, but it might create environmental stresses in Siberia as well as along the transport route to Central Asia. It may also perpetuate or reinforce the indifferent and inequitable distribution of water resources that presently exist. Fertilizers can be (and have been) applied to increase crop yields but those chemicals will (did) end up contaminating the region's ground and surface water systems. As populations continue to increase in arid lands, pressure on the natural resource base will without doubt intensify. To gain a glimpse of the future under a "business as usual" scenario, one can review conditions in other similar river basins and desert areas.

Central Asian Republics are in the midst of what could be described as a scissors situation: populations in the various republics are increasing, thereby generating an increase in the demand for resources at the same time that the resource base is increasingly being degraded. These are what we referred to as "creeping environmental changes." There is a need to solve these problems today and not wait until one of the

proposed (feasible) climate change scenarios is supposed to take effect, e.g., a few degrees warmer and much less water in the region's rivers. Assuming that water shortages will continue to grow for whatever reason and population will continue to increase, what options are available for governments to do with or for the several million people (and still increasing) who are totally dependent on Amudarya water for agriculture and domestic consumption?

Clearly there are scores of studies and assessments about the problems that the governments and inhabitants face in the greater Central Asia region as it was defined earlier in this report. Many of those problems relate to water and to the upstream-downstream "divide" or, put in another way, the "water haves" and the "water have-nots', respectively. And many of these problems relate to traditions, traditions with regard to the way that water has been distributed and used in the region not only in ancient times but especially in Soviet times. While it is easy to offer solutions for others to put into action, we realize that the "ordeal of change" (Hoffer, 1976) has its psychological as well as political and socio-economic constraints. With these thoughts in mind, the following suggestions for "next steps" regarding "Climate, water and economic development in the Amudarya Basin" are put forth amidst the many possible "next steps" that could be found in the body of the report and elsewhere. They are not prioritized because to do so would require biasing away from some important disciplinary concerns toward a forced consensus, which we hoped to avoid.

- How can sustainable reconstruction of the agricultural system be successfully carried out in war-torn Afghanistan in an unstable domestic political and social environment? How best can Afghanistan compete or cooperate with other countries in the region with respect to climate- and water-related issues?

- Can the sustainable reconstruction of the irrigation system in Afghanistan and the other 5 Central Asian States be successfully carried out under existing financial and political constraints?

- What should be the priority for agricultural development in Afghanistan ? In the next 2 years? In the next 5 years and beyond?

- Identify and catalogue the existing activities at the national and regional levels that are the functional equivalent of early warning systems related to demographic, water, climate and food production and food security.

- What is Afghanistan's legitimate claim to Amudarya water resources? When might it be in a position to use its allocation, given the internal situation in the country? More broadly stated, by what standard can states in the region claim legitimacy in their water demands: Per capita (does this encourage population growth?)? Each state gets an equal amount (fair?)? By the amount of agriculture in the state (a disincentive to switch to less water-intensive crops)? By the amount of rainfall falling in each country? (unfair?)? By its proximity to the water sources/rivers? By old Soviet allocations? Finally, should the approach to regional water allocation be "rights-based" or "needs-based?"

- What measure(s) can be used to determine an equitable division of water resources in the Amudarya basin? Which social, political or economic issues (and institutions) should be addressed if equitable water distribution is to be

effective in the long run? Should we consider only water, or should we consider other trade-offs as well between water and energy which could lead to inter-state cooperation?

- Is it possible to link different basins in negotiations, e.g., the Amudarya basin and the rivers flowing into Turkmenistan?

- How can climate-related capacity building be carried out so that Afghanistan can participate fully in discussion of regional water and climate issues?

- What is the role of groundwater in Central Asia with regard to addressing the water needs in urban and in rural areas? Are those needs for drinking water or for greening the urban areas.

- Identify all the ways that water is inefficiently used in the Central Asian Republics. Are lessons that have been learned in the region and elsewhere about how to improve the efficient use of water being applied? What have been the constraints and how might they be removed?

- What is the impact of increased water use in Afghanistan on water supply to other Central Asian Republics?

- What is the historic and current level of water usage in the CAR's and Afghanistan ? How accurate is this information, given the notion that "If we can't measure it, we can't manage it?"

- What are the implications of climate change of a few degrees C in 2030, if there are no changes in demographic trends?

- Identify the pros and cons for convening a few months in advance of a Regional Climate Outlook Forum (COF) focused only on Afghanistan and use the occasion to identify the country's needs with respect to climate and weather services.

- Does the notion of "downstream profits" have any value in the context of water resources in the Amudarya basin?

- Is it useful to focus on specific countries, or would it be also useful to distinguish among downstream, midstream and upstream, would this shift the bargaining powers of the stakeholder?

- What influence did the recent 3-year drought have on the way decision makers in Central Asia look at climate and climate-related issues?

- What influence did the drought have on existing approaches to water management nationally and regionally?

- Under what condition(s) might Russian authorities decide to divert water from its north-flowing Siberian rivers toward arid Central Asia? What kind of implications would more water from outside the basin have on the current allocation and use of existing water resources?

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APPENDIX

AGENDA

Monday, 17 June

7:00 - 9:00 p.m. ***Informal Gathering*** *(at Penn's View Hotel)*

Tuesday, 18 June

8:30 - 9:45 a.m. Welcome to Workshop: Roundtable introductions
Purpose of Workshop (Informal Planning Meeting, IPM)

9:45 - 10:15 a.m. BREAK

10:15 - 12:15 p.m. ***Climate and water resources in the region: What exists? Setting (as it was until 2001)***

10:15 - 11:15 a.m. ***Regional***

- Regional Political Setting
- Water Setting
- Climate Setting

11:15 - 12:15 p.m. ***Global***

- Geopolitics of the region
- Watercourse law
- The Afghan situation

12:15 - 1:15 p.m. LUNCH

1:15 - 3:00 p.m. ***Transboundary Water Issues 1***

1:15 - 2:15 p.m. The Amudarya River Basin (pre-2002)
The Karakum Canal (past, present, and future)
Regional (CAR) management of the Aral Basin water

2:15 - 3:00 p.m. The Amudarya River Basin (post-2002)
What happens when you add Afghanistan?

3:00 - 3:30 p.m. BREAK

3:30 - 5:00 p.m. **Transboundary Water Issues 2**

3:30 - 4:00 p.m. Upstream vs. downstream water quantity, quality
What's climate got to do with it?

- Water
- Agriculture
- Energy
- Health

4:00 - 4:30 p.m. SWOC (Strengths, Weaknesses, Opportunities, Constraints) for improvement of water situation in Central Asia

- For Aral Basin
- For CAR Basin States
- For Afghanistan
- For Amudarya Basin
- For Karakalpakstan

4:30 - 4:45 p.m. Climate Change

4:45 - 5:00 p.m. Day's Summary

5:00 - 6:00 p.m. ***Put issues/comments on line***

Wednesday, 19 June

8:30 - 9:00 a.m. ***Answer questions that were e-mailed via Internet exposure***

9:00 - 10:00 a.m. ***Forecasting Climate; forecasting water, in terms of monitoring weather and climate.***

9:00 - 9:30 a.m. What do they have in terms of early warning?
What do they have in terms of capacity building?

9:30 - 10:00 a.m. A special emphasis is on Afghanistan and the Amudarya River Basin

- Seasonal, interannual
- What exists (methods, technology, techniques)
  - Outside the region
  - Inside the region
- What is needed?
- What can we get realistically?

10:00 - 10:30 a.m. BREAK

10:30 a.m. - 12:00 p.m. ***Early Warning Systems (From EWS to Flashpoints)***

- For streamflow
- For demand (demographic changes, seasonal demands)
- For drought
- For agricultural production
- For Flashpoints (disaster avoidance)

12:00 - 1:15 p.m. **LUNCH**

1:15 - 2:30 p.m. ***Monitoring the water and climate resources of the region: What do we have? What do we need?***

- How to build capacity?
    - Regional?
    - Amudarya Basin?
    - Northern Afghanistan?
    - Afghanistan?
- What priority (i.e., what to do first?)

2:30 - 2:45 p.m. BREAK

2:45 - 4:30 p.m. ***What next?***

- Training programs
- Proposal
- Should there be a meeting in the region?
- Are we asking the right questions?

4:30 - 5:30 p.m. *Prepare material for website*

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BIOGRAPHICAL INFORMATION

Yahya Abawi

Yahya Abawi is the Principal Research Officer and Program leader (Water Resources) with the Queensland Centre for Climate Applications in Toowoomba. Yahya was born in Afghanistan and moved to Australia in 1976 where he obtained a degree in Agricultural Engineering and a PhD in Operations Research from the University of Queensland.

Yahya has over 20 years of experience in hydrologic investigation, modeling, water resources management, cropping systems, irrigation management and post harvest management. Over the past 10 years his research interests are in the application of seasonal climate forecasts in water and crop management. He is the leader of several national and international projects in the Murray Darling Basin area of Australia and on the eastern islands of Indonesia investigating the application of seasonal climate forecasts in irrigation management, water allocation decisions, cropping decisions and environmental flows.

From 1994 to 1998 he was Executive Engineer of the National Centre for Engineering in Agriculture based at the University of Southern Queensland. He is a member of the Agricultural Production Research Unit (www.apsru.gov.au) management committee and is involved in Cooperative Research Centre (CRC) for Catchment Hydrology and CRC for Freshwater Ecology. He is also a part time lecturer in Operations Research and stochastic process modeling at the University of Southern Queensland and has published over 40 conference papers, journals articles and monographs.

Sada Aksartova

Sada Aksartova is a PhD candidate at Princeton University. She received a Dissertation Research Fellowship from the Program on Philanthropy and the Nonprofit Sector, Social Science Research Council, for 2002–03. At present she acts as a research assistant to Professors Michele Lamont (Department of Sociology, Princeton) and Stanley Katz (Woodrow Wilson School of Public and International Affairs, Princeton). Her interests include cultural, comparative, political and organizational sociology; gender; foundation philanthropy; civil society; Soviet and post-Soviet history and society; and Central Asia.

Mathew Barlow

Mathew Barlow is an Associate Research Scientist in Climate Monitoring and Dissemination at the International Research Institute for Climate Prediction (IRI) in Palisades, New York. Dr. Barlow received his PhD in Meteorology from the University of Maryland in 1999. His interests include climate variability, droughts, and the effect of climate on society. His research focuses on decadal Pacific sea surface temperature variability and the use of climate information for malaria control in Africa.

Candyce Clark

Candyce E. Clark is the Program Director for the Research Applications Program for the Office of Global Programs (NOAA). Her professional interests include the application of scientific information in the decision-making process, particularly the application of climate forecasts for societal benefit. She studied Biology, Oceanography, Political Science and Marine Affairs at

Mount Holyoke College, University College of North Wales (Menai Bridge), and the University of Rhode Island.

Heidi Cullen

Heidi Cullen is a Scientist in the Environmental and Societal Impacts Group, a program at the National Center for Atmospheric Research (NCAR) in Boulder, Colorado. Her interests include monitoring and assessment of flood hazard risks in the United States and drought in Central and Southwest Asia, especially the connections between regional atmospheric circulation and large-scale climate variability.

Tyler Felgenhauer

Tyler Felgenhauer has been for the past three years with the Liechtenstein Institute on Self-Determination at Princeton University, and currently serves as Research Associate and Program Manager for Eurasia. Prior to earning his Masters in Public Affairs from the Woodrow Wilson School (1999, International Relations), Tyler worked in Baku, Azerbaijan for the National Democratic Institute (NDI). In the summer of 1998 he did a stint in the political section of the U.S. Embassy in Bangkok, Thailand. In 1994–95 he was in Moscow, Russia, working for both Moscow News and the Baltic News Service, as well as teaching English. Tyler graduated from Cornell University in 1994 (BA Government), and hails originally from Spokane, WA. He has written before on minority rights in the Former Soviet Union – specifically as they apply to the Nagorno-Karabakh problem – as well as self-determination and the stability of the Russian Federation. He is researching materials for both a book chapter on the links between organized crime and the Chechen independence movement, and an article on the relationship between self-determination and the environment. His interests include self-determination, democratization, and conflict zones, and the links between environmental degradation and international relations.

Michael H. Glantz

Michael H. (Mickey) Glantz is a Senior Scientist in the Environmental and Societal Impacts Group, a program at the National Center for Atmospheric Research (NCAR). He is interested in how climate affects society and how society affects climate, especially how the interaction between climate anomalies and human activities affect quality of life issues. His research relates to African drought and desertification and food production problems and prospects; societal impacts of climate anomalies related to El Niño events, and the use of El Niño-related teleconnections to forecast these impacts; to developing methods of forecasting possible societal responses to the regional impacts of climate change; and the use of climate-related information for economic development. He has also coordinated joint research in the Central Asian Republics of the ex-USSR. Mickey has published more than 100 articles in various journals and books, has edited more than 17 books and several more are in progress. His book on El Niño (*Currents of Change: Impacts of El Niño and La Niña on Climate and Society*) is available from Cambridge University Press and has been translated into several languages. He has organized more than 20 international conferences during the past two decades.

Mikhail Gogolev

Mikhail Gogolev has over 25 years of international experience in hydrogeologic and environmental consulting and developing hydrogeologic and soil hydrologic models and expert systems for landfill design, protection of groundwater resources, drainage design and irrigation planning. He is a primary developer of the Visual Help and UnSat Suite software packages that have gained around one thousand installations internationally and become major instruments for landfill design in the USA, Canada, Australia and many countries in Europe.

He has been running numerous consulting and software projects in the US, Canada, Netherlands, Ukraine, Russia, Armenia, and Central Asia and has a number of publications on soil and groundwater hydrology and contaminant transport and fate in vadose zone. His research interests include: application of unsaturated zone and groundwater models for irrigation planning, landfill design and groundwater protection; development of Internet online information systems for water management that bring data on the state and quality of water systems to the specialists and concerned public.

Markus Muller

Markus Muller is currently a Visiting Scholar at the Harvard Program on Central Asia and the Caucasus in Cambridge, Massachusetts. He has worked for the past four years as Program Coordinator for the Swiss Agency for Development and Cooperation. Dr. Muller's main research interest is the question of the institutional and political aspects of regional water management. He has been in charge of developing the concept of the Swiss Cooperation for its program in Central Asia and will be working, beginning in August this year, in the Swiss Afghanistan Cooperation program (posted in Kabul). Because of this, the new dimension of Amudarya water management holds special interest for him.

Jon M. Nese

Dr. Nese is the Chief Meteorologist at the Frank Institute Science Museum in Philadelphia. He oversees the day-to-day operation of the weather station as both an operational forecast facility and an exhibit, providing weather forecasts daily to Philadelphia's NPR station. He assists with museum development and answers media and visitor requests for weather information, conducts meteorology-related demonstrations and programs in the museum, and works on special projects related to meteorology.

Shannon O'Lear

Shannon O'Lear is Assistant Professor of Geography, University of Illinois at Urbana. Her research interests include: Political Geography, Human dimensions of global change, Environmental and human security, Russia, the Caucasus and the Caspian Sea region. She is interested in environmental issues from a political geographic perspective. Her current work focuses on environmental and human security in the Caspian Sea region and specifically within the oil-rich Republic of Azerbaijan.

Leah Orlovsky

Leah Orlovsky was born in Turkmenistan, worked at the Desert Research Institute of Turkmen Academy of Sciences in 1981-1995. In 1995, she immigrated to Israel, and since 1995 she has been working at the Remote Sensing Laboratory of the Department of Solar Energy and Environmental Physics, Jacob Blaustein Institute for Desert Research, Ben-Gurion University of the Negev. Her scientific interests concerns ecological applications of remote sensing, and deals with monitoring of dust storms and land cover changes due to various desertification factors such as soil salinization, over- and undergrazing.

Current projects:

- Effect of Biogenic Crusts on Biomass Estimation in Arid Regions by Satellite Imagery (Israel-Germany-Turkmenistan_Kazakhstan, INTAS-EC, 4th framework).

- Assessment of the Agricultural Potential of an Indigenous Water Harvesting System in the Central Asian Deserts (the Netherlands-Israel-Turkmenistan-Uzbekistan, INCO-Copernicus - EC, 4th Framework).
- Assessment and Monitoring of Desertification Processes in Mongolia using Remote Sensing Methods and Geographic Information System (Israel-Germany-Mongolia-Russia. Global Change, Climate & Biodiversity, EC, 5th Framework).

Nikolai Orlovsky

Nikolai Orlovsky was the Deputy Director of the Desert Research Institute of Turkmen Academy of Sciences in 1972–94. Since 1995, Nikolai has been working at the Department of Desert Agrobiology of Jacob Blaustein Institute for Desert Research, Ben-Gurion University of the Negev, Israel. His research deals with assessment and utilization of the Middle Asia climatic resources, desertification processes and anthropogenic impact on desert climate. Nikolai Orlovsky has published more than 150 articles and 12 monographs.

Current projects:

- Determination of Genetic Variation for Modeling Efficient Germplasm Collection Strategies, USAID-CAR, Israel-Turkmenistan.
- Assessing and monitoring land degradation due to salinization in Turkmenistan and examining new phytoremediation methods, USAID-CAR, Israel-Turkmenistan.
- Assessment and monitoring of desertification processes in Mongolia using Geographic Information System, USAID-CDR, Israel-USA-Mongolia.

Yusufjan Shadimetov

Dr. Yusufjan Shadimetov has worked on the staff of the President of the Republic of Uzbekistan as the main advisor on questions of education, ecology, science, and culture. Dr. Shadimetov has been the head of a Cabinet Department on questions of society and culture. He is the author of more than 40 scientific articles, as well as 5 monographs and textbooks.

Professor Shadimetov has created a methodology for the study of societal and environmental problems in Central Asia. He is the President of the Tashkent branch of "ECOSAN" which cooperates with the 20 other ECOSAN centers. He is an elected member of advisory councils of the United Nations, such as UNESCO, UNEP, UNFPA, WHO, and UNICEF. Since 1993, he has been a member of the Interstate Council on the rescue of the Aral Sea. In 1994, he was elected the State Coordinator of the International Organization "GREEN" in Central Asia. For more information on ECOSAN, see the website at www.business.uz/ecosan/indexeng.html

Lisa Vaughan (née Farrow)

Lisa Farrow Vaughan serves as the Program Director for Environment and Development for the Office of Global Programs (NOAA). In this capacity, she is responsible for the development of programs, methods and pilot projects that integrate socially defined needs with science and technology for the purpose of fostering sustainable development. Her professional interests include transboundary management of shared resources; climate, equity and ethics; Latin America and the Caribbean; and the development of innovative international institutional arrangements for understanding and adapting to climate variations. She received her M.S. in Environmental Science and Policy from Johns Hopkins University.

Kai Wegerich

Kai Wegerich is a researcher at the School of Oriental and African Studies [SOAS] focusing on water management and institutions in Central Asia. His research interests include multi-level water management, environmental scarcity, social adaptive capacity, risk, institutional change and conflict. Mr. Wegerich worked as a consultant for the International Water Management Institute [IWMI] on Water User Associations in Uzbekistan and Kyrgyzstan in 2000, and as a consultant for the British Geological Survey [BGS] on Common Pool Resources in 2002.

Qian Ye

Dr. Qian Ye is a Visiting Scientist in the Environmental and Societal Impacts Group at the National Center for Atmospheric Research (NCAR) in Boulder, Colorado. He is the Director of the Center for Development and Application of Atmospheric Sciences, Institute of Atmospheric Physics, Chinese Academy of Sciences (CAS) in Beijing, P.R. China. Dr. Ye's interests include drought and desertification issues, and he is also working on the Chinese Western Region Development Strategy. He received his PhD in 1993 in Satellite Climatology from Oregon State University in Corvallis, Oregon.

Igor Zonn

Since 1987, Igor Zonn has been the Deputy Director of the Engineering Research Center on Water Management of Land Reclamation and Environment "Soyuzvodproject" and Vice-president of the Russian UNEPCOM.

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Doctor of Geography - 1990
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His project experience include:

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- Reclamation and Water Economy Development Project in Uzbekistan, Azerbaijan, Moldova, Kyrgyzstan, Turkmenistan - 1963-1973
- Plan of Action for the Kalahari-Namib Region - 1990
- Water Economy and Environmental. Impact in Colorado-Amudarya River Systems - 1991-1993
- Project of Recultivation and Environmental Consequences of Asbestos Lands in Russia - 1993-1995
- Aral Sea Project - 1991-1995

Igor Zonn has published more than 300 articles and monographs.