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Afghanistan Revival:
Irrigation on the right and left banks of Amu Darya

Fuchinoue, H.[1], Tsukatani, T.[2], Toderich, K.N.[3]

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Kyoto Institute of Economic Research
Kyoto University

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1 Kyoto University Graduate School of Economics, hiva@t02.mbox.media.kyoto-u.ac.jp
2 Kyoto University Institute of Economic Research, tsuka@kier.kyoto-u.ac.jp
3 Uzbekistan Academy of Sciences, Samarkand Branch, ktoderich@yahoo.com

Preface

In Afghanistan and Central Asia, more than ten million residents and refugees have been suffering from desperate famine, drought, and poverty. Moreover, mono-cultural economy in Central Asian republics forced by the former Soviet Union has made it difficult to transfer their old economy to a modern market economy. It is important to amend their situation in terms of not only the domestic view, but also of the interstate view. We propose here a critical long-term resolution to overcome this tragedy. Agricultural development using Subsurface Drip Irrigation (SDI) for such crops as rice on the Left Bank of Amu Darya (Afghanistan) is what we suggest. It is well known that the former Soviet Union and Central Asian Republics have irrigated the Right Bank of Amu Darya (Uzbekistan) since the end of the 19^{th} century. On the contrary, the Left Bank of Amu Darya has been ignored although it also possesses an almost equivalent edaphic and agricultural potential compared to the Right Bank. The purpose of our proposal is to build permanent food production systems on these forgotten dry lands in order to feed Afghan people who are suffering from a desperate famine, and to provide local people with jobs.

There are some issues to make the proposal feasible in terms of engineering technology, political economics, international legitimacy and international law. The main objectives of this volume are to address the issues related to international legitimacy, and to propose practical resolutions. Afghanistan needs to be integrated within the framework of Amu Darya Basin water resources agreement to reduce the likelihood of inter-state water conflicts and to provide a stable and reasonable political climate for reconstruction efforts in Afghanistan. The international community may have to donate, besides the above mentioned Afghanistan Reconstruction Funds, more than $4.5 billion, to contribute to the Central Asian republics. This is mostly because the population of the Aral Sea Basin countries is continuously growing, and consequently the demand for fresh drinking water and local food production are gradually increasing. There is also need for providing employment opportunities in the areas of higher population growth rate. Under condition of depleting water resources, non-conventional water sources for irrigation should be explored. Sustainable management of such water resources with sustainable development of irrigated structures will contribute to agricultural yield stabilizing, that is a primary concern in all riparian countries (Uzbekistan, Turkmenistan, Tajikistan and Afghanistan). Without the knowledge and experience of former Soviet republics on irrigated farming production under the arid climate, and without the cooperative improvement in agriculture and water resources usage with those republics, Afghanistan can never achieve effective reconstruction.

Today, many existing situations in the Amu Darya Basin ecosystems are too complex and diverse for a single national strategy to prescribe in detail how they should be corrected, managed or sustained. Scientifically sound strategies are needed because these riparian countries often face a wide range of common dynamic problems that cannot be easily resolved with current legislation, institutions, governments, existing dispute resolution procedures, or even present scientific knowledge. There is an apparent need to reconsider the definition of water and land resources use that result in desertification (commonly land degradation induced by a combination of human actions and climatic extremes.) We also have to make sure of who is responsible for.

In the first section of this volume, information about Amu Darya and development of irrigation shall be provided. Information about rice irrigation production is also provided in this section. The second section describes the former agricultural situation in Afghanistan. We can understand the types of crops that Afghan people harvested and how they firmed before the Soviet invasion in 1979. The third section describes the historical relationship between Afghanistan and the Soviet Union in regards to the usage of the Amu Darya's water resources. The current framework for Amu Darya water resources is presented in the fourth section. This section lists the organizations that managed Amu Darya water usage after the disintegration of the Soviet Union. The fifth section answers why the interstate coordination for Amu Darya water resources is required. The sixth section concludes our proposal.

1. Amu Darya and Irrigation

1.1 Amu Darya

Amu Darya is the second longest river in Central Asia with a maximum tributary length of approximately 2,500km. Its annual river flow is the greatest in Central Asia at approximately 79km^3/year (Micklin, 2000). Figure 1 shows one of Amu Darya's tributaries, Pyandzh. This is a special spot in Afghanistan where many tributaries flow inside its territory.

Figure 1. US Astronaut Photograph of Pyandzh, August 1989 (N37.5, E69.5. at the center)

Earth Science & Image Analysis (http://eol.jsc.nasa.gov/sseop/clickmap/)

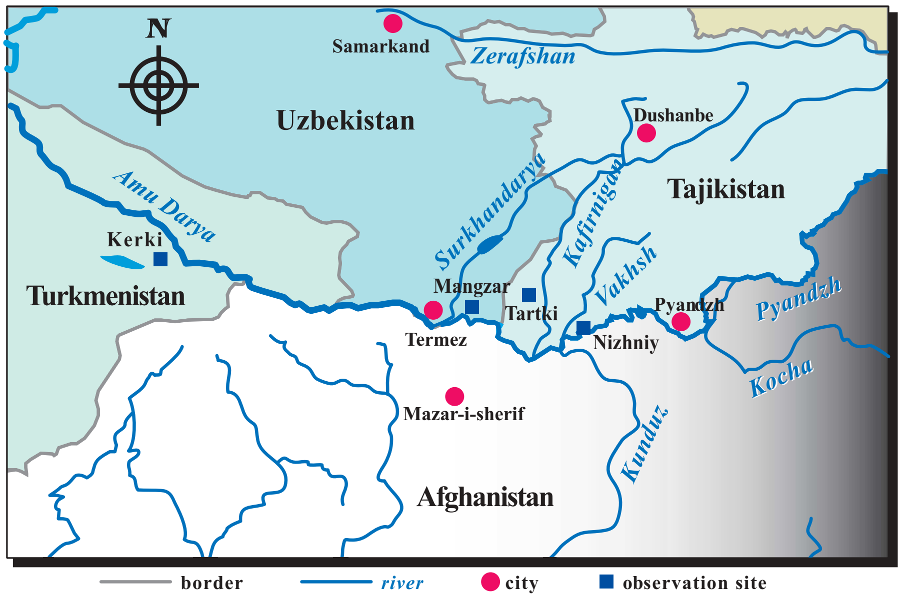


Figure 2. Amu Darya Riparian States and Tributaries.

Figure 2 shows the geographic location of tributaries. Zerafshan no longer reaches Amu Darya, but it was once a tributary of Amu Darya. After the confluence of Pyandzh and Kunduz, Amu Darya proceeds on the boundary between southern Uzbekistan and northern Afghanistan, and then flows through the desert of Turkmenistan and south west Uzbekistan (Amu Darya delta), before reaching its final destination, the southern part of the Aral Sea.

Figure 3 shows daily river flow rates for Amu Darya and its tributaries: Kafirnigan, Surkhandarya, and Pyandzh. We should appreciate the remarkable efforts of local recorders who have tracked daily flow data over several decades.

Figure 3.1 Time Series of Daily Flow Rate at Kerki, Amu Darya

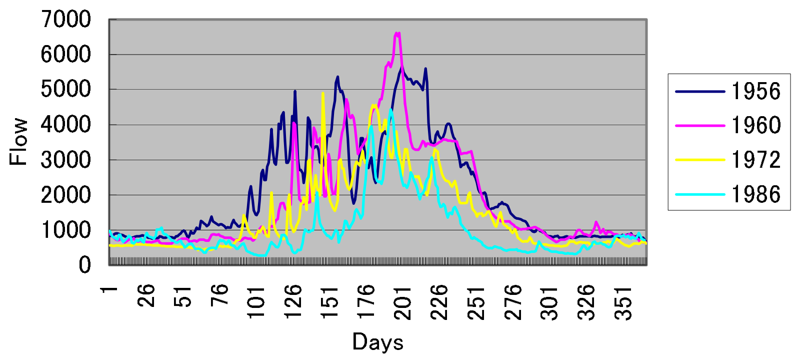
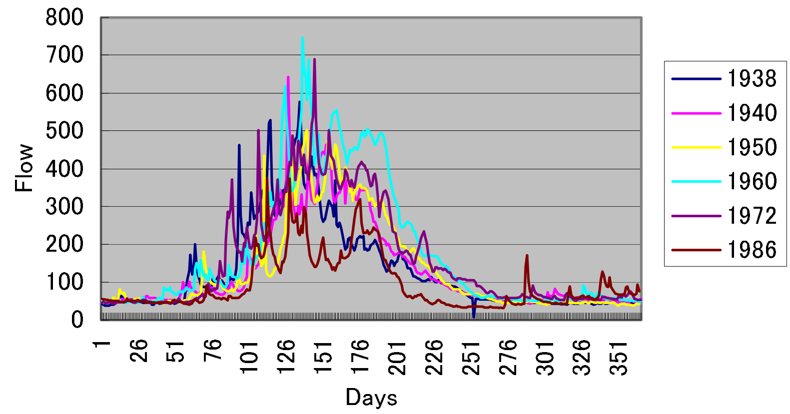
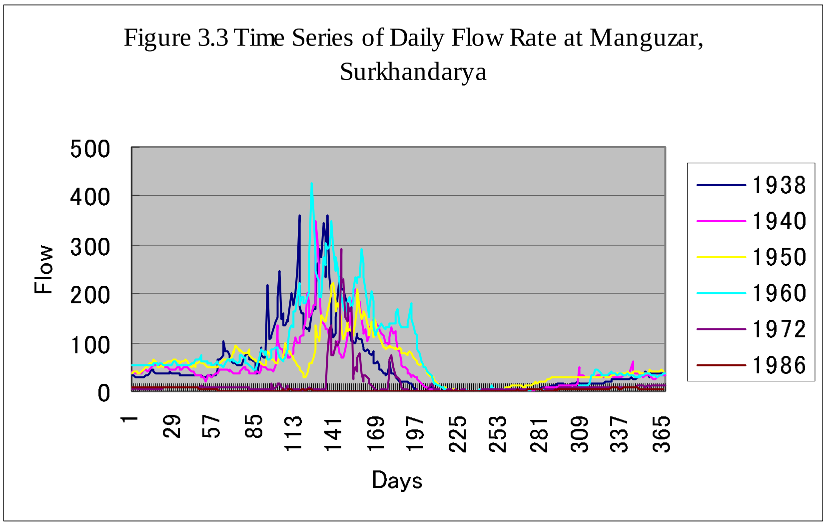


Figure 3.2 Time Series of Daily Flow Rate at Tartki, Kafirnigan





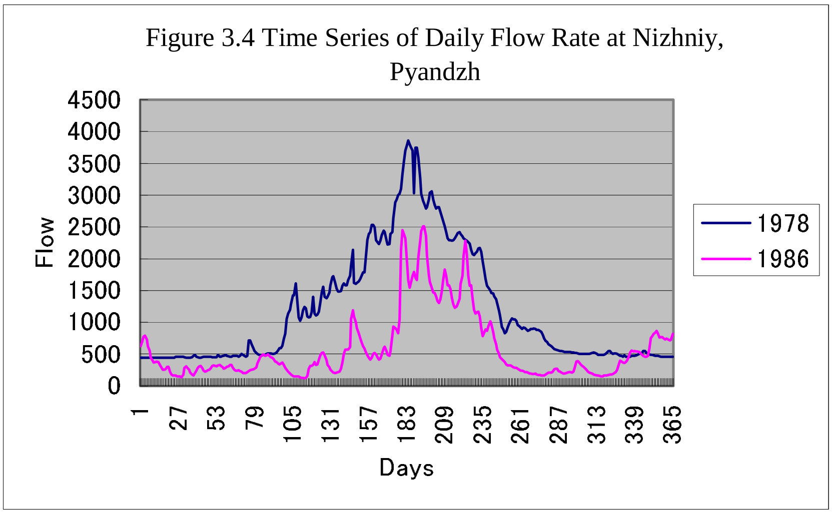


Figure 3. Time Series of Daily Flow Rate.

Tsuneo Tsukatani, Kristina N. Toderich, and Umirzak M. Sultangazin, "Daily Flow Database from Aral Sea Basin", Kyoto Institute of Economic Research Discussion Paper No.526, 2001. (Unit of flow rate is $x10^5$ m^3/day)

The word, "Amu," describes noise of water in Turkish, Mongolian, and Tungus. "Darya" means "river" from Turkish. In local Uzbek understands, "Amu Darya" means "noisy river". Amu Darya Basin is fed by snow and glacial melts from the mountains in Afghanistan, Pamirs in Tajikistan and in China. This feature determines the favor for irrigation within annual flow distribution where 80-90% of the annual flow is generated in from April to October; the maximum flood falls from June to August. Amu Darya Basin includes some tributaries such as Pyandzh, Vakhsh, Kafirnigan, Sherabad, Surkhandarya, Kashkadarya, and Kunduz. Table 1 shows flow of tributaries of Amu Darya with multi-aqueous years from 1921 to 1969.

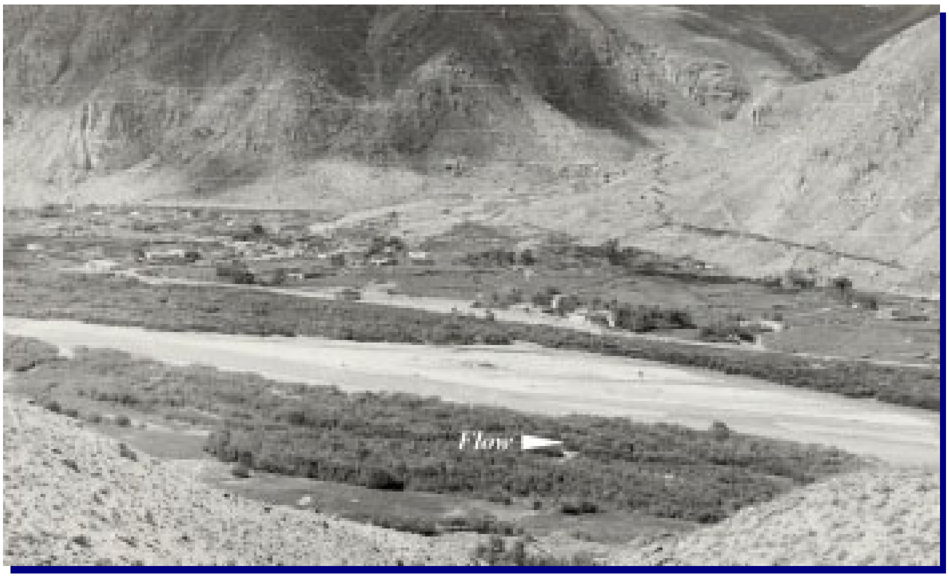


Figure 4. Pyandzh River near Khorog City, Tajikistan, July 1974.

Photo by Z. Izatullaev.

Tributary	Average long term flow (m^3/s)	Average annual drainage volume (km^3/year)	Maximum annual drainage volume (km^3/year)	Minimum annual drainage volume (km^3/year)
Pyandzh	1,140	35.91	NA	NA
Vakhsh	661	20.8	27.60	16.2
Kafirnigan	187	5.89	9.81	4.09
Surkhandarya	127	4.00	NA	NA
Kunduz	165	5.20	NA	NA
Kocha	211	6.65	NA	NA

Table 1. Flow of tributaries of Amu Darya with multi-aqueous years from 1921 to 1969.

V.E. Chub (2000), Climate change and its impact on the natural resources potential of the Republic of Uzbekistan, p54, Table 1.22.

The water resources of the Amu Darya Basin (except the rivers of closed basin) are generated in the basins of Pyandzh (36 km^3/year) and Vakhsh (21 km^3/year), and in the basins of Kafirnigan, Surkhandarya and Sherabad (8 km^3/year.) (Borovikova et al, 1999.)

In the process of development of Amu Darya floodplains and delta, Amu Darya constantly migrated by following the accumulation of alluvial depositions and changes in the direction of principal riverbed. In general, humid landscapes with the prevalence of hydrophylous plants (Phragmites, Typha, Erianthus, Calamagrostis and etc) and Tugai forests, covered by Tamarix, Populous, Elaeagnus, and Salix, occur there. Up to the present, the main role in the formation of relief of the floodplains and delta belonged to the hydrological regime in particular to the peculiarities of deposition and re-deposition of river drifts, as well as to the granulometric compositions of the rock.

Appendix 1 shows the fraction of alluvial soil of Amu Darya at Termez from 1990 to 2001. The average annual discharge of weighted particles made up 3-4 tons per second during a period of the natural regime of the delta. The annual growth of the deposits in the floodplains made up 7mm. The intensity of the deposition reached 1mm/day in the regions of the active accumulation. The carrying capacity and hydrodynamic regime of flows determined the granulometric composition of deposition. The largest sand fractions were precipitated in the riverbeds and channels. The water raising and overflow process were slowed. Smaller fractions precipitated along its further motion during flooding. The riverbed of floodplains basically consists of the interstratified horizons of clay sand and clay loam.

In the lowest parts of the delta, floods, bogs and lakes formed the internal floodplains. The soils that composed them as a rule consisted of loam and clay of heavy compositions. The surface covered by silt generated due to putrefaction of vegetable remains.

The oases with the irrigated areas of cotton, graminous crops, joughara, lucerne, melons and gourds occupy upper part of the delta while rice crops are frequently occurred on bog and waterlogged soils.

1.2 History of irrigation on the Right Bank of Amu Darya

Human intervention has long been a factor in the evolution of Uzbekistan’s water resources use. In some regions of Uzbekistan‘s arid and semiarid zones, the development of irrigation systems has a long history. Development began during the Neolithic time (5000-3000 B.C.) and Bronze Ages (3000-800 B.C.). It has expanded mostly into the Syr Darya, Amu Darya and Zerafshan River Basins. Some archaeological findings of ancient Neolithic time irrigation constructions, consisted from two channels for about 2.5 km, have been revealed in the area of the old delta of Tedzhen River (Southern Turkmenia). This old irrigated system is still a unique one, and has been preserved up to today in the territory of Central Asia. In the central and western parts of Central Asian region, the irrigated agriculture occurred far later. The archaeological excavations on settlement’s farms in the foothills oasis of Uzbekistan, mainly in Surkhandarya Valley (Sappalitepa and Kuchuktepa), Fergana Valley (Chust and Dalvarzintepa), as well as in lower reaches of Amu Darya (Kocha, Bazar-1-3 etc.) and Zarafshan Basin (Zamanbaba) showed that premises of transition from “limanno-kairnoe oroshenie” to the regular irrigation had been arisen at 2 thousand years B.C. Limanno-kairnoe oroshenie was the construction of small ditches (temporal water reservoir), that ancient local people used for water collection and consequently irrigation at antique time.

Later the irrigation technique has been essentially improved during Antique time (100-400 A.D.), when ancient irrigators began to use for irrigation the underground water. For such purpose, the water reservoir “hauzy”, and “kyarizy”, which was a special complicated construction for exploitation of underground water, were developed (Tolstov, 1969).

One of the most important achievements of the Uzbek medieval irrigation technique was the invention of water pumping constructions ("chigired" system, which was the water lifting wheels) that were widely used from the 9th to the 11th century, especially in the flood plain areas and delta of Amu Darya. The major advantage of this kind of old irrigation system is to be simple.

From the 12th to 18th century, the installation of an irrigating mainline (water quantity intake) system was one of the basic constructions associated with the irrigation technologies development in Khoresm, Zerafshan and Fergana Valleys.

A highly advanced irrigation system has been developed following the addition of Turkestan into Russia. In 1877, the principles of water use and development of the irrigation techniques were applied within the Golodnaya steppe (Syr Darya Basin.) The initial projects on the land reclamation and irrigation system improvement of Golodnaya steppe has been developed by N.A. Petrtov, F.A. Elistratov, and I.G Aleksandrov beginning from early 1885 to 1912.

The irrigated system, however, was considerably improved in Fergana Valley. In 1909-1917, the construction of large irrigated main line canal networks from Naryn, Aravan, Isfayram, Shahimardan and Sokh Rivers were started there based on the designs of A.K. Kuznetsov, N.N. Epanchin and I.G. Aleksandrov (Aleksandrov, 1924).

The most interesting idea was suggested by A.V. Chapligyn in 1916 concerning the construction of pumping stations along the main line canal from Amu Darya River intended for the irrigation of Buchara and Karakul oases.

Russian engineers at the Buchara-Afghan border near Kerki-Yola made the first experiments of irrigation in the Surkhandarya river valley in 1855 where Termez city was later constructed. Later the construction of water reservoirs from the Tupolang, Karatag and Sherabad rivers commenced here as well.

At the same time, G.K. Rizenkampf suggested the most interesting irrigated project on crop irrigation system on dry lands of Caspian region in 1912. He proposed the scheme of project for construction of trans-Caspian canal from Amu Darya at the place of Vakhsh and Pyandzh junction. The route of such mainline canal was planned from southwest part of Kattakum through sandy dunes of Karakum (Turkmenistan) and for about 300 thousand ha on the territory of Afghanistan (Sadykov, 1975).

In the upper part of Amu Darya Basin, B.N. Kastal'skii (1855) first proposed a new design of irrigated system. This project had envisaged the reclamation and farming land improvement with using artificial irrigations on the arid/semiarid lands at Buchara-Afghan border near Kerki-Iola. A few years later, it was also founded near Termez city. From the Soviet era, the construction and reconstruction of different irrigated systems were tested on the territory of Surkhandarya valley although the production of new irrigation technologies was lower than that of other Uzbek regions such as Golodnaya steppe, Fergana valley and even Khoresm. (Karakalpakstan). The construction of

Uchkzyl water reservoir and irrigated network of new lands in lower part of Zang canal was completed in 1958. The construction of Ujno-Surkhanskoe water reservoir (with capacity of 800 mln/m^3) designed by V.M. Kritskii was finished in 1962.

The large-scale irrigation system development that still continues to be improved on within all territories of Uzbekistan was noted from 1958 through to the 1980's and later. The contemporary water economy of the Republic of Uzbekistan has under its responsibility more than 267 irrigation systems, 129 thousand hydro-technical constructions, 1860 pumping stations, and 39 water reservoirs with total capacity, 57.5km^3 (Nigmadjanov, 2001.)

The basic out-of-date equipments that generate large losses of water have applied to the majority of old irrigated lands in Uzbekistan at the present stage due to difficulties of transition period. It was determined that 10 % of various hydraulic engineering systems, hydro technical constructions, and more than 20 % from closed collectors and drain networks on all their extent require technical reconstruction. Nowadays, 50 % of irrigated lands and irrigation systems require improvement, physical repairs of the canal system, restoration and modernization of many pump stations, collector-drainage systems, and introduction of new cost-effective water protection technologies. Improving the institutional environment for canal operations, controlling outputs and computerizing the process are urgently needed. The advanced experience of various electro technical equipments for the regulation of water discharge and water-salt regime for opened irrigated systems, developed by the Tashkent Institute of Irrigation and Agricultural Mechanization Engineers, fits the regions well (Djabarrov et al.2001.)

An overview on improvement and maintenance of irrigation systems in Uzbekistan has shown that the systems still tend to be administrated, but not to be managed. As a result, it is not done cost-effectively. This is also the case for many irrigation systems in the neighboring countries. The formal institutional structures are no longer adequate to address modern innovations, issues and problems. The serious policy and management problems underlying the absence of an orientation to achieve high performance, provision of services to customers or the slow pace of innovation are deeply rooted in institutional structures. For example, the state-sponsored irrigation schemes are organized into interstate cooperation with self-management as the ultimate goal in Uzbekistan. The cooperation has no access to credit. It is able to raise sufficient funds to cover their costs, including investment renewal such as pump replacement. Cooperation and shares of information are still problematic.

Another key reason is that the Ministry of Agriculture and Water Resources of the Republic of Uzbekistan is characterized as a high degree of centralized authority, and the diversity of tasks. A few senior officials hold most authority. They have a wide span of control with little delegation of responsibility. Subordinates are reluctant to accept authority even though it is offered. There is a significant "accountability gap" between the Ministry officials and water users. Human resources policies are also not available to adopt innovations and improve performance. In short, the Ministry would need further improvements in its overall framework, management processes and human resource policies if it deserved to attain efficient and effective uses of technological innovation of irrigation systems in the future.

In our opinion, the design process of larger irrigation systems is best conceived as a socio-technical process rather than a purely technical process. It should be based on a dialogue with water users and designs that are simple to maintain and operate. It should also use low-cost materials, and should be driven by local demands. A comparative analysis of different strategies for rehabilitation, reconstruction and modernization of irrigation systems in Uzbekistan indicated that more attention to institutional strengthening, involvement of water users in planning and implementation of improvements, made such projects far more cost-effective.

1.3 Frontier spirit in Central Asia

Lyman D. Wilbur, an American engineer, reported about his irrigation engineering jobs under the two-year contract with the Soviet Union in “Surveying through Khoresm, a journey into parts of Asiatic Russia which have been closed to western travelers since the World War” (*The National Geographic Magazine*, 1932, p753-780.). Two other Americans, Arthur P. Davis, who was a director of the United States Reclamation Service from 1914 to 1923, and V. V. Tchikoff, worked on the same project with Wilbur. Their purpose was to investigate possibilities of reclaiming great tracts of rich, but spasmodically watered country. At that time, the Russian government was interested in increasing cotton production. They found its soil and climate well suited to cotton growing in Amu Darya river basin, and started thinking about means of bringing water to the lands using modern irrigation technology.

They found some problems with the primitive irrigation system in use. First, the bottoms of the present canals were below the surface of river water when river flow was maximum in late spring and early summer, but above that in fall and winter. Thus, the amount of water diverted depended on the level of water surface that was high only in summer. Second, a large amount of silt was carried into the canals every year, so farmers had to devote much time to cleaning silt away that they could not properly care for the lands. Third, all of the old canals were constructed in sinuous lines. When the Russians first laid out straight canals, native people refused to work on those canals because they believed that the water would refuse to run if it could have seen itself. Sinuous canals generated significant water loss in terms of infiltration and evaporation. Fourth, native pump “system” did not have enough capacity to provide water into the lands. As a patient donkey turned the wheel, the native pump called, “chigir” would lift 100 gallons of water a minute, irrigating only about 7.5 acres.

We can see sophisticated irrigation systems that resolve those problems mentioned above on the Right Bank of Amu Darya these days. American irrigation technology and frontier spirits gave a significant impact to those irrigation systems in the early stage of modern irrigation development.

1.4 Irrigated Agriculture Development

Uzbek irrigated agriculture is characterized as high average crop yields compared with those of other Central Asian riparian countries. This apparent success can be attributed to excess use of water resources that are currently to sartisfy demands in most places. This situation to meet agricultural water demands is remarkable in view of Uzbekistan‘s total dependence on irrigation water from the Amu Darya ,Syr Darya and other rivers. There is increasing pressure on its limited water supply. Nevertheless, there are excellent opportunities for adding the value of agricultural outputs especially in the plains and foothilss areas. On the other hands, several trends show a future likelihood that the productive agriculture of the Amu Darya Basin would have a hard time.

There are different types of irrigation technology that were still applied for the cultivation of various arable crops in the territory of Uzbekistan. All these irrigation technologies can be divided into two subgroups: superficial (furrow/grooved irrigation, strip irrigation, sprinkling, inundation or flooding irrigation, and drip irrigation) and subsurface types of irrigation.

The traditional and oldest irrigation technology that has been in large-scale use in Uzbekistan since medieval times, and has continued to exist today, is the furrow / grooved irrigation system. At first this type of irigation was developed and widely used in the old irrigation zones such as Samarkand, Khiva, Termez and Buchara. This irrigation technology showed very effective results on the agricultural development of arid and semiarid areas in all Central Asian countries and Caucasus.

This traditional irrigation system (network of open canals) was well developed by 1959 on approximately 10,000 ha by B.D. Sukernik and B.E. Plesovskiy in Golodnaya steppe (Mirzachul with about 10,000km^2) that included territories of Syrdarinskaya and Dzhizakskaya provinces (Uzbekistan), part of southern Kazakhstan, and Zapharobod region from Tadzhikistan. This experiement was rapidly extended on large part of Golodnaya steppe in 1965. In its southern part, a network of more than 750 km of open irrigation canals, 1,330 km of drainage canals, and 118 vertical drainage pumps, was constructed.

The essential purpose of this irrigation system was to supply crops with water, which was achieved through an artificially created furrow network. Water from any water source was transported into the net of interdistrict canals using a special machine pumping mechanism through an irrigation main line canal. Each cooperative farm called “sherkat” took water through the owner net of interfarm canals. The management of water use by each sherkat was regulated through so called “uchastkovyi raspredeliteli” (divisional distributors) from where water flow was allocated into furrows, that could be arranged transversally or longitudinally. Each watering furrow had a height of

15-17 cm and reached 200-300m in length. The furrows were constructed using a special furrow-cutting machine, while the distribution and water management had been performed manually. Depending on field inclination and edaphic characteristics, about 1 liter/sec of water was provided simultaneously by each furrow.

The volume of water used for watering mostly depended on crop variety. For example, for cotton cultivation, one watering required 900 m^3 of water per hectare in Surkhadarya region while 500 m^3/ha was required for cultivation of grapes or fruit trees. Rice cultivation farms required more than 1,000 – 1,200 m^3/ha per watering. The water flow rate also depended on plants' ontogenetic developmental stage. Generally, all of the above-mentioned crops required more water at the blooming stage. The total number of waterings made during cultivation of cotton were 10-12 per harvesting period.

Advantages of furrow irrigation:

-Ccould be used for any type of soils;

-Could be used for any crops, except for rice;

-Highly turbid water could be used. In this case the particles (silt/sand) dropped out of the stream into the soil;

-It was very simple and economical using technique/machines, and effective in arid/semiarid zones, and even on sands.

Disadvantages:

-Could not be used on highly-inclined sites;

-Much manpower (labour force) for distribution and water management in the field was needed;

-This irrigation system required much water from water sources. In addition, more than 50% of water was lost during the watering outflow process;

-Special treatment of soils after watering was required.

-The gradual accumulation of salts into the upper layers of soil was occurred;

-The operating ratio of water and considerable difficulties arised in its mechanization and automation.

Besides that, a possible problem of increasing water and soil salinity should be considered in Zerafshan, Syr Darya rivers basin, Karakalpakstan, and Buchara oasis after they used the furrow type of irrigation. In order to decrease the level of salinization and mineralization of both the groundwater and soil, different types of drainage systems were used. For such purposes, the drainage system could be constructed between two neighboring divisional distributor canals in each cultivating farm. Depending on the hydrological regime of arable lands, three types of cut drainage systems (open, closed and vertical pump) had still been in frequent use in Uzbekistan.

The construction of any network drainage system required consideration of the geomorphological structure of landscape and hydrogeological characteristics of the arid/semiarid area. For instance, 40,000 km² of Amu Darya delta was dissected by many dry riverbeds, marshes and small lakes, resulting from the change in the Amu Darya river course during past geological time. River beds of Surkhandarya and Sherabad steppes developed a special mechanism of drainage, the so-called natural mechanism of desalinization, over a long period. In this case, groundwater flowed into the river. Since the groundwater table rose, the increase in level of their salinisation and mineralisation did not occur. This phenomena suggested the use of Amu Darya river water for promotion of a subsurface irrigation system in all ripparian countries of Amu Darya River Basin (Afganistan, Uzbekistan, Turkmenistan, and Tajikistan).

In the lower part, however, Amu Darya river delta,strongly affected by actual eolian erosion, feeded neogenic sand deposits of the Kyzylkum desert. As a result, turbidity, concentration of silts/sand particles and level of salinization and mineralization of groundwater were higher than those of the lower reaches of Amu Darya delta (Surkhandarya, Kashkadarya regions in Uzbekistan, nothern parts of Afganistan and a few lands near the Tajik border).

The farmers of Surkhandarya province, however, have developed a very perspective irrigation system in terms of agricultural developemnt of sands and/or extreme dry lands by using of artesian (weakly saline water). Special attention should be given to the irrigated agriculture development that widely occurred in the Kattakum desert and in the lower part of the Surkhandarya province. Patchy sands spread in the north-western part of Termez, Dzharkurgan district, and Kumkurgan district. Then, they extend into Turkmenistan and Afghanistan.

The Kattakum Desert represents low lands and sandy hills with elevation between 200m and 380m. It encloses heterogeneous environment comprising sand dunes, rarely gypseous flats and clay depressions. It undergoes extreme continental arid conditions, limited and unreliable winter precipitation (90-180 mm), and high level of evapotranspiration. Temperature in the desert extreamlly fluctuates daily, seasonally and annually. Soils contain low salinity and gypsum content. As a result of all theses extreme conditions, the Kattakum Desert has sparse and diverse psammophytic vegetation covers.

The distinctive features of Kattakum sandy desert in contrast to other Central Asian desert are a low humus content (0.3-0.6%), a high water infiltration rate, insignificant mobile substrate, condensation ability, and low salinity. All of these futures are due to the sand properties. Nevertheless the gradually sedimentation of clayely particles from watering water (adjoin irrigated field) decreases deflation of sands. It also improves water (moisture) holding capacity of soil. It facilitates the large accumulation of humus and nutritional elements into the soil. Moreover, the sandy substrate differs from other substrates. A favorable water regime provides a long period of growth for the vegetation because of easily available stored water in the soil profile.

Otherwise, a number of negative aspect affect the plant cover on sandy soils such as sand mobility that limits plant establishment, especially at the early stage of ontogenesis. Poor soil structure and low organic matter also appear. It is easily loosened with trampling by livestocks' grazing.

A special crop rotation is taken into account there. As is shown on figure 5, the cultivation of grapes, fruit trees, melon-guard crops and/or a different assortiment of perennial drought/saline tolerant forage plants, especially from Gramineae is recommended for the agriculture developement of very fragile sandy desert lands at the first stage of their reclamation. Local farmers for irrigation of such kind of crops use the artesian (fresh) water by drilling a hole (of about 50-60 m in depth) with gradually collected water (stock) into a special tower (Figure 6).

Figure 5. Grapes and fruit trees under irrigation with artesian water in Kattakum, Uzbekistan, August 2002.

Photo by K. Toderich.

Figure 6. Water tower in Kattakum, Uzbekistan, August 2002.

Photo by K. Toderich.

Water to the irrigated field is given through a system of pipes with about 12-15 cm in diameter. For successfull developemnet and fruit development of indicated crops 2-3 waterings are made, usually in spring and early summer seasons. The cotton cultivation and, rarely rice cultivation has been done at the second desert sands reclamation/rahabilitation stage when the soil improvement is observed.

1.5 History of subsurface irrigation use

Many local and foreign experts consider the subsurface irrigation system available today as one of the most rational and effective irrigation technologies. The subsurface irrigation concept has more than a century of history. In many advanced countries, scientists have studied this advantageous type of irrigation for many years. In the Soviet Union, the study of subsurface irrigation began in 1923. Subsurface irrigation didn't find wide application until 1950's due to a lack of access to cheap and durable materials required for installation and maintenance. This irrigation system has been developed on a large-scale on the serosems soil in Ukraine, Caucasus and to a lesser extent in Central Asian countries.

B.G. Kornev and A.N. Kostyakov have conducted many years of research to promote this system and adapt it to the conditions of Uzbekistan. Firstly, the moistened polyethylene perforated tube system was applied in 1967 in Tashkent region on the experimental plots of All Union Institute of Agriculture. In 1970, the systematic scientific research on the application of subsurface irrigation system started during the agricultural development of Golodnaya steppe virgin lands. This type of new technology was used for the cultivation of traditional crops, in particular, cotton in many collective farms there. In the territory of Syr Darya region, the collective farm under the name of K. Voroshilov has only a single function today. In this region, the area of more than 120ha continued to use and test a subsurface irrigation system. A long-time exploitation of subsurface irrigation by Voroshilov sherkat' farmer demonstrates the necessity of construction of a settling tank that avoids the untimely up silting of the perforated tubular pipe system. The cleaning of the pipe system after 3-5 years of exploitation is recommended in that case.

Nevertheless, high cost of installation, maintenance and management of such kinds of irrigation prevented their expansion into other arid/semiarid regions of Uzbekistan. In Surkhandarya valley, no cultivating farm has used the subsurface type of irrigation. The low salinity of water both from Amu Darya and groundwater indicates the perceptivity of development of subsurface irrigation in this region, especially in its southern part.

1.6 Principle and mechanism of subsurface irrigation

Subsurface irrigation involves the supply of water to crops through special moistened pipes laid in rows in arable lands. Water flows in these pipes due to a low-pressure head, and water moves vertically to a plant's root system due to a soaking up force of the soil (capillary pressure). It is possible to adjust the subsurface irrigation system precisely to allow air-moisture soil conditions as well.

Settling-tanks should be constructed before the installation of any pipe system. Their mechanism of working is connected with the sedimentation of mechanical silt/dust particles, as well as precipitation of many heavy cations (Al, Mg, Ca etc.) that easily lead to the up silting and/or corking of tubular pipes. The use of clean/pure and non-saline water is more efficient particularly for the development of subsurface irrigation system in Uzbekistan.

For such purposes, the artesian water (natural springs) that gushes out from a 6.5-20m and more depth with a mineral content of 5-7g/l in the arid/semiarid zone can be applied for the cultivation of crops, grapes and fruit trees. It is very important to take the type of soil into account. High yield and good development of plants are anticipated when serosems, slightly clayey loam, and rare non-saline gray brown sandy soils, are used under subsurface irrigation system. For instance, the annual yield capacity of cotton is 0, 32-0,42t/ha, sometimes more than 0,60t/ha, which is 20% higher than after applying furrow irrigation.

The effectiveness of the subsurface irrigation system is also determined by crop variety and mostly by root system morphology. Cultivated fodder grain, legumes, melon and gourd crops respond positively to the subsurface irrigation while fruit trees due to high ramification of their root system, leads to the corking of pipe perforations. In such a case, drip irrigation seems to be one of the most effective technologies for viticulture and horticulture development. For prevention of secondary soil salinization, crop rotation should be used. For example, it is recommended to harvest rice after other crops harvesting 3-5 years later.

Subsurface irrigation technology increases yield (usually more than 20%). It decreases water intake to 1.3-1.5 times less than that of furrow irrigation. It decreases evaporation that disturbs the treatment of soils under irrigation area. It can simplify the treatment of plants. It increases the efficiency of water-soluble fertilizer and oversimplifies its drilled fertilizing. The seasonal watering is automatically and easily controlled. The subsurface irrigation technology allows for control of the soil aerial-moisture regime. Long-term use of polyethylene pipes would save maintenance costs. Besides, this type is a sustainable and technically viable irrigation method that can be applied for farming crop cultivation of steep slopes to prevent soils and water erosions. Inter-row and non-wetted space can be used for vegetable cultivation that will eliminate common negative local farmer’s perception on vine production under drip irrigation. They cannot earn any income during first 3-4 years of grape harvesting. By using this technology, farmers will be able to earn some money from producing vegetable and melon in the first year. These are examples of advantages for the subsurface irrigation system.

Disadvantages of subsurface irrigation system in all riparian states would be still high cost for construction and installation. Insufficient moistening of upper soil layer sometimes deteriorates the germination and growth of seedlings, especially in the early stage of plant ontogenesis.

Traditional subsurface drip irrigation system includes pumping equipments that are very expensive. Therefore, it is planned to develop a design of new systems to make the subsurface drip irrigation more attractive and acceptable for the farmers. An operation head of 1.5-2.0atm is generated by natural difference in altitude of water diversion point and water divides (self-pressurized system). The upper portion of the land adjacent to the water diversion point where the water head does not reach 1.5-2atm can be irrigated by using low-pressurized drip-jet systems.

In the Right Bank of Amu Darya, low-productive manual works of labors are still widely accepted with out-of-date irrigation methods and technologies. Irrigation operated manually does not provide uniform distribution of irrigation water and irrigation rates that often exceed crop water requirement in 1.5-2.0 times. This circumstance leads to low water and fertilizer use efficiency. It also negatively affects the environment (soil erosion, buildup of pesticides, and nutrient contamination of surface and groundwater sources, soil salinization and water-logging.) Hence, there is a need for promotion of efficient irrigation methods that would meet the requirements for sustainable water use, soil conservation and improvement of agriculture crop productivity.

New models of irrigation systems (sprinkler, conjunctive, subsurface drip irrigation, lift irrigation, and ground water utilization) have been tested in the region. New technologies on utilization of marginal water sources (recycled water, and drainage water) improving crop rotations through crop diversification and conservation tillage practice as well as involving new alternative crops and their varieties (grains, fodder legumes and other crops) have been also examined. The utilization of saline water for irrigation of windbreak forest strips in the dry areas of Fergana Valley is also a good example of technology introduction into the region in terms of how to save water quality and how to contribute to the improvement of environmental status in the region.

One of the most progressive sprinkler irrigation systems including special sprinkling carts has been recently tested in Uzbekistan. The Ministry of Agriculture and Water Resources of Uzbekistan has experimented a new machine “Beinlich” (Germany) in agricultural production in Hungry Steppe.

In recent years, Uzbek rural agriculture production system dependent on groundwater pumped from private tube wells has grown increasingly. Nevertheless, few studies have revealed how water markets should be operated and what the social and environmental consequences of privatization will be. Private sector of tube well water extraction and operations are not monitored or regulated. International Irrigation Management Institute (IIMI) Research described strong reservations about the likely impact on the sustainability of irrigated agriculture with the turnover of public sector tube wells to the private sector (Johnson and Vander Velde 1992, and Merrey, 1997.) The research activities in many south Asiatic and Indus Basin countries, however, demonstrate how owners of private wells use susceptible groundwater for government energy pricing policies, technology promotion programs, and canal allocation rules (Murray-Rust and Vander Velde, 1994). Further research is needed for these issues

In Afghanistan, those types of irrigation system mentioned above have not widely been used yet. There were many attempts of soviet scientists (1967-1978) to transfer the Uzbekistan irrigation experience to Afghanistan, especially in the northwestern part (Dzhurabekov et al, 1981.) Nowadays, local farmers, however, preferred to use the flooding irrigation technology for the cultivation of arable crops, citric and fruit trees, grapes etc.

Many of the researches on operation and management transfer of irrigation systems indicated a considerable gap of integrated activity between local researchers, policy markers, managers, or farmers, and those of international in Uzbekistan and other Central Asian States. Nevertheless, the long term experience and functions of irrigated agriculture systems in Uzbekistan will provide a model for regional activities in the future

1.7 Rice Irrigation

World rice prices dropped in the early 1980s. That was in substantial measure due to the success of rice research and irrigation development, causing production deficits to be replaced by surpluses in several countries. A response against falling of prices was a favor to introduce other higher–value crops (crop diversification programs) along with rice into many irrigation systems of South and South East Asia (Miranda et al 1993.)

The recent research confirmed the paradox that, although economic analysis showed many crops to be more profitable than rice, the farmers hardly adopted these crops. The progress of diversification was very slow. In many cases, water delivery problems seemed to explain this situation. Most alternative crops required much higher levels of investment of time and money. They also carried much higher level of risk, than that of rice cultivation. The research and networking specified that diversification was not a technological matter. It affected production relations, social and economic relations, and institutional behavior at many levels (Kikuchi, 1992.)

Interest of Central Asian countries in rice-cultivation has a long history. Rice-farming system has been transferred from India about 3000 years ago during the Bactrian time. The large-scale development of rice-production in the Central Asian region started at the beginning of the 19th century. At present, irrigated rice agriculture of the countries located within the area of Aral Sea Basin has been developing with exhausting water resources. Water deficits of various duration and severity are commonly observed in this region along with deterioration of water quality. This situation has grown more serious especially in the Amu Darya Basin where the rice-irrigated fields are concentrated. Nowadays, most of the river water is used for industry, drinking, and irrigation in floodplains (upstream, mainly in Surkhandarya region) and Delta (Khoresm region, and Karakalpakstan Autonomous Republic.) It is strongly depleted before approaching the Aral Sea.

Recent drought has deteriorated water supply and damaged agriculture especially in the Amu Darya Delta. Rice acreage had remained stable within 150,000-190,000 ha until 1999. Then it dropped to only 37 000 ha harvested in 2001. Rice yield remained fairly stable over the whole period (mean=2.5 t/ha, Stdev=0.64 t/ha, n=10) in spite of a sharp drop in 1999.

State or Region	Area Harvest (ha)
Karakalpkstan	80,000
Khorezm	25,000
Tashkent Region	9,000
Syr Darya Region	6,000
Surkhandarya Region	5,000
Total	125,000

Table 2. Planed rice harvest area in Uzbekistan in 2001.

Narodnoe Slovo, January 30, 2001.

Table 2 shows the planned rice harvest area in Uzbekistan in 2001. The Uzbekistan government was supposed to produce 433,700 tons of rice in a 125,000 ha harvest area. Figure 7 shows the rice field on Right Bank of Amu Darya floodplains in Surkhandarya region, Uzbekistan in August 2002.

Figure 7. Rice field on Right Bank of Amu Darya floodplains, Surkhandarya, Uzbekistan, August 2002.

Photo by K. Toderich.

Nevertheless, only 135,542 ton was produced in the harvest area of 37,557 ha. Table 3 shows actual rice production in Uzbekistan. It was only 31 % of the estimated production. 90 % of total rice harvest areas (80,000 ha) in Karakalpkstan were subversive due to the shortage of water.

Year	Production (t)	Area Harvest (ha)	Yield (t/ha)
2001	135,542	37,557	36.1
2000	154,800	124,900	12.4
1999	420,800	164,200	25.6
1998	346,300	148,400	23.3
1997	388,800	195,300	19.9
1996	450,000	185,000	24.3
1995	327,600	165,900	19.7
1994	498,300	167,000	29.8
1993	544,600	180,700	30.1
1992	538,900	182,020	29.6

Table 3. Rice production in Uzbekistan

FAOSTAT (http://apps.fao.org/default.htm)

Figure 8 shows the dynamics of average yield (ton/ha) of barley, cottonseeds, wheat and rice in Uzbekistan from 1992 to 2001. Figure 9 shows relative harvesting areas for these crops in Uzbekistan from 1992 to 2001. Regression lines (broken lines) in figure 8 describe trends of yield for wheat and barley.

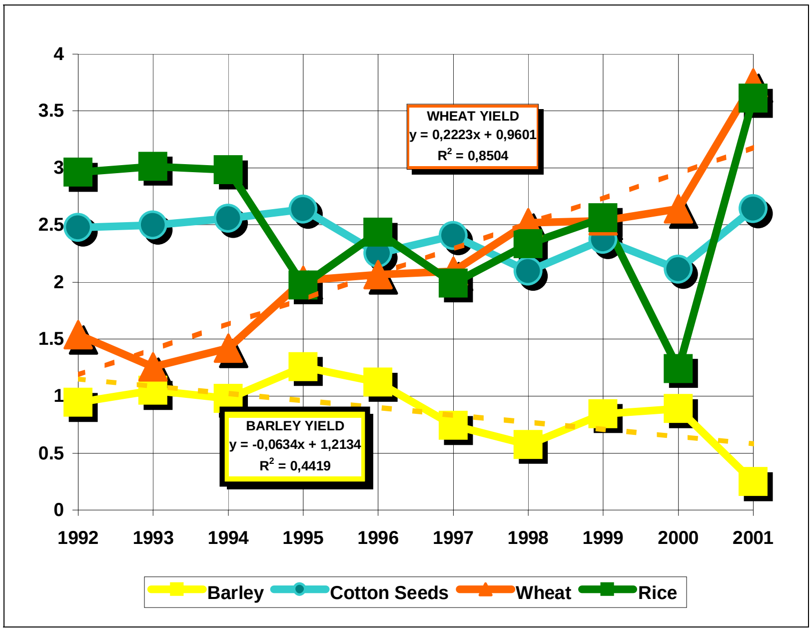


Figure 8. Average yield (t/ha) of major crops in Uzbekistan, 1992-2001.

FAOSTAT (http://apps.fao.org/default.htm)

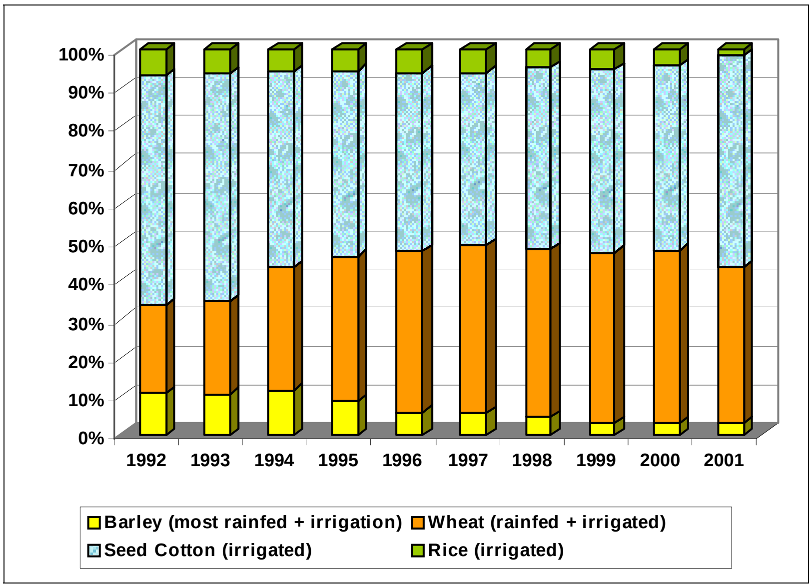


Figure 9. Relative areas of major crops harvested in Uzbekistan, 1992-2001.

FAOSTAT (http://apps.fao.org/default.htm)

Crop farming in Amu Darya Delta, particularly rice cultivation under irrigation, is not competitive with other alternatives. Despite several subsequent reforms that aimed at maintaining grain production and keeping peasants in farming farmers seemed to be worse off. Amu Darya Delta areas go out of production.

1.8 Stalin and Koreans

We had better review the history of Stalin era to understand why Amu Darya River Basin became one of the most prosperous rice producing districts in Central Asia. The keys to answering this issue are “Stalin” and “Koreans.” In 1937, about 180 thousand Koreans were compulsorily migrated from boundary areas of Far East edge to Central Asia. The National Council of the Union of Soviet Socialist Republic (USSR) and the Central Committee of USSR adapted the Decision No.1428-326cc on August 21, 1937. According to the Decision, the purpose of this forced migration was to prevent Japanese intelligence from penetrating Far East areas in Soviet Union. Provision 3 and 4 of the decision presented related information about the issue.

3. *A Korean person can have possessions, agricultural tools, and animals in the case of migration.*
4. *The movable properties, real estates and seeds that the migrating people will leave are estimated in money and compensated for.*

Nevertheless, Aeliah Lee argued that these provisions were not implemented (Lee, 2002.)

At that time, Korean people did not have enough time to prepare the forced migration. Migration of 180 thousand Koreans had been completed within 2 months. This instance showed us how intensively and immediately this forced migration was implemented. Some Koreans received a receipt or a certificate for their property, but most of them were never compensated for. In short, Koreans arrived in Central Asia with nothing.

Lee insisted that there were a few other purposes of Korean migration. First, the Soviets expected the installation of far advanced rice cultivation skills of Koreans into semi-arid barren lands of Central Asia. Besides, the Soviets wanted to supply labor forces where the population was decreased strikingly. Therefore, forced migration of Koreans facilitated rice cultivation in Amu Darya River Basin. This was a passive or dark-side reason.

There was a positive reason. Before the forced migration, a small population of Koreans voluntarily migrated in Central Asia. A 1926 census showed a small number of Korean residents in Tashkent, Buhara, and Surkhandarya. Korean Agricultural Cooperative Association existed in Tashkent in 1924 (Maruge, 1982.) They named their rice, “Uzris” in Uzbekistan and “Kazris” in Kazakhstan. Uzris is still a popular cultivated sort in Surkhandarya region today.

As we can see in this section, the Right Bank of Amu Darya has been highly productive lands for irrigated agriculture. Besides, some new irrigation technologies such as subsurface drip irrigation are available to increase production and to improve yields of crops. These technologies also enable us to cultivate crops that we cannot cultivate with limited water resources in the semi-acid region so far. We assume that the Left Bank of Amu Darya possesses equivalent edaphic and agricultural potential compared to the Right Bank. Therefore, we should apply these new irrigation technologies to the Left Bank to construct permanent food production for starved Afghan people. In the next section, we will review the Left Bank of Amu Darya, Afghanistan.

2. Agriculture in Northern Afghanistan before the Soviet Invasion

Learning former agricultural conditions in Afghanistan might give us a better understanding of local agriculture in Afghanistan and help us develop a more elaborate agricultural rehabilitation plan. Kyoto University has been the top institution for Afghan studies in Japan, and it has accumulated a great deal of valuable works. Let us review some of them to know how northern Afghan people farmed before the Soviet Invasion.

The Kyoto University Scientific Mission to Iranian Plateau and Hindukush has been conducted since 1955. The research team of the 5th Scientific Mission to Iranian Plateau and Hindukush left for Afghanistan in 1964. One of the objectives was to investigate agricultural districts in the provinces of Heart, Badghis, Faryab, Jawzjan, Balkh, Samangan, Kunduz, Takhar, and Badakhshan.

Double cropping was in general in those semi-arid regions. Farmers generally harvested wheat or barley in winter and cotton, beet, or melon in summer by lift brook irrigation. Irrigation canals we can see on the Right Bank of Amu Darya these days had hardly been seen there. “Qanat” or “karez”, which was subsurface water channel, existed to provide drinking water to local residents, but those water resources were not enough to harvest crops. Figure 10 shows Amu Darya River near old Termez, Uzbekistan, and the Left Bank of Amu Darya, Afghanistan in August 2002. It gives us a brief image of the Left Bank.

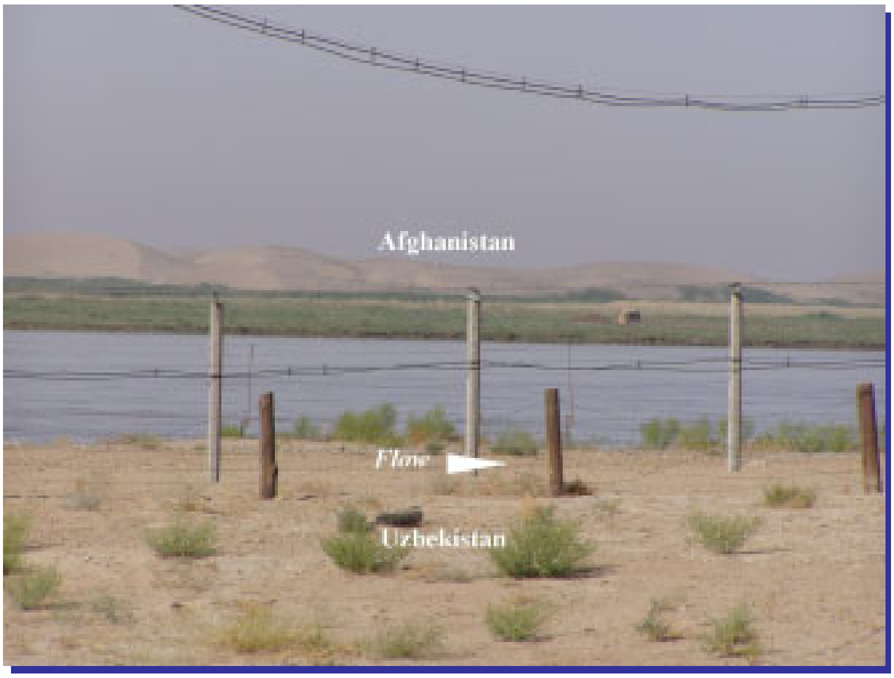


Figure 10. Amu Darya near old Termez, Uzbekistan, and Left Bank of Amu Darya, Afghanistan, August 2002.

(N 37 16’05, E 67 11’03.) Photo by K. Toderich.

Single crop rice fields with bunded irrigation had been seen near the cities of Khanabad and Kunduz in Kunduz province. Bunded irrigation used temporal reservoirs surrounded by low height ditches (1~2m). When the level of river water was high in early summer, farmers built ditches near stream and stored water for irrigation. Lift irrigation systems by waterwheel had hardly been seen in this area. That was because the slope of the river was very gentle even though the volume of water was rich. Permanent canals had not been seen either. Large-scale irrigation systems like those on the Right Bank of Amu Darya were not necessary for Afghan local agriculture sustaining the small local population.

Lift irrigation was a typical method of local agriculture along the Balkh River in northern Afghanistan. There were many waterwheels (paikwo or ab-juaz) along the Balkh River near the city of Mazar-i-sherif. Local farmers used the waterwheels to pump up river water for irrigated crops and to grind grains (wheat, barley, and corns) into flour. The gradient of the river was steep to provide strong flow rotating a waterwheel. On the other hand, there were few waterwheels on the Left Bank of Amu Darya (Afghanistan) because the hydraulic gradient was too gentle to rotate the waterwheel. This was one of the reasons why the Left Bank of Amu Darya had not been irrigated. Figure 11 describes waterwheel distribution along Balkh River in Turkestan Dasht, Afghanistan in 1964.

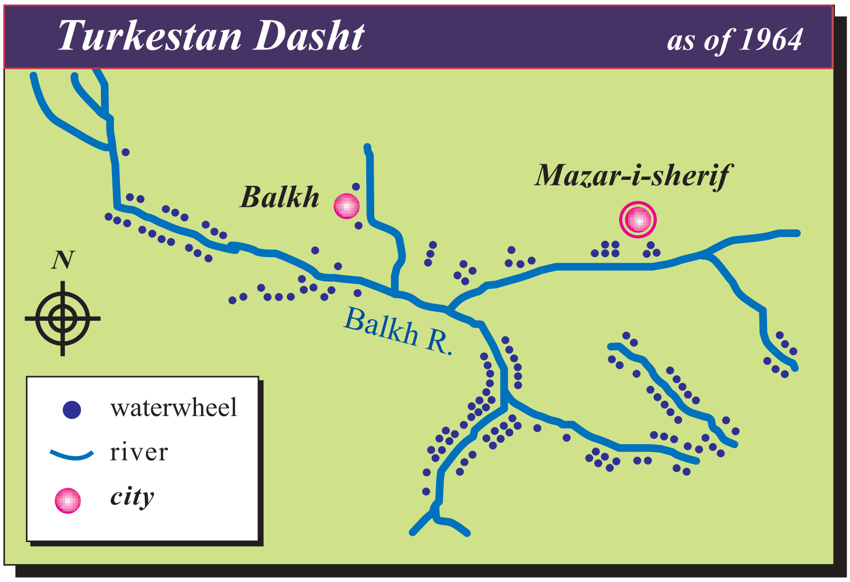


Figure 11. Waterwheels Distribution in the Balkh River Basin, 1964.

"Agriculture on Rural Economy in South-West Asia," 1967, p184-185.

Famine has been a continuous and chronic problem in Afghanistan since the Soviet Invasion in 1979. The United States military action against the Taliban beginning from the 7th of October in 2001 made the problem worse. According to the United Nations World Food Programme (WFP) press releases, six million Afghans need food assistance from the international societies. WFP has estimated that 544,000 tons of food will be required in 2002. Furthermore, more than 3,580,000 afghan refugees exist in Iran and Pakistan according to the United Nations High Commissioner for Refugees (UNHCR). Additional 250,000 Afghan refugees have come into Pakistan since the 11th of September in 2001. Food is the most immediate and significant concern in and near Afghanistan.

Food assistance may temporary satisfy the Afghan's hunger, but it shall not resolve the absolute scarcity of food production. The long-term reconstruction and rehabilitation of domestic agriculture in Afghanistan are critical for the resolution. This is what we stand for and is the main purpose of this volume. Actually, several rehabilitation plans are ongoing. The United Nations Food and Agriculture Organization (FAO) have distributed 1500 tons of wheat seed to approximately 30,000 families in rural areas of northern Afghanistan. FAO estimated that Afghan farmers would be able to harvest around 16,000 tons of wheat from the seeds distributed.

WFP is also set to shift the focus of its operations from relief to rehabilitation. WFP has announced a new nine-month emergency operation that uses innovative food aid projects to help millions of Afghans reestablish their shattered lives and build the future for their devastated country. This $285 million operation will provide Afghan people not only continuous emergency food aid, but also foundations for reconstructing the country devastated by the three-year-drought and the two-decade-war. The operation will also fund a series of rapid impact programs designed to reconstruct basic infrastructures such as irrigation systems.

Nevertheless, these irrigation systems require much water from watercourses including Amu Darya and its tributaries such as the Kunduz River, and the Pyandzh River. Again, Afghanistan has not participated in the interstate agreement for transboundary water resources of Amu Darya. It is easy to infer what will happen next. International conflicts between Afghanistan and the Central Asian Republics may occur. In the worst case, these conflicts might bring another tragedy to Afghanistan. Therefore, it is inevitable to arrange the interstate coordination for transboundary water use among all riparian states before the rehabilitation plan for Afghan irrigation systems is promoted.

3. Afghanistan and the Soviet Union

International agreements on the use and quality of Amu Darya transboundary water between Afghanistan and the Soviet Union were signed in the 2 different eras. The first era was the Stalin era (~1953). Afghanistan and the Soviet Union signed the border agreement on June 13 in 1946. Afghanistan gave Kuczka region back to the Soviet Union, granted to Afghanistan in the Afghanistan and the Soviet Union Treaty in 1921. This circumstance entailed closer relationship between both nations. Then, they reached the international water agreement in 1946.

The second era was the Khruchchyov-Daoud era (1953~1963). Nikita Sergeevich Khruchchyov (1894~1971) became the first secretary of the Communist Party of the Soviet Union (1953~1964) and the premier of the Soviet Union (1958~1964). Mohammad Daoud (~1978) was a nephew of Mohammed Zahir Shah, the former King of Afghanistan. Daoud became the Afghanistan prime minister in 1953. After the demise of Stalin, Khruchchyov and Daoud were inextricably tied to each other. The Prime Minister Daoud had steadily promoted economic assistance and military aid from the Soviet Union. In 1954, the Soviet Union offered the grants, $240 million to Afghanistan, and built 60 miles of pipeline from Termez, Uzbekistan. Khruchchyov visited Afghanistan with the Premier Nikolai Bulganin on December 15 in 1955. Then, a joint communiqué was announced on December 18 of the same year. The communiqué designated further assistance from the Soviet Union, such as agricultural development, hydroelectric generations, construction for irrigation, construction of garages, and reconstruction of the Kabul Airport. The Soviet Union also offered $100 million credits to Afghanistan to assist those projects. In 1956, Afghanistan signed a contract accepting Russian supervisors for water facilities construction on July 26. At the beginning of 1958, Afghanistan and the Soviet Union reconfirmed and signed the border agreement on January 18. Then, the second international agreement on the use and quality of Amu Darya transboundary water was signed in 1958. These agreements founded an international commission to cope with the uses and quality of transboundary water resources. Vinogradov and Langford (1999) pointed out that Central Asian Republics inherited the responsibility of this commission after the dissolution of the Soviet Union, but that it became nominal.

After the second era, the relationship between 2 nations had gradually deteriorated. Besides, foreign assistance and aid from the Soviet Unions had inclined towards security and economy. The Premier Khruchchyov was resigned in 1964, and passed away on September 11 in 1971. Zahir Shah resigned the Prime Minister Daoud in 1963. Nevertheless, Daoud carried out a coup d'etat and became the first president of Afghanistan in 1973 while Zahir Shah was visiting Europe. Daoud's spectacular career was put to an end by execution in 1978. Mohammad Turki founded the revolutionary council and became the chairman. Then, the Soviet invasion had disordered Afghanistan from 1979 to 1989. After the Soviet withdrew from Afghanistan in 1989, the Soviet Union collapsed in 1991. Nevertheless, this invasion left profound effects such as ethnic conflicts and the raise of the Taliban, which was a radical Islamic fundamentalism mass in Afghanistan. Hence, any formal framework of international coordination for Amu Darya Basin between Afghanistan and the Soviet Union had not existed after the second era.

4. The framework of regional cooperation after the dissolution of Soviet Union

There were 2 international freshwater treaties for Amu Darya, signed by the Central Asian Republics. Both of them did not include Afghanistan though. The first treaty was "Agreement on joint activities in addressing the Aral Sea and the zone around the Sea crisis, improving the environment, and enduring the social and economic development of the Aral Sea region (1993 Agreement)," signed on May 23, 1993. The second treaty was "Resolution of the Heads of States of the Central Asia on work of the EC of ICAS on implementation of Action Plan on improvement of ecological situation in the Aral Sea Basin for the 3-5 years to come with consideration of social and economic development of the region (1995 Agreement)," signed on May 3, 1995.

Figure 12. Hydro junction from Uchkzyl water reservoir and an Uzbek army lookout in Kattakum, Uzbekistan, August 2002. Photo by K. Toderich.

The 1993 Agreement consisted of 5 articles. This agreement basically said that republics knew that there were some issues relevant to environmental degradation and inadequate water use in the Aral Sea basin. Hence, interstate coordination would be required to solve the issues. Nevertheless, water resources allocation was not covered in this treaty. Four intergovernmental institutions were approved by this agreement: the Interstate Council on the Aral Sea Basin (ICAS); the Executive Committee of ICAS (EC-ICAS); Commission of Social and Economic Development and Cooperation in Scientific, Technical, and Ecological Spheres; and Coordinating Commission on Water resources, acting as the Interstate Commission for Water Coordination (ICWC) in conformity with the agreement signed on February 18 in 1992. ICWC was responsible for water allocation throughout Central Asia. ICAS was charged with implementing the 1993 Agreement. One of the noteworthy points for this treaty was that Russia promised financial and technical assistance in water treatment in Article 3 although Russia did not sign the treaty. The other point was that the importance of legal framework such as international water law appeared on the interstate concern in the Preamble.

The 1995 agreement also consisted of 7 resolutions and 1 joint declaration. The joint declaration was composed of 5 articles. Those articles were the same as those in 1993. The seven resolutions contained the clarification of establishing the International Fund for the Aral Sea (IFAS), and the Executive Committee of IFAS (EC-IFAS). The new IFAS was established in 1997 as a successor to the former ICAS and IFAS. The International Fund for the Aral Sea (IFAS), 1994, provides funds for the protection of the Aral Sea. Setting up ICAS and EC-ICAS was the main purpose of this treaty.

There are some other organizations with respect to Amu Darya water issues. The Scientific Information Centre of ICWC (SIC-ICWC) is a technical function that is in charge of the creation and management of a unified database for water resources in the Aral Sea basin. The Basin Water Management Body Amu Darya (BVO Amu Darya), established in April 1992, is responsible for water allocation, quality control and operation of structures in Amu Darya river basin. There are many institutions dealing with water issues in Amu Darya Basin, but we can hardly understand what institution is responsible for what circumstance due to the lack of legal precision.

5. **Is interstate coordination required?**

A number of researches have been conducted by a variety of institutes and scholars for Amu Darya Basin since the dissolution of the Soviet Union. Most of the researches concluded that the legal and institutional framework for the cooperative management of scarce transboundary water was required to resolve unsustainable economic practices, environmental degradation, and serious social problems in Amu Darya Basin. The first question of this chapter should be whether or not this is true.

E.A. Chait (2000) clarified an interesting analysis in his working paper, "Water Politics of SyrDarya Basin, Central Asia: Question of State Interests." According to his paper, the national leaders of the Central Asian Republics believed that the cooperative management over shared transboundary water resources was not a better option for achieving their own political and economic goals. The reason why they thought like that was the conservationist water management schemes proposed by the international organizations such as the World Bank and United Nations Development Programme (UNDP). Those schemes did not fit the republics' agenda reflecting economical development. Besides, their ineffective continuous investments in regional institutions have disappointed national leaders and upper echelons of republics.

Why don't we go back to the first question of this chapter? The answer seems to be "No" in terms of the thought of national leaders of republics. Nevertheless, the answer should be "Yes" because incompatibility among republics' water development programs can be compromised only by the sophisticated interstate coordination. We should not answer the question based on the deficient interstate coordination they have developed so far. Many scholars have been conceived, as the current interstate coordination framework should be meliorated. McKinney and Karimov (1996) reported that there was a need to develop a basis for international water law that would regulate the republics' relations, their rights and responsibilities, and coordinated their measures for interstate

Amu Darya Basin administration, data collection for water allocation and common planning needs. In their contents, they placed an emphasis on pricing water properly to attain optimum water resources allocation. Vinogradov and Langford (1999) concluded that legal and institutional mechanisms played an increasingly important role in cooperative efforts to manage transboundary water resources in the Aral Sea basin, including Amu Darya Basin. The mechanisms shall be critical to achieve equitable and reasonable utilization, the obligation not to cause significant harm to other republics and sustainable development. These criteria have been stated in Article 5, the Draft Articles of the Law of Non-Navigational Uses of International Water Courses, approved by the General Assembly of United Nations in 1997. They also described that the development of hydrocarbon resources could promote the solution of conflicts relevant to the difference between upstream power generation in Tajikistan and downstream irrigation in Uzbekistan and Turkmenistan in terms of seasonal demands for water.

International law in Amu Darya Basin should be developed to achieve the optimum transboundary water resources management. The law must be enforceable for any riparian states including Afghanistan located in the Left Bank of Amu Darya. Presence of free riders invalidates the law. Therefore, Afghanistan must be contained in the interstate coordination.

6. Conclusion

There are four conditions necessary to attain equitable, reasonable, and optimal utilization of Amu Darya river water resources among all riparian states. First of all, sophisticated interstate agreements for water use must be signed. Second, all riparian states: Uzbekistan, Tajikistan, Turkmenistan, and Afghanistan must participate in the agreement. Third, an independent institution that has superior authority for water use of all participants must be founded. Without these conditions, we shall not be able to achieve effective reconstruction assistance to Afghanistan. Finally, reconstruction funds must be used to support these conditions. Some of the Afghanistan Reconstruction Funds must be allocated to co-improvement of water use efficiency and agricultural development for all riparian States.

Sophisticated interstate agreements can be developed by further understanding the recent international legislative framework for non-navigational use of international watercourses. International Law Commission (ILC) had developed the draft articles on the law of the non-navigational uses of international watercourses in 1994. Then, the General Assembly of the UN approved the draft articles in 1997. These articles have become the common legislative framework for international watercourses since then, although they still seem deficient. For example, the word, “equitable” should be defined more precisely in terms of Economics and Law. Moreover, an ambiguous word such as “refrain” ought not to be stated in the provisions. Ambiguousness may cause eventual excuse of states that tend to prioritize their own benefits.

Article 4 talks about parties to watercourse agreements. The first provision says that every watercourse state is entitled to participate in the negotiation of and to become a party to any watercourse agreement that applies to the entire international watercourse, as well as to participate in any relevant consultation. Then, the second provision says that a watercourse state use of an international watercourse may be affected to a significant extent by the implementation of a proposed water agreement that applies to only a part of the watercourse or to a particular project, program, or use is entitled to participate in consultations on, and in the negotiation of, such an agreement, to the extent that its use is thereby affected, and to become a party thereto. Therefore, Afghanistan is entitled to participate in a proposed water agreement such as the 1993 Agreement and 1995 Agreement signed by the Central Asian states according to the Article 4.

Many empirical and theoretical researches concluded that equitable and optimal scarce resource allocation was never achieved when a free rider existed. Since watercourses have a nature of public good (nonrivalness and nonexcludability), we can regard them as commons. Especially a boundary-making watercourse like Amu Darya has further nonexcludability. Nonrivalness does not exist in the upstream state. However, a watercourse generally has some tributaries, so rivalness might be eased. Tajikistan and Afghanistan have rivalness for their tributaries: the Kunduz River and the Pyandzh River respectively, but they do not have rivalness for Amu Darya because of the presence of tributaries. This fact gives a superior power to upstream states, Tajikistan and Afghanistan, against downstream countries, Uzbekistan and Turkmenistan. The situation whereby the larger the number of tributaries and upstream states, the less the superior power of upstream states against downstream states, is due to declination of rivalness. Therefore, we can regard Amu Darya as commons.

What would happen if Afghanistan did not participate in the agreement? Game theory gives us a clear cut of the issue. In short, Afghanistan becomes a free rider, and an undesirable circumstance, what we call, “Tragedy of the Commons” will occur. Shapley and Shubik (1969) described a similar case in “On the core of an economic system with externalities.” They concluded that commons would have been exhausted if all economic units had respectively pursued their own profits without any regulation or agreement. The issue of resource allocation under an economy where commons exist is one of the most significant propositions in Public Economics, Welfare Economics, or Micro Economics. We do know whether efficient resource allocation can ever be achieved with a market system under this type of economy due to externalities (missing markets). Furthermore, each economic unit has an incentive to enjoy the profits of commons shared with others while taking too much for it (Free-Rider Problem). Therefore, Afghan participation in the interstates agreement for limited water resources use of Amu Darya is unconditional to attain optimal water resources allocation and to conserve commons.

An independent juristic body is required to settle an interstate dispute. Existing institutions such as ICWC, ICAS, and IFAS are not juristic institutions that prescribe interstate water law, have authority of compulsory execution, and settle disputes. They are not legislative organizations either. Since Central Asian Republics did not have a place of dispute settlement, the serious dispute and quarrel occurred between Kyrgyzstan and Uzbekistan in 1997 due to the difference in seasonal water demands. Kyrgyzstan finally decided that most of its water resources would be introduced into hydroelectric power generations in 2001 to complement energy shortage.

To settle this kind of dispute, all riparian states must entrust authority of water allocation to the independent juristic institution whose major objective is to achieve equitable and optimal water resources allocation among all riparian states based on the sophisticated international water law. The institution should consist of independent judges and agents independent from riparian states. They can be of foreign origin such as Russia or Japan. Without the settlement system of dispute, it is very difficult for riparian states to achieve peaceful optimal water resources allocation.

Water resources are vital for Afghan people to feed themselves. Efficient use of scarce transboundary water resources of Amu Darya shall facilitate successful reconstruction assistance to Afghanistan. Interstates coordination of water uses by the independent juristic institution helps optimal water resources allocation and peaceful settlement of disputes. Sophisticated interstate water law provides fair provisions. Therefore, we must tailor interstate legislative coordination for Amu Darya water resources to fit sustainable development of Amu Darya Basin before we proceed with reconstruction assistance in Afghanistan. Finally, funds must be provided to facilitate the above-mentioned activities to reconstruct Afghanistan and the Central Asian states.

Appendix

1. Fraction of Alluvial Soil of Amu Darya at Termez, 1990~2001. (%)

1990

Month	Size of Alluvial Soil Particles (mm)											
	Over 10	10-5	5-2	2-1	1-0.5	0.5-0.2	0.2-0.1	0.1-0.05	0.05-0.01	0.01-0.005	0.005-0.001	Under 0.001
April		62.0	6.0	2.9	5.2	1.0	11.1	9.8	0.5	0.2	0.2	1.1
May		77.0	3.3	0.6	1	7.0	8.5	1.7	0.6	0.1	0.1	0.1
June		98.7	0.3	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1
July				0.4	64.1	23.8	0.7	0.2	8.8	0.4	0.9	0.7

1991

Month	Size of Alluvial Soil Particles (mm)											
	Over 10	10-5	5-2	2-1	1-0.5	0.5-0.2	0.2-0.1	0.1-0.05	0.05-0.01	0.01-0.005	0.005-0.001	Under 0.001
March			87.9	5.3	2.9	1.5	1.8	0.2	0.1	0.1	0.1	0.1
April			93.1	3.6	2.6	0.1	0.1	0.1	0.1	0.1	0.1	0.1
May		47.7	7.6	4.7	16.1	13	9.4	0.8	0.4	0.1	0.1	0.1
June		79.8	5	2.5	8.9	2.6	0.7	0.1	0.1	0.1	0.1	0.1

1992

Month	Size of Alluvial Soil Particles (mm)											
	Over 10	10-5	5-2	2-1	Under 1							
March		49.9	15.7	5.4	29.0							
April		38.7	8.1	6.5	46.7							
May		80.5	1.5	0.7	17.3							
June		53.6	27.1	5.8	13.5							
July		40.7	25.6	8.5	25.2							

1993

Month	Size of Alluvial Soil Particles (mm)											
	Over 10	10-5	5-2	2-1	1-0.5	0.5-0.2	0.2-0.1	0.1-0.05	0.05-0.01	0.01-0.005	0.005-0.001	Under 0.001
March	71.8	8.3	4.6	4.5	7.6	2.1	0.8	0.1	0.2			
April	51.3	16.5	8.2	10.0	12.5	1.5	0					
May	40.4	23.8	10.7	12.7	12.1	0.3	0					
June	31.6	18.1	13.2	19.1	15.8	1.9	0	0.1	0.1	0.1		
July	15.5	26.8	13.9	23.9	13.3	5.4	0.6	0.1	0.1	0.4		

1994

Month	Size of Alluvial Soil Particles (mm)											
	Over 10	10-5	5-2	2-1	1-0.5	0.5-0.2	0.2-0.1	0.1-0.05	0.05-0.01	0.01-0.005	0.005-0.001	Under 0.001
March	54.4	22.6	9.9	8.5	1.6	1	0.7	0.3	0.2	0.8		
April	42.0	21.8	18.4	14.2	0.7	1.8	0.1	0.9	0.1			
May	50.3	19.1	14.2	13.6	1	1.2	0.4	0.1	0.1			
June	65.8	15.4	10.4	5.4	0.9	1.3	0.6	0.2				
July	68.8	15.4	9.5	3.7	1.4	0.8	0.3	0.1				

1995

Month	Size of Alluvial Soil Particles (mm)											
	Over 10	10-5	5-2	2-1	1-0.5	0.5-0.2	0.2-0.1	0.1-0.05	0.05-0.01	0.01-0.005	0.005-0.001	Under 0.001
March	50.4	20.8	12.5	10.0	1.4	3.1	1.1	0.7				
April	62.6	19.1	7.8	6.7	0.6	3.0	0.2					
May	56.3	15.3	12.2	10.3	2.1	3.3	0.5					
June	62.2	17.9	8.8	7.4	1.2	2.2	0.3					
July	62.2	14.1	8.7	8.2	1.1	4.6	1.1					

1996

Month	Size of Alluvial Soil Particles (mm)											
	Over 10	10-5	5-2	2-1	1-0.5	0.5-0.2	0.2-0.1	0.1-0.05	0.05-0.01	0.01-0.005	0.005-0.001	Under 0.001
March	23.0	19.7	27.2	9.7	9.0	7.6	0.7	0.6	2.5			
April	37.2	14.3	10.5	9.9	13.1	12.1	1.0	0.6	1.3			
May	27.3	21.1	21.3	12.2	10.4	5.4	1.1	0.4	0.8			
June	48.7	13.1	13.5	8.6	6.8	5.4	1.2	1.6	1.1			
July	54.7	18.6	10.3	5.2	4.8	3.0	1.3	0.6	1.5			

1997

Month	Size of Alluvial Soil Particles (mm)											
	Over 10	10-5	5-2	2-1	1-0.5	0.5-0.2	0.2-0.1	0.1-0.05	0.05-0.01	0.01-0.005	0.005-0.001	Under 0.001
March	62.2	17.8	7.9	4.6	3.6	2.5	0.7	0.3	0.4			
April	47.9	21.4	15.4	7.9	3.3	2.7	0.8	0.2	0.4			
May	70.6	9.3	7.2	3.8	3.5	3.5	1.2	0.3	0.6			
June	65.7	9.9	7.9	9.5	3.0	2.9	0.7	0.2	0.2			
July	55.6	14.1	12.4	6.2	5.6	4.4	0.9	0.3	0.5			

1998

Month	Size of Alluvial Soil Particles (mm)											
	Over 10	10-5	5-2	2-1	1-0.5	0.5-0.2	0.2-0.1	0.1-0.05	0.05-0.01	0.01-0.005	0.005-0.001	Under 0.001
March	54.2	10.7	9.9	12.9	5.3	6.1	0.9					
April	27.8	24.7	14.9	26.7	0.8	4.5	0.6					
May	42.9	17.3	13.8	19.6	3.1	2.8	0.5					
June	38.4	16.2	17.9	21.9	2.2	3.0	0.4					
July	36.5	17.0	16.9	22.2	3.9	3.4	0.1					

1999

Month	Size of Alluvial Soil Particles (mm)											
	Over 10	10-5	5-2	2-1	1-0.5	0.5-0.2	0.2-0.1	0.1-0.05	0.05-0.01	0.01-0.005	0.005-0.001	Under 0.001
March	57.5	17.2	10.7	10.1	1.1	2.5	0.3	0.1	0.5			
April	38.5	20.2	17.6	20.2	1.6	1.0	0.5	0.1	0.3			
May	35.8	22.4	16.8	22.5	0.2	1.5	0.4	0.1	0.3			
June	33.7	22.2	20.7	18.9	0.3	3.1	0.7	0.2	0.2			
July	21.4	29.2	21.5	24.5	0.7	1.9	0.5	0.1	0.2			

2000

Month	Size of Alluvial Soil Particles (mm)											
	Over 10	10-5	5-2	2-1	1-0.5	0.5-0.2	0.2-0.1	0.1-0.05	0.05-0.01	0.01-0.005	0.005-0.001	Under 0.001
March	32.4	20.4	24.2	20.7	0.8	0.9	0.3	0	0.3			
April	27.5	25.0	24	21.0	0.6	1.2	0.3	0.2	0.2			
May	35.1	21.2	24.7	16.2	1.3	1.1	0.3	0.1	0			
June	30.4	19.8	24.8	22.1	0.9	1.2	0.4	0.2	0.2			
July	26.5	22.9	27.3	21.4	1.2	0.4	0.1	0.2	0			

2001

Month	Size of Alluvial Soil Particles (mm)											
	Over 10	10-5	5-2	2-1	1-0.5	0.5-0.2	0.2-0.1	0.1-0.05	0.05-0.01	0.01-0.005	0.005-0.001	Under 0.001
March	24.4	21.6	21.9	28.9	1.2	0.9	0.7	0.4				
April	31.0	18.7	19.1	28.6	1.2	1.0	0.3	0.1				
May	27.2	24.3	20.0	26.2	1.1	1.0	0.1	0.1				
June	29.6	24.4	20.9	22.1	0.8	1.8	0.3	0.1				
July	24.6	24.4	24.5	23.3	1.3	1.6	0.2	0.1				

2. Agreement on joint activities in addressing the Aral Sea and the zone around the Sea crisis, improving the environment, and enduring the social and economic development of the Aral Sea region (March 26, 1993).

Republic of Kazakhstan, Republic of Kyrgyzstan, Republic of Tajikistan, Turkmenistan, and Republic of Uzbekistan, hereinafter referred to as states-participants:

-taking into account the global character of the Aral Sea designation and the associated deterioration of the environment in the zone close to the Sea, as well as the overall ecological crisis resulting from the deficit of water resources in the basin;

-realizing the danger of the process taking place to the health and well-being of the people in the region, and its negative impact on the environment in other regions, the air basin balance, the economic development and basic functioning of the Aral region, and its negative impact on the environment in other regions, the air basin balance, the economic development and basic functioning of the Aral region countries;

-recognizing the necessity and urgency of uniting material and financial resources in order to overcome the crisis an environmental safety system in the region, primarily in the zone around the Sea;

-confirming their commitment to the international water law principles, respecting the mutual interests of each of the sovereign states-participants of this Agreement in the matters of usage and protection of water resources in the basin, proceeding from the necessity of preserving the Sea; agreed upon the following:

ARTICLE I

States-participants recognize as common objectives:

-ensuring rational usage of the limited land and water resources of the Aral Sea basin in order to ensure the necessary social and economic development and well being of their people;

-maintaining the required water quality in the rivers, reservoirs, and springs, due to an, in future, preventing the release into these bodies of industrial and urban waste waters, and polluted and mineralized collector and drainage waters;

-ensuring the water inflows to the Aral Sea required for sustaining its lowered but stable, ecologically acceptable, levels and by this means preserving the Sea as an object of nature;

-restoring the balance of the destroyed ecosystems in the region, primarily in the Amu Darya and Syr Darya Deltas and on the exposed seabed areas, creating manmade stable landscapes there;

-regulating the system and enhancing the discipline of water usage in the basin, and working out the required interstate legal and regulatory acts that will provide for the application, for the region, of unified principles of indemnifying for damages;

-improving the sanitary and medico-biological living conditions, especially for the sea zone residents, and addressing the urgent problem of a clean drinking water supply for the region;

-working out and implementing the coordinated social and economic development strategy that would meet the requirements of environmental safety for the people in the region;
-carrying out the measures for the protection of migrating animals, including those inhabiting the areas that border on the states-participants, and for creating the nature reserve zones;
-on the basis of the new mutually acceptable terms that have been worked out, resuming the work on having additional water resources flow into the Aral Sea Basin;
-fostering, to the maximum extent, scientific research, projects, and other kinds of activities aimed at the resolution of the listed tasks;
-creating most favored nation treatment conditions, and granting privileges and protection measures to the investors that put their funds into the programs and works aimed at environmental sanitation and social and economic development of the region.

Article II

States-participants consider it necessary:

to establish, on a parity basis, the Interstate Council for the Aral Sea basin crisis, and under it: Standing Tashkent-based Executive Committee; Commission of Social and Economic Development and Cooperation in Scientific, Technical, and Ecological Spheres; Coordinating Commission on Water resources, acting in conformity with the Agreement signed on February 18, 1992 in Almaty. The statute on Interstate Agreement is approved by the Heads of the states-participants. States-participants agreed to draft a joint conception of addressing the Aral Sea crisis and rehabilitating the environment in the area around the Sea, and to draw up a coordinated program on the scientific research and activities, and also to create a common information system of monitoring the environment and to organize issuance of the "Information Review" on the Aral Sea Basin problems.

Article III

The Russian Federation participates in the Interstate Council work as an observer in addressing the Aral Sea crisis and the rehabilitation of the disaster zone. It also provides the required financial and technical assistance in water treatment, creating the domestic and drinking water supply system in the region and fighting desertification. The Russian Federation also cooperates in the scientific and technical spheres, in designing projects of regional significance, in creating the environment monitoring system, and renders expert services and also assists in the training of specialists.

Article IV

The present Agreement is open for joining by any state interested in addressing the tasks and objectives determined within it. This Agreement is concluded for a ten-year period and is being considered for extension for a similar time period, provided none of the states-participants rejects it. A state-participant can withdraw from this Agreement having informed the Depository and other states-participants of its intent at least six months in advance.

Article V

The present Agreement comes into force upon signature. Executed in Kyzyl-Ords on March 26, 1993 in one original copy in Russian. The original copy is kept in the Archives of the Government of the Republic of Kazakhstan, and the latter will forward the certified copy to the states that have signed this Agreement.

FOR THE REPUBLIC OF KAZAKHSTAN
FOR THE REPUBLIC OF TUKENMENISTAN
FOR THE REPUBLIC OF KYRGYZSTAN
FOR THE REPUBLIC OF UZBEKISTAN
FOR THE REPUBLIC OF TAJIKISTAN

3. Resolution of the Heads of States of the Central Asia on work of the EC of ICAS on implementation (March 3, 1995.)

Parties: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan

Resolution
of the Heads of States of the Central Asia on work of the EC of ICAS on implementation of Action Plan on improvement of ecological situation in the Aral Sea Basin for the 3 -5 years to come with consideration of social and economic development of the region

(Main issues)
The Heads of the States of the Central Asia have resolved:
1. To take into consideration the information provided by Mr. A. I. Ilamanov, the Chairman of the EC of the ICAS, on the implementation of Action Plan on improvement of ecological situation in the Aral Sea basin for the nearest 3 - 5 years with consideration of social and economic development of the region (main issues).
2. To instruct the ICAS:
-to improve the work of the EC concerning coordination and supervision on the implementation of the Plan, and to develop mechanism for interaction with international agencies;
-to ensure efficient work of Commission for Social and Economic Development, Scientific, Technical and Ecological cooperation. Accomplished in the town of Dashkhowuz on March 3, 1995 in one original copy in Russian. The original copy is kept in the Archives of the Government of Turkmenistan. The Government will provide each State that had signed the Resolution, with a certified copy.

Signatures:
for the Republic of Kazakhstan, for the Kyrgyz Republic, for the Republic of Tajikistan, for Turkmenistan, for the Republic of Uzbekistan

Resolution
of the Heads of States of the Central Asia on the formation of funds of the IFAS the Heads of the States of the Central Asia - founders of the IFAS have resolved:
l. To take into consideration the information provided by Mr. A. N, Nurushev, Executive Director of the IFAS on the formation of funds of the IFAS.
2. To instruct the Executive Directorate of the IFAS within one month's period in coordination with the Governments of States founders of the Fund to determine the amounts of funds allocated to the implementation of regional programs. The Governments should transfer the specified amounts to the

IFAS and its branches by November 1, 1995.

3. To instruct the Governments of the States - founders to report on the annual basis to the Executive Board of the IFAS on the amounts of funds, channeled to the implementation of national programs, related to the Aral Sea Basin problems. Accomplished in the town of Dashkhowuz on March 3, 1995 in one original copy in Russian. The original copy is kept in the Archives of the Government of Turkmenistan. The Government will provide each State that had signed the Resolution, with a certified copy.

signatures:

for the Republic of Kazakhstan, for the Kyrgyz Republic, for the Republic of Tajikistan, for Turkmenistan, for the Republic of Uzbekistan

Resolution

of the Heads of States on changes in the composition of the ICAS and amendments to the Regulations on the ICAS.

The Heads of the States of Central Asia have resolved:

1. To introduce into the composition of the ICAS: from the Republic of Kazakhstan: Mr. Esimov, Akhmetjan Smagulovich, Deputy Prime Minister;; Mr. Sagadiev, Kenjgali Abenovich, President of the National Academy of Sciences; (instead Messrs, Abilsiitov G. A, and Tursumbaev B. M.); from the Kyrgyz Republic: Mr. Melnichenko, Valery Nikolaevich, of Minister of Water Economy; (instead Mr. Zulpuev M.) from the Republic of Tajikistan: Mr. Akilov, Akil Gaibullaevich, Deputy Prime Minister; Mr. Makhmudov, Isroil Ismoilovich, First Deputy Minister of Economy and Foreign Economic Relations; Mr. Eshmirzoev, Ismat, Minister of Melioration and Water Economy; Mr. Pachadjanov, Daler Nabidjanovich, Vice President of the National Academy of Sciences; (instead Messrs. Nazriev M. , Shafoev V, Safarov N, M. and Djalilov M. R.); from Turkmenistan: Mr. Rajapov, Matkarim, Deputy Chairman of the Cabinet of Ministers; Mr. Kurbanov, Dortkula, Minister of Nature Use and Environment Protection; (instead Messrs. Babakulyev J. and Ashirov N. A.); from the Republic of Uzbekistan: Mr. Dzhumaniyazov, Bakhrom Yadgarovich, Chairman of the Council of Ministers of the Republic of Karakalpakstan; Mr. Gorshkov, Yuri Konstantinovich, Head of Sector of the Cabinet of Ministers; (instead Messrs Yuldashev R. I, and Shadimetov Yu. Sh.) .

2. To establish rotated chairmanship on the meetings of the ICAS, where the representatives of the States of Central Asia will take the Chair in turn in alphabetic order for 1 year period, acquiring the rank of Deputy Head of the Government for the said period; to introduce corresponding changes into the Regulations on the ICAS.

3. Consecutive meetings of the ICAS and the Executive Board of the IFAS should be held in October, 1995 in the town of Kyzyl Orda. Accomplished in the town of Dashkhowuz on March 3, 1995 in one

original copy in Russian. The original copy is kept in the Archives of the Government of Turkmenistan. The Government will provide each State that had signed the Resolution, with a certified-copy.

signatures:
for the Republic of Kazakhstan, for the Kyrgyz Republic, for the Republic of Tajikistan, for Turkmenistan, for the Republic of Uzbekistan

Resolution
of the Heads of States of Central Asia on the election of the President of the IFAS the Heads of States of the Central Asia have resolved:
1. To take into consideration the information of the President of the International Fund
for the Aral Sea Mr. A.N. Nazarbaev on activities of the Fund in 1993-1994 and approve the efforts and measures undertaken by the Fund aimed at improvement of the socio-ecologic situation in the Aral Sea region,
2. To prolong the terms of power of the President of the Fund A.N. Nazarbaev for the period of another year. Accomplished in the town of Dashkhowuz on March 3, 1995 in one original copy in Russian. The original copy is kept in the Archives of the Government of Turkmenistan. The Government will provide each State, that had signed the Resolution, with a certified copy,

Signatures:
for the Republic of Kazakhstan, for the Kyrgyz Republic, for the Republic of Tajikistan, for Turkmenistan, for the Republic of Uzbekistan

Resolution
of the Heads of States of central Asia on Candidate for Chairmanship in the EC Council of the ICAS the Heads of States of the Central Asia have resolved. To appoint one permanent plenipotentiary representative from each Central Asian State that will comprise the Council of the EC. Each member of the EC Council has one vote. ICAS should make appropriate amendments in the EC Regulations. To approve the appointment Mr. Rajapov Matkarim a part time Chairman of the Council of the Executive Committee of the Interstate Council for Addressing the Aral Sea Crisis for a period of one year. Accomplished in the town of Dashkhowuz on March 3, 1995 in one original copy in Russian. The original copy is kept in the Archives of the Government of Turkmenistan. The Government will provide each State that had signed the Resolution, with a certified copy.

Signatures:
for the Republic of Kazakhstan, for the Kyrgyz Republic, for the Republic of Tajikistan, for Turkmenistan,

for the Republic of Uzbekistan

Resolution

of the Heads of States of Central Asia on changes in the composition of the Directorate of the IFAS The Heads of States of the Central Asia have resolved: To introduce into the Directorate of the IFAS: from the Republic of Kazakhstan: Mr. Pavlov Aleksandr Sergeevich, Minister for Finances; Mr. Izteleuov Bisenbay Izteleuovich, Chairman of the State Bank for Development of Kazakhstan; (instead Messrs. Karamanov U.K. and Derbisov E. Zh.); from the Kyrgyz Republic: Mr. Hasanov Rafkat Fagazyanovich, Deputy Minister for Finances; (instead Mr. Atashev K, K.); from the Republic of Tajikistan: Mr. Muzafarov Anvarsho, Minister for Finances; Mr. Alimardonov Murotali Mukhamadievich, Chairman of the National Bank; (instead Messrs. Yunusov I. Yu. and Kavmidinov K. K.); from the Turkmenistan: Mr. Geldyev Oraz Kurbanovich, Deputy Minister of Nature Use and Environment Protection; (instead Mr. Chorekliev T.). Accomplished in the town of Dashkhowuz on March 3, 1995 in one original copy in Russian. The original copy is kept in the Archives of the Government of Turkmenistan. The Government will provide each State that had signed the Resolution, with a certified copy.

Signatures:

for the Republic of Kazakhstan, for the Kyrgyz Republic, for the Republic of Tajikistan, for Turkmenistan, for the Republic of Uzbekistan

Resolution

of the Interstate Council for Addressing the Aral Sea Crisis on the appointment of the Chairman of the EC of the ICAS The Heads of States of Central Asia have resolved: To appoint Mr. Matkarim Rajapov a part-time Chairman of the Executive Committee - Chairman of the Council of the EC of the Interstate Council for Addressing the Aral Sea Crisis for the term of one year. Accomplished in the town of Dashkhowuz on March 3, 1995 in one original copy in Russian. The original copy is kept in the Archives of the Government of Turkmenistan. The Government will provide each State that had signed the Resolution, with a certified copy.

Signatures:

for the Government of the Republic of Kazakhstan, for the Government of the Kyrgyz Republic, for the Government of the Republic of Tajikistan, for the Government of Turkmenistan, for the Government of the Republic of Uzbekistan

JOINT DECLARATION

by Presidents of Turkmenistan, the Republic of Kazakhstan, Kyrgyz Republic, the Republic of Tajikistan and the Republic of Uzbekistan, March 3, 1995, Dashkhowuz.

We, Presidents of Turkmenistan, the Republic of Kazakhstan, Kyrgyz Republic, the Republic of Uzbekistan, having gathered in Dashkhovuz for the annual meeting devoted to problems of the Aral Sea and having conducted bilateral and multilateral negotiations, DECLARE: At present our Region is living through an important, crucial moment in our history, Since gaining independence and sovereignty by our states deep-root structural changes in their social, economic, political and cultural development are taking place. Today foundation of democratic government institutions and society at large are being laid down. Based on the importance of the current moment, being conscious of our responsibility for the present situation and future of peoples of our countries, we confirm that equitable cooperation, good neighborhood relations and mutual respect will become fundamental principles of our policy toward each other. We declare of our willingness to by all means assist to establishment a favorable climate for close cooperation among other countries in political, trade and economic, scientific and technical, cultural and humanitarian areas. Peoples living in this Region are united by common historical and cultural heritage, ages old traditions and moral values. They have always been living together in a spirit of mutual respect, peaceful disposition and good neighborly relations. Along with common spiritual values we are also united by traditional trade and other economic ties based on energy, water and other natural resources of the region. We, heads of new states, should bear this in mind, by our practical actions contribute to further growing of the great heritage left to us by our noble ancestors, should employ it for the purpose of revealing the economic potential available in the countries. This very potential should be employed for resolving vital issues of environment, among which the most burning is the problem of the Aral Sea. Our countries are members of the United Nations organizations, Organization for Security and Cooperation in Europe, CIS and other authoritative international organizations. Observing and keeping in their external policy to commonly recognized principles of international law, we declare on indisputable, respect to territorial integrity and sovereignty of each other, recognizing historically established boundaries. We also acknowledge the right of each state to independently decide ones way of development, to choose one's model of state and social structure, confirm our willingness to refrain from any declarations toward each other which might arise any doubt in relation to unity of our goals and might serve the interests of unfriendly forces. We are engaged in resolving similar issues in the area of statehood building, creating in our countries just society based on democratic values, on abhorrence of political, religious and other forms of extremism. We declare of our openness to equitable and mutually beneficial cooperation with each other, with all countries both on a bilateral and multilateral basis, of our firm and invariable adherence to these principles as a fundamental principle for attaining well-being and prosperity by our countries and peoples.

President of Turkmenistan, S. Niyazov

President of the Republic of Kazakhstan, N. Nazarbaev

President of the Kyrgyz Republic, A. Akaev

President of the Republic of Tajikistan, E. Rakhmonov

President of the Republic of Uzbekistan, I. Karimov

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