ECONOMIC COMMISSION FOR EUROPE

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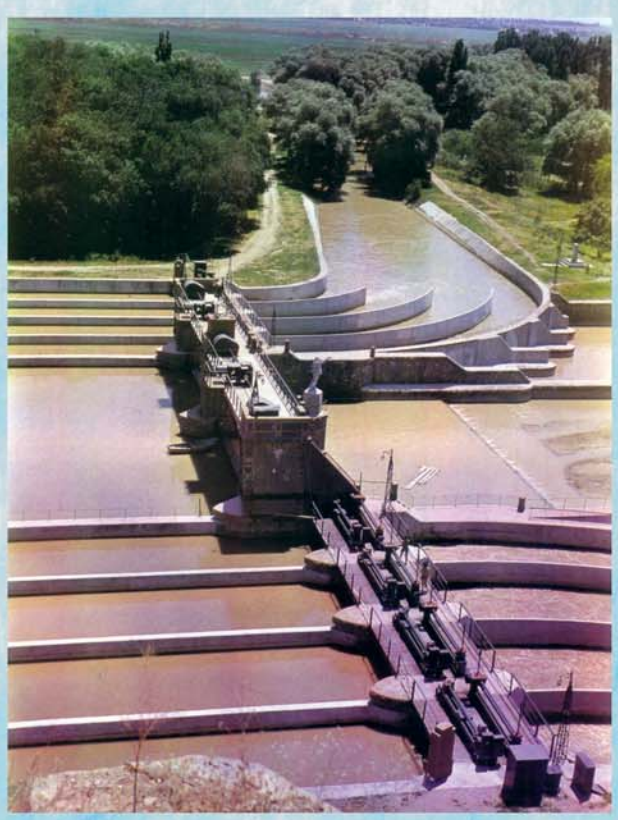
Special Programme for the Economies of Central Asia

Project Working Group on Energy and Water Resources

STRENGTHENING COOPERATION FOR RATIONAL AND EFFICIENT USE OF WATER AND ENERGY RESOURCES IN CENTRAL ASIA



UNITED NATIONS

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FOREWORD

The United Nations accords high priority to Central Asia and its programmes to assist the Central Asian countries in their transition process to a market economy as well as in their economic and social development. As a part of the assistance, the United Nations Special Programme for the Economies of Central Asia (SPECA), has been set up with a view to support efforts of the countries of Central Asia in developing intraregional cooperation and integrating their economies into the world economy. In Central Asia, many of the major development issues and problems are predominantly transboundary in nature and scope. This underscores the importance of intra-Central Asian cooperation for meeting the challenges of globalization and pursuing the path of sustainable development. The pace of progress towards achieving the goals of sustainable development can be greatly accelerated through concerted collective action and equitable partnership of all the Central Asian countries.

Since 1998, the Economic Commission for Europe (ECE) and the Economic and Social Commission for Asia and the Pacific (ESCAP) have been working jointly with the Central Asian countries for the implementation of SPECA. Within the programme, rational use of the region's energy and water resources has been accorded high priority for enhancing cooperation. A Working Group, led by Kyrgyzstan, was established to coordinate and guide collaborative activities in this area. Activities of the Working Group have been boosted with the implementation of a 3-year project on rational and efficient use of energy and water resources in the region, funded from the United Nations Development Account aiming at fostering cooperation among the Central Asian countries.

As a significant outcome of the above project, completed in 2003, the experts nominated by the Governments of Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan, with the assistance of international consultants, have developed two comprehensive background documents, of which one is a diagnostic study on energy issues in Central Asia and the other a diagnostic study on water issues in Central Asia. These documents address major issues facing the Central Asian countries in these sectors and assess the potential for the region's energy and water resources development. The studies also provided a solid basis for the formulation of a strategy for cooperation in promoting the rational and efficient use of energy and water resources in Central Asia. The strategy which is the major outcome of the project, has been formulated on the basis of intensive consultations among the participating countries. It outlines the broad prospects for collective actions to secure a sustainable future for energy and water resources development in the region.

We hope that the present publication, which contains the strategy for intraregional cooperation and the two background studies, will catalyze a process of enhanced collaboration in the critical areas of energy and water resources management in Central Asia for the mutual benefit and well-being of the peoples of the region.

Brigita Schmognerova
Executive Secretary
European Economic Commission

Kim Hak-Su
Executive Secretary
Economic and Social Commission
for Asia and the Pacific

ACRONYMS AND ABBREVIATIONS

BWA	Basin Water-Economy Association
CIS	Commonwealth of Independent States
EPC	Energy Policy Centre
ERI	Energy Research Institute (Russian Academy of Sciences)
FEC	fuel and energy complex
GDP	gross domestic product
ICWC	Inter-State Coordination Water Commission of the Aral Sea basin
IEA	International Energy Agency
IFAS	International Fund for Saving the Aral Sea
OECD	Organization for Economic Cooperation and Development
NCRE	non-conventional renewable energy plan
SIC ICWC	Scientific-Information Center of the Inter-State Commission for Water Coordination
SHEPS	small hydroelectric power stations
WEC	World Energy Council

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act.	actual
insig.	insignificant
Kaz	Kazakhstan
Kyr	Kyrgyzstan
n/a	not available
Reg.	whole Central Asian region
Taj	Tajikistan
tce	ton of coal equivalent
Tur	Turkmenistan
Uzb	Uzbekistan

B	business-as-usual scenario
G	gas scenario
HC	hydro-coal scenario

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ha	hectare
mWt	megawatt
kWh	kilowatt/hour


CENTRAL ASIA
RUSSIAN FEDERATION
KAZAKHSTAN
UZBEKISTAN
TURKMENISTAN
KYRGYZSTAN
TAJIKISTAN
AFGHANISTAN
ISLAMIC REPUBLIC OF IRAN
PAKISTAN
INDIA
CHINA
MONGOLIA
UKRAINE
GEORGIA
ARMENIA
AZERBAIJAN
Caspian Sea
Coastal line in 2000
Coastal line in 1957
Perm'
Izhevsk
Kazan'
Yekaterinburg
Tyumen'
Ufa
Chelyabinsk
Kurgan
Petropavl
Omsk
Tomsk
Novosibirsk
Krasnoyarsk
Novokuznetsk
Barnaul
Togliatti
Samara
Penza
Saratov
Voronezh
Volgograd
Rostov na Donu
Magnitogorsk
Qostanay
Rûdnyy
Köshetau
Pavlodar
Rubtsovsk
Oral
Orenburg
Orsk
Aqtöbe
Atyraû
Astrakhan'
Astana
Semey
Oskemen
Temirtaû
Qaraghandy
Zaysan
Zhezqazghan
Taldyqorghan
Ürümqi
Aqtaû
Qyzylorda
Almaty
Bishkek
Zhambyl
Shymkent
Tashkent
Chirchiq
Angren
Namangan
Qüqon
Osh
Farghona
Nukus
Dashhowuz
Urganch
Türkmenbashi
Kara Bogaz Gol
Tbilisi
Yerevan
Baku
Tabriz
Rasht
Tehrān
Ashgabat
Mary
Bukhoro
Samarqand
Qarshi
Charjew
Kashi
Dushanbe
Qondûz
Baghlān
Kabul
Herāt
Mashhad
Ysyk Kol
Lake Balqash
Volga
Ural
Ob'
Irtysh
Yenisey
Tobol
Ishim
Esil
Nura
Turgay
Irgiz
Saryesu
Ertix
Syr Darya
Amu Darya
Zeravshan
Murgab
Atrak
Karakumsk Canal
Tarim
Hotan
Yarkant
Toskan
Shû
Ili
Katon
Biya
Chulym
Tom'
The boundaries and names shown on this map do not imply official endorsement or acceptance by the United Nations.
0 200 400 600 800 km
0 100 200 300 400 500 mi

I. COOPERATION STRATEGY TO PROMOTE THE RATIONAL AND EFFICIENT USE OF WATER AND ENERGY RESOURCES IN CENTRAL ASIA

Foreword

This Strategy has been formulated within the framework of the United Nations Special Programme for the Economies of Central Asia (SPECA). The project has been funded from the United Nations Development Account and implemented jointly by the United Nations Economic Commission for Europe (UNECE) and the United Nations Economic and Social Commission for Asia and the Pacific (UN ESCAP).

A group of national experts representing Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan, together with international water and energy advisers, prepared two diagnostic reports and a strategy concept for regional cooperation in promoting the rational and efficient use of water and energy resources in Central Asia. These papers contain vast volumes of statistics and a comprehensive assessment of the current status of and prospects for cooperation among Central Asian countries in the use of water and energy resources.

All these materials have served to formulate this strategy that consolidates the positions of the States taking part in the project to draw up water and energy policies that would apply to the whole of Central Asia.

Introduction

1. Due to Central Asia's specific geographic and climatic features and its uneven patterns of natural resource distribution and consumption, the economic potential of any country depends on the degree of efficiency with which these resources, and, in particular, water and energy, are being used. The promotion of mutually beneficial inter-State cooperation in this sphere, therefore, constitutes a precondition for achieving further regional integration and sustainable social and economic development as well as for establishing equitable partnerships.

2. The Cooperation Strategy to promote the rational and efficient use of water and energy resources in Central Asia (Strategy) establishes agreed principles governing the resolution of water and energy issues, the drafting of multilateral and bilateral agreements, collaborative programmes and projects relating to integrated management and use of water and energy resources, and the protection of water ecosystems.

3. The purpose of the Strategy is to develop a coordinated regional policy providing for the equitable and reasonable use of water and energy resources with due regard for the social, economic and environmental interests of the countries of the region.

4. The Strategy is based on international law, national legislation, inter-State agreements and other instruments governing different aspects of water, energy and environmental policy.

5. The Strategy provides for the development of inter-State cooperation in Central Asia along the following principles:

   5.1. Sovereign equality, territorial integrity and mutual benefits derived from the equitable use of water and energy resources, as well as expansion of cooperation in this sphere with the other countries concerned;

   5.2. The right to use water and energy resources within territorial borders in accordance with norms set by national legislation, with due regard for the interests of other States and the need to ensure the sustainability of ecosystems;

   5.3. Reasonable restriction of any activity that pollutes water, soil, subsoil and air, depletes natural resources or otherwise disrupts the environmental balance in the region;

5.4. Avoidance of significant harm to neighbouring States resulting from the use of water or fuel and energy resources;

5.5. Reliance on the river-basin approach in arranging for the supply, use and protection of water;

5.6. Sharing of the costs of economic, environmental and other activities of inter-State significance by the Parties concerned;

5.7. Sharing of information on the status and use of water and energy resources, timely notification of any planned activities in these areas and of any technology-related and natural phenomena capable of affecting the interests of other States;

5.8. The peaceful resolution of inter-State water and energy disputes on the basis of agreed procedures.

1. Water and energy resources in Central Asia and problems of sustainable development

1.1 Water and energy resources

6. Central Asia includes Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. It covers approximately 4 million km^2 and has a population of over 55 million.

7. Central Asia possesses a considerable and diversified resource base. Its proven recoverable reserves of oil are assessed as sufficient for approximately 65 years, natural gas for 75 years and coal for nearly 600 years. In addition, the region has large deposits of uranium and a significant potential in terms of renewable energy resources. The economically viable annual hydropower potential is evaluated at 400 billion kWh, of which no more than 10 per cent has been developed.

8. A distinctive feature of the energy resources base in Central Asia is its uneven distribution. Practically all proven recoverable reserves of organic fuel are concentrated in Kazakhstan, Turkmenistan and Uzbekistan, whereas Kyrgyzstan and Tajikistan possess nearly 90 per cent of the economically viable hydropower potential.

9. Water resources include renewable surface water, groundwater and return flow. Freshwater resources are also unevenly distributed in Central Asia.

10. Population growth and the growth of the water-consuming sectors of the economy, especially irrigation farming, which accounts for approximately 90 per cent of total water abstraction, have led to growing water shortages in this region with nearly all of its water reserves already used in economic activities. The slight reduction in water use over the past 10 years has only temporarily weakened this trend.

1.2 Issues related to the use of water and energy resources

11. In the period of USSR, interconnected water-management and power-generation infrastructures and extensive distribution networks were created. Under a single State, there existed a fairly efficient system of water allocation, electricity exchange and fuel, and energy resources among the then republics.

12. Geopolitical changes coupled with the transformation of the region's economy disrupted that stable pattern of water use and energy exchange. The newly sovereign States were faced with a real threat to their national food and energy security and, in particular, a threat to their reliable supply of water and electric power as well as of organic fuel to meet the needs of their economies and their people.

13. The transition period in Central Asia was marked by a decline in production, deteriorating living standards, inflationary pressures and other social and economic crises. In the later stages of this

transition period, the region has seen a relative stabilization of its economic situation.

14. The high rate of deterioration of fixed capital assets in the water-management, fuel and energy complexes, in the water- and energy-consuming sectors and in other spheres of the economy makes the use of existing facilities and maintenance of their entire infrastructure more difficult, thereby increasing the risk of emergencies.

15. The limited availability of financial resources in the countries of the region, with concomitant low levels of investment, delays the technical rehabilitation of existing water management, fuel and energy facilities, the construction of new ones and the introduction of advanced resource-saving technologies. Excessive losses of water and energy resources persists against a backdrop of increasing shortages and an expected growth in demand for these resources, which, together with their inefficient use, may place significant obstacles in the way of economic development of the region.

16. In all Central Asian countries, the efficiency of water and energy use is significantly below the world average. The energy-saving potential stands at nearly 30 per cent of total energy consumption in the region. The trend toward increasing water losses is sustained in most water-consuming sectors and, first and foremost, in irrigation farming and public water supply.

17. The legal and institutional framework for regional cooperation to promote the rational and efficient use of water and energy resources has not yet been harmonized owing to inherent conflicts of national interest, the different timing of, and approaches to, the development of a market-economy, as well as the insufficient experience of Central Asian countries in settling disputes and implementing joint decisions.

18. Water allocation in Central Asia is based on water use quotas for each country in each transboundary water basin. In the former, unified water-management system, the quotas secured a balance of interests, even though they were not sufficient to stabilize the region's environment. The quota arrangement has remained basically intact, even though it does not fully meet the national interests of certain Central Asian countries.

19. Inter-State disagreements have been at their highest with regard to the water use regimes in the Syr Darya basin. Previously, the control of water flow of this river by reservoirs of the Naryn-Syr Darya system, especially by the Toktogul reservoir, was aimed at meeting irrigation schedules, which gave priority to the needs of irrigation farming in Kazakhstan and Uzbekistan. Since 1993, the annual discharge schedules for the Toktogul reservoir have been changed to allow for the accumulation of water in summer and its increased discharge in winter in order to generate enough electric power to meet Kyrgyzstan's domestic demand.

20. The Central Asian countries recognize the need for water use quotas. However, Kyrgyzstan and Tajikistan are planning to increase their water use since they have much lower rates of irrigated area per capita than the other Central Asian countries. Turkmenistan intends to steer a considerable portion of return irrigation waters to its inner regions. The other Central Asian countries are also planning national water management activities that may somehow affect the interests of neighbouring States and the region's environment.

21. Financial constraints and other factors have resulted in an overall reduction in the number of weather stations, observation units monitoring snow cover and glaciers in mountainous areas, stream gauges, drainage and observation wells, and water quality control laboratories. Monitoring networks are using obsolete equipment and outdated technologies to process and transmit data. The reliability of forecasts has thus diminished, which complicates planning in the sphere of water and energy use and hinders the prevention and advance warning of natural disasters and accidents.

1.3 Environmental problems

22. Intensive use of water and energy resources has impacted on climatic conditions and led to water

and air pollution, degradation of soils, deteriorating biodiversity and diminished productivity of natural landscapes, rivers and reservoirs, all of which has affected the quality of life and public health.

23. Problems in areas generating surface water run-off have become very acute. They include the shrinkage of glaciers, snowfields and alpine woodlands, the risk of outbursts from mountain lakes, mud flows and floods, land erosion, as well as environmental risks brought on by the inadequate conditions of sites for storing waste from mines, industry and sewerage systems.

24. The most widespread negative impacts in zones of transit and dispersal of surface runoff include salinization, swamping and desertification of land, increased mineralization and toxic pollution of rivers, reservoirs and groundwater deposits.

25. The growth in the extensive use of water resources in the Amu Darya and Syr Darya river basins will further increase the risk that the Aral Sea will disappear completely as a natural and geographic site. This would accelerate desertification and salt transport, disrupt the environmental equilibrium and significantly lower the living standards and reduce the economic opportunities for the population of large parts of the region.

2. Objectives and areas of regional cooperation

26. The regional cooperation aims to achieve sustainable supplies of drinking water to the population as well as sustainable supplies of water and energy to the economic sectors, and to make the use of these supplies more efficient, and improve the region's environment.

27. Its priorities include:

27.1. Strengthening the legal framework for cooperation;

27.2. Improving the institutional and economic mechanisms for cooperation;

27.3. Improving the mechanisms and procedures for inter-State water allocation;

27.4. Developing water management and power sectors, and maintaining their technical reliability and safety;

27.5. Establishing a regional water and energy conservation policy;

27.6. Monitoring the state of water and energy resources and the patterns of their use;

27.7. Strengthening environmental protection;

27.8. Diversifying the use of the scientific and technical capacity;

27.9. Establishing an efficient information exchange system.

3. National water and energy policy issues in regional cooperation

28. Inter-State or regional cooperation implies the implementation of concerted water and energy policies at the national level, and includes:

28.1. Streamlining and harmonizing national legislation within the framework of a regional water and energy policy;

28.2. Improving the institutional structure and intersectoral collaboration, the accounting and public control arrangements relating to water and energy use, as well as the organizational and technical base for the monitoring of water and energy resources;

28.3. Assessing water and energy resources, and forecasting the demand for them;

28.4. Adopting the river basin (hydrographical) principle in the organization of water resource management with water user participation;

28.5. Rehabilitating the water management and energy infrastructure, and safeguarding its technical reliability, safety and efficient operation;

28.6. Implementing national water and energy conservation programmes, including water-demand management, as a priority, and making water and energy use more efficient;

28.7. Protecting the quality of water;

28.8. Strengthening environmental protection to reduce the adverse environmental impact of water management, fuel and energy sectors, preserving water and energy reserves and maintaining their quality;

28.9. Using renewable energy, local water sources and treated return and wastewaters;

28.10. Preventing water-related adverse impact, including prevention of floods and mud flows;

28.11. Improving economic policy, and developing market-based relationships in water management and energy sectors to facilitate entrepreneurial activity and improve the investment climate;

28.12. Strengthening the scientific and technological capacity of water management, fuel and energy sectors;

28.13. Securing public access to information on water and energy issues and involving public institutions and the community at large in water and energy conservation policies.

29. When planning and implementing national projects involving the use of water, fuel and energy and capable of causing significant damage to or otherwise affecting the interests of the countries in the region, Central Asian countries will notify the Parties concerned in good time of planned activities and take appropriate action to prevent negative impact.

4. Legal framework for regional cooperation

30. The legal framework for cooperation will be defined in inter-State agreements, intergovernmental and interdepartmental agreements, memoranda, protocols or other international legal instruments.

31. The Central Asian countries recognize that provisions contained in international agreements concluded by them will take precedence over national legislation.

32 . Cooperation arrangements relating to water and energy use and environmental protection will be modified by improving existing and preparing new inter-State legal instruments.

33. Inter-State agreements will give priority to clarifying, agreeing and establishing:

33.1. Water allocation procedures, related regimes of water use in transboundary rivers and terms of operation for water facilities of inter-State significance;

33.2. Collaborative arrangements for, and procedures related to, the supply of water and energy by national water management, fuel and energy sectors;

33.3. Terms of implementation for joint investment programmes and projects relating to water management and power generation including risk management during their implementation;

33.4. Issues related to joint or unilateral flood control, bank and water protection, reclamation and other work carried out in transboundary rivers, as well as rules for countries' participation in these activities on a cost-sharing basis;

33.5. Arrangements to compensate for the cost of carrying out work and providing services for the benefit of other States in the region;

33.6. Approaches to establishing the liability of parties for damage caused by activities relating to water and energy use;

33.7. Ways to monitor compliance with inter-State agreements and settle disputes among States and economic actors;

33.8. Provisions for the sharing of information and the timely information on emergencies;

33.9. Joint action in emergencies.

34. Regional water and energy policy will be based on the convergence of national laws, the harmonization of technical and other standards, as well as norms and regulations relating to water and energy use, environmental protection and resource-saving activities.

35. The Central Asian countries intend jointly to draw up terms for agreements for integrated measures aiming to achieve sustainable development in the region, which provide for cooperation on production, a division of labour, a diversification of water management as well as of the fuel and energy sectors and resource-consuming sectors, and an expansion of export capacity.

36. The Central Asian countries will improve their legal framework for cooperation with other interested States in matters relating to the use of water and energy resources in compliance with the objectives, principles and provisions of this Strategy.

5. Institutional framework for regional cooperation

37. Cooperation will be based on the principle of equal participation of parties in preparing decisions of regional significance, which will be approved by consensus. In the planning of measures to improve the organization of cooperation, due account will be taken of the comprehensive experience accumulated by regional and international institutions.

38. Existing institutions may be reformed or new specialized ones may be established to improve cooperation on the use of water and energy resources. Their sphere of competence may include:

38.1. Improving the legal framework for cooperation;

38.2. Drawing up recommendations for the coordination of various aspects of regional policy on the use of water and energy resources;

38.3. Working out, coordinating and monitoring the execution of joint programmes to ensure the efficient and safe operation of water-management, fuel and energy sectors, and the equitable distribution of water resources, and to conserve water and energy;

38.4. Planning for and coordinating activities aimed at preventing or eliminating the consequences of natural and technological disasters;

38.5. Promoting the establishment of markets for capital, fuel, electricity, works and services;

38.6. Making recommendations on infrastructure development aimed at achieving sustainability in the inter-State supply of water and energy and gaining entry to external markets;

38.7. Participating in the expansion of inter-State links between Central Asian countries and international organizations, donors and partners;

38.8. Organizing efficient interaction among the national systems responsible for monitoring the state and use of water and energy resources;

38.9. Supporting scientific and technological cooperation and information exchange.

39. The functions and powers of inter-State institutions will be specified with due account of

national and regional interests, and be reflected in laws and regulations. Each Central Asian state will develop an organizational framework allowing it to participate in the activities of these institutions based on mutually agreed terms and reflecting the specifics of national legislation.

40. The Central Asian countries will promote the expansion of organizational cooperation with the other States concerned in the region, in particular by involving them in the work of inter-State institutions.

41. The Central Asian countries will support the establishment of joint ventures, companies, consortia and other independent institutions to implement joint projects for the rehabilitation and development of water-management, fuel and energy sectors.

6. Inter-State water allocation

42. The countries of Central Asia recognize that improving the inter-State water allocation system is a prerequisite for the region's stable development and environmental safety.

43. Water will be allocated among Central Asian States according to the following principles:

43.1. The amount of water resources subject to allocation is summed up in each transboundary river basin as per the agreed list of such basins;

43.2. Each state retains the right to use within its territory water resources within its agreed quotas;

43.3. Quotas are adjusted on the basis of mutually acceptable criteria and procedures are addressed in intergovernmental agreements;

43.4. When adjusting quotas, priority is given to fully meeting the population's water demand for drinking and household purposes;

43.5. The regimes of the long-term and seasonal flow regulation of transboundary rivers through storage reservoirs used for irrigation and power generation are subject to agreement. The filling and discharge schedules for storage reservoirs are drawn up so as to ensure integrated use of water and energy resources and meet environmental requirements;

43.6. The schedules governing water intake and discharge at facilities on transboundary rivers and in water-management systems supplying water to neighbouring countries and capable of having a transboundary impact are subject to agreement;

43.7. Water use should not lead to a significant deterioration in water quality in transboundary river basins, and pollutant concentrations should not exceed agreed limits. The Central Asian countries will therefore take appropriate steps to limit pollutant concentrations in return waters and the municipal and household effluents discharged into water ecosystems.

44. Compliance with the terms of inter-State water allocation will be monitored based on:

44.1. Coordination among national databases on water resource availability;

44.2. The regular sharing of data on water use and actual operation schedules applied in water facilities of inter-State significance.

45. The operational management of water facilities, including those of inter-State significance, will generally be the responsibility of the country in whose territory they are located. However, countries can transfer the functions and powers involved in the operation of specific installations to inter-State bodies, including parity commissions, consortia and others.

46. To optimize the patterns of water use and demand, the countries of Central Asia will take consistent steps to use integrated water management

methods. The representatives of water users, local authorities, environmental agencies, the local population and the community at large will be encouraged to participate in this endeavour.

47. In allocating quotas, the countries of Central Asia will take into consideration the interests of neighbouring countries and also the possible conclusion of intergovernmental agreements with these countries.

7. Water and energy infrastructure

48. The countries of Central Asia will coordinate activities and implement joint projects for the operation, rehabilitation and modernization of water management and hydropower facilities of inter-State significance. Cooperation in this sphere may include:

    48.1. Harmonizing standards ensuring the technical reliability, safety and efficient operation of hydropower facilities of inter-State significance;

    48.2. Establishing an inventory describing the technical condition of the systems and facilities of inter-State significance, and developing programmes to rehabilitate and modernize them;

    48.3. Coordinating technological policies with regard to the import and manufacture of equipment, control and monitoring systems and appliances, instruments and spare parts for the modernization of infrastructure, and the upkeep and operation of facilities and communications of inter-State significance;

    48.4. Coordinating, where appropriate, measures to prevent the adverse environmental impact of work to construct, repair and operate facilities;

    48.5. Harmonizing training and advanced training programmes for the managers and operators of systems and facilities of inter-State significance.

49. In addition to measures designed to ensure the reliable functioning of the existing water management and energy infrastructure, the countries of Central Asia will continue their mutually beneficial cooperation in designing and building new facilities and communications systems.

50. To this end, agreed activities will be carried out to:

    50.1. Develop feasibility studies for new projects, which will identify the benefits for each country concerned;

    50.2. Consolidate internal financial, material and technological resources and bring in foreign partners and investment;

    50.3. Agree on arrangements for cost- and profit-sharing among project participants;

    50.4. Develop organizational arrangements for the implementation of investment projects.

8. Optimization of water and energy use

51. The countries of Central Asia, to the extent of their economic and technical ability to save water and energy resources, will carry out the following agreed measures to reduce the waste of resources in irrigation, and in industrial and municipal systems for the supply of water, power and heat:

    51.1. Introduce resource-saving technologies, widely use energy-efficient equipment and tools in management, control and regulation processes as well as closed-circuit, recycling and consecutive-recycling water-supply systems, etc.;

    51.2. Introduce government and market regulation of demand for water and energy;

    51.3. Account for, and monitor, the use of water and energy;

51.4. Improve the administrative and legal regulation of water and energy conservation;

51.5. Provide better economic incentives for energy and water conservation.

52. Additional measures to satisfy demand for water and energy may include:

52.1. Development of new water and energy resources;

52.2. Use of renewable energy as part of the overall energy balance;

52.3. Development of groundwater and local water sources and the use of treated return and waste waters;

52.4. Combating water shortages through the construction of new reservoirs, and the redistribution of water between river basins and water distribution systems.

53. Joint scientific and technological cooperation programmes will provide for standard-setting in resource conservation, and cooperation in the design and manufacturing of water- and energy-efficient equipment.

9. Inter-State economic mechanisms

54. The Central Asian States are interested in developing economic relations in connection with the use of water and energy resources, based on equitable partnerships and market arrangements.

55. To establish regional markets for capital, fuel, electric power, construction and water-management activities and other works and services, joint measures will be taken, including:

55.1. Coordination of investment, pricing, tax, tariff and customs policies;

55.2. Sharing of the cost involved in providing funds for activities of inter-State significance;

55.3. Further development of repayment options provided by seasonal water- and power-exchange schemes;

55.4. Consolidation of economic relations between government and municipal authorities and between economic actors of neighbouring countries;

55.5. Cooperation in attracting foreign investment and donor aid for regional cooperation programmes.

56. The countries of Central Asia will comply with international legal norms providing for fair compensation for damage caused by breaches of inter-State agreements, to be based on mutually acceptable methods of valuating and compensation procedures.

57. The countries of Central Asia intend to facilitate appropriate research and consultations among themselves aimed at creating a water resources market.

10. Monitoring water and energy resources

58. The countries of Central Asia acknowledge that establishing an efficient monitoring system is a prerequisite for the sound use of water and energy resources and the basis for taking decisions at the national and regional levels.

59. Specialized national agencies will be mandated to monitor water resources of transboundary rivers through regular observations, inspections and audits. They will, gather, process and share consolidated data, set up databases and make forecasts.

60. The countries of Central Asia will take the following measures to strengthen collaboration among monitoring organizations and ensure the effective use of the available information:

60.1. Agree on the siting, number and other parameters of monitoring units used for inter-State cooperation;

60.2. Collaborate and share the cost of modernizing and developing monitoring equipment;

60.3. Harmonize standards and procedures to achieve compatibility among national monitoring systems and ensure the coherence of qualitative and quantitative observation parameters;

60.4. Harmonize the methods of standardization, certification and metrological support of instruments used in measuring and accounting for the use of water and energy resources;

60.5. Agree on the lists of data of common interest obtained through monitoring and on the process of data exchange.

11. Cooperation in environmental protection

61. As part of the measures designed to make the use of water and energy resources more efficient, inter-State cooperation in environmental protection will be steered towards:

61.1. Upgrading and harmonizing the environmental requirements relating to the state of air, soil and water ecosystems that must be observed in connection with water and energy use;

61.2. Setting water quality standards for various types of water use, based on an updated list of pollutants and their maximum permissible concentrations;

61.3. Assessing environmentally permissible limits on the use of surface, groundwater and return waters in transboundary river basins;

61.4. Agreeing on measures to monitor and protect alpine lakes, glaciers, snowfields, forests, the Aral Sea, estuaries and coastal areas, unique landscapes, habitats of rare species and plants;

61.5. Agreeing on measures to prevent the salinization, swamping, desertification and soil erosion and other types of land degradation;

61.6. Upgrading technologies for the utilization of household, industrial, agricultural, animal husbandry and other waste;

61.7. Agreeing on measures to ensure safety with regard to household waste storage sites, tailing ponds, mining dumps and other potential sources of pollution, thereby preventing the contamination of water ecosystems with harmful substances and micro-organisms from these sources;

61.8. Establishing procedures for environmental audits of sources of pollution intransboundary river basins, as well as in soil, subsoil and air;

61.9. Establishing mutually acceptable normative requirements and approaches to be applied in the environmental impact assessment of large industrial and other projects potentially capable of impacting on transboundary rivers.

62. Environmental protection cooperation will take place within the framework of inter-State agreements, action programmes and joint environmental projects. Preventive environmental measures, which are less capital-intensive and more effective than those taken to correct the negative environmental impact of an economic activity, will receive priority.

12. Plan of action

63. To achieve the aims of this Strategy, the following national and regional action will be taken:

64. Short-term measures (within five years):

64.1. Establish up-to-date lists of water management facilities of inter-State significance;

64.2. Develop national strategies and action plans to promote the sound and efficient use of water and energy resources;

64.3. Set water and energy conservation policy priorities at the regional level;

64.4. Develop approaches to the coordination of investment, pricing, taxation, tariffs and customs policies;

64.5. Develop a legal framework for inter-State cooperation with regard to:

- Water allocation;
- Operation of water-management systems and facilities of inter-State significance;
- Power exchange;
- Monitoring of water bodies and the status of the energy sector;
- Ecosystem protection;
- Science and technology

64.6. Introduce the necessary institutional reforms at the national level;

64.7. Strengthen the institutional framework for regional cooperation, conceptualize an agreement for the establishment of an international water and energy consortium;

64.8. Adjust water quotas for each country with due consideration for its national requirements and ecosystem protection standards;

64.9. Agree on water abstraction and supply schedules for transboundary rivers;

64.10. Agree on water-quality standards;

64.11. Develop a compensation methodology for damage resulting from breaches of inter-State agreements;

64.12. Harmonize monitoring systems for water resources;

64.13. Agree on areas of scientific cooperation in the development and use of innovative technologies relating to water and energy resources;

64.14. Formulate and implement national programmes and pilot projects relating to water and energy conservation.

65. Medium-term measures (within 10-15 years):

65.1. Repair, modernize and/or gradually decommission obsolete, inefficient or potentially accident-prone equipment at hydropower facilities;

65.2. Introduce water- and energy-conservation technologies and scientific and technical schemes relating to water and energy use;

65.3. Provide for community participation in decision-making on water and energy conservation;

65.4. Repair and reconstruct monitoring stations and commission new monitoring systems for water and energy resources;

65.5. Protect watersheds and ecosystems, including, first and foremost, the entire area of the Aral Sea and alpine lakes, such as Lake Sarez and other burst-prone lakes;

65.6. Introduce a river basin approach in wateruse management based on the hydrographical principle and equitable participation of the economic sectors and local authorities concerned;

65.7. Conduct research and hold consultations aimed at the creation of a regional market for water and energy resources and services;

65.8. Agree on investment, pricing, taxation, tariffs and customs policies;

65.9. Agree on projects for the construction of new water-management facilities for inter-State water allocation.

66. Long-term measures (up to 20 years):

66.1. Provide for sustainability in the functioning and development of water and energy infrastructure;

66.2. Create a regional system for the warning of and protection against mud flows, avalanches and mud slides as well as outburst floods from mountain lakes;

66.3. Guarantee access to drinking water of good quality for the population of the region;

66.4. Discontinue the practice of discharging untreated wastewater into water bodies, and build or rehabilitate infrastructure for collecting and discharging of storm, drainage and return water;

66.5. Develop and implement coordinated investment, pricing, taxation, tariffs and customs policies;

66.6. Introduce water- and energy-saving technologies across the region;

66.7. Ensure the integrated development of the region so as to facilitate the efficient functioning of the water and energy sectors and provide for environmental safety and economic and social sustainability.

II. DIAGNOSTIC REPORT ON WATER RESOURCES IN CENTRAL ASIA

Introduction

This report represents an initial contribution to the development of the water management component of the Cooperation strategy to promote the rational and efficient use of energy and water resources in Central Asia. It contains a short overview of the status of water resources in Central Asia and their use (section A) and a list of major issues requiring broader cooperation between interested countries (section B). Possible approaches to existing problems are also outlined (section C); These were developed in greater detail during the formulation of the strategy for the rational and efficient use of energy and water resources in Central Asia.

The report does not claim to contain exhaustive and comprehensive information on the water resources and water management facilities in Central Asia, nor does it seek to spell out all the numerous approaches to solving problems in this area. It merely attempts to sum up the positions of parties involved in the compilation of the report. Whenever differing opinions or judgements were expressed, these are presented fully in the report. Obviously, different visions of problems and solutions exist not only among Central Asian countries but also among authorities and institutions involved in the management of water resources within each country. Hopefully, such differences will not prove an obstacle to a constructive dialogue among organizations and individuals concerned and the report will serve to improve mutual understanding in the development of a regional strategy for the rational use and conservation of water resources in Central Asia, which in turn will contribute to sustainable economic development of and security for the countries of the region.

Data for the report were provided in early 2001 by the governmental agencies of Kazakhstan, Kyrgyzstan and Tajikistan. Additional data gathered by Mr. S. Vinogradov, project consultant, during his visit to Uzbekistan and Kyrgyzstan. Data for section A were provided by the Scientific and Information Centre of the Interstate Commission for Water Coordination – SIC ICWC (Mr. V. Sokolov).

The final version of the report was compiled by a group of government-appointed experts, including Messrs. N. Kipshakbaev and T. Sarsembekov (Kazakhstan), K. Valentini (Kyrgyzstan), A. Kholmatov (Tajikistan), with the active participation of Ms. I. Krasnova, project consultant. Government officials and NGO representatives involved in the management of water resources use in Central Asia, including Messrs. I. Beyshekeev, L. Borovikova, V. Dukhovny, Y. Ivanov, B. Koshmatov, K. Kudaybergenuly, R. Madumarov, D. Mamatkanov, A. Nazirov, M. Nazriev, A. Ryabtsev, M. Khamidov, and A. Chub, provided additional information and made valuable comments.

During discussions of the draft at the meetings preceding the 6th (June 2001), 7th (November 2001) and 8th (February 2002) sessions of the PWG Energo held in Bishkek, constructive comments were made, in particular, by Messrs. R. Apasov, K. Beyshekeev, O. Bilik, A. Jaylobaev, B. Koshmatov, K. Kudaybergenuly, D. Mamatkanov, E. Makhmudov, A. Meldebekov, S. Shoymardonov, A. Nurushev, M. Ospanov and L. Sherfedinov. Messrs. B. Bosniakovic, Bo Libert (UNECE) and Yuri Steklov (UNESCAP) provided coordination on behalf of the United Nations. The work carried out by national experts was coordinated by Mr. E. Orolbayev.

SECTION A. CURRENT STATUS AND USE OF WATER RESOURCES IN CENTRAL ASIA

1. Description of the region

This section describes the status as well as the current and projected patterns of water use in the five independent countries of Central Asia: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan.

The five States are located in the middle of the Eurasian continent and have a total area of around 4 million km^2, with Kazakhstan occupying 2,717,000 km^2, Kyrgyzstan - 198,500 km^2, Tajikistan - 143,100 km^2, Turkmenistan - 488,100 km^2, and Uzbekistan - 448,800 km^2. All quantitative data in the report refer to the Aral Sea basin encompassing all of Tajikistan and Uzbekistan, a large part of Turkmenistan, as well as four Kyrgyz provinces, the south of Kazakhstan and the north of Afghanistan and the Islamic Republic of Iran. The Aral Sea basin lies between 56° and 78° east longitude and 33° and 52° north latitude and has a total area of 1,549,000 km^2, of which nearly 590,000 km^2 are arable land (table 1). It should be noted that the interests of Kyrgyzstan, Kazakhstan and Turkmenistan in the use of water resources are not restricted to only the Aral Sea basin area. Within the Aral Sea basin, Kazakhstan has only 35% of its total irrigated land, while Kyrgyzstan has around 40% of its total land under irrigation.

The Aral Sea basin can be divided into two main areas: the Turan Plain and the mountain zone. The western and north-western parts of the basin within the Turan Plain are covered by the deserts of Kara-Kum and Kazyl-Kum. The eastern and south-eastern parts include the Tyan-Shan and Pamir Mountains. The remainder is formed by the alluvial and mountain valleys and arid and semi- arid steppes. Mountains occupy 93% of Tajikistan and 87% of Kyrgyzstan. This type of terrain is positive for the formation of water resources but is also the reason for the shortage of arable land in those countries.

The region is widely known for its oases, such as the Fergana Valley, Khoresm, Tashauz, Mary, Zerafshan, Tashkent-Chimkent and others, which, although they constitute only a small part of the total area, have served as centres of civilization since early times.

Central Asia's prosperity has always been linked with the use of land. At present, 60% of rural residents in the Aral Sea basin area are engaged in agriculture. Its successful development therefore acquires special significance, as fertile land has always formed the basis of people's welfare. The total area of arable land is 59 million hectares, of which only 10 million hectares are actually being cultivated (table 1).

Half of the cultivated land belongs to the oases, where it is naturally drained and the soil is fertile. The rest of the potentially arable land would require complex and costly improvement work, including drainage, land

Table 1. Land resources of the Aral Sea basin

Country	Area	Potential arable land	Arable land	Irrigated land
	ha	ha	ha	ha
Kazakhstan*	34 440 000	23 872 400	1 658 800	786 200
Kyrgyzstan*	12 490 000	1 570 000	595 000	422 000
Tajikistan	14 310 000	1 571 000**	874 000	719 000
Turkmenistan	48 810 000	7 013 000	1 805 300	1 735 000
Uzbekistan	44 884 000	25 447 700	5 207 800	4 233 400
Aral Sea Basin	154 934 000	59 474 100	10 140 900	7 895 600

* Territories within the Aral Sea basin.

** Areas suitable for irrigation.

Source: FAO, 1997

grading and even improvements in the soil structure. Arable land is unevenly distributed across the region, with Kazakhstan and Turkmenistan having enough to meet their present and future needs. The other three countries have a shortage of land, either throughout the country (Kyrgyzstan, Tajikistan) or in some parts (e.g. Uzbekistan – in the provinces of Samarkand, Khoresm and Fergana Valley). The shortage of water resources aggravates the situation and may result in conflicts not only among countries but also within them, especially in areas with strong demographic pressure. At present, none of the countries has the economic potential for the large-scale resettlement of people from densely populated areas, creation of jobs and infrastructure, etc.

All of the above calls for a more efficient use of available water resources throughout the region.

2. Water resources

Central Asian water resources are comprised of renewable surface water and groundwater, as well as return flow associated with human activity. Water resources are mostly available in the Syr Darya and the Amu Darya basins. Independent basins (closed drainage basins adjacent to the Amu Darya basin) are formed by the Kashka Darya, Zerafshan, Murgab and Tedzhen rivers, which have lost their hydrological links to the main river. The water resources of Kazakhstan and Kyrgyzstan are also formed in other basins, e.g. Kazakhstan has seven additional independent river basins, while Kyrgyzstan has four.

2.1 Surface flow formation

Hydrologically, the region comprises three major zones: flow formation zone; flow transit and dispersion zone, and river deltas . The construction of large dams and reservoirs tends to impact significantly on flow regimes in downstream river sections. In the transit and dispersion zones, hydrological regimes and water quality are changed as huge volumes are withdrawn for industry and agriculture, while return flows containing salts, chemicals and other pollutants find their way back into the river.

The Amu Darya is the largest river in the region. It stretches for 2,540 km from the Pyandj headstream and has a basin of 309,000 km^2. From the point where the Pyandj flows into the Vakhshay, the river is known as the Amu Darya. The river's main catchment area is in Tajikistan, from where it flows along the border between Afghanistan and Uzbekistan, crosses Turkmenistan, flows back into Uzbekistan and finally into the Aral Sea in Uzbekistan.

In its midflow, the Amu Darya is joined by two right tributaries, the Kafirnigan and the Surkhan Darya, and one left tributary, Kunduz. Further down to the Aral Sea, it is not joined by a single tributary. Melting snow and glaciers provide whatever water it receives. The flow, therefore, is the strongest in summer and the weakest in January and February. This annual pattern favours the use of the Amu Darya waters for irrigation. All along the valley from Kerka to Nukus, the Amu Darya loses a large part of its flow through evaporation, filtering and abstraction for irrigation. In terms of silt content, the Amu Darya clearly ranks first in Central Asia and is one of the first in the world.

The Syr Darya ranks second in terms of run-off, even though it is actually the longest river in Central Asia. From the source of the Naryn, its tributary, the Syr Darya has a length of 3,019 km and the basin area is 219,000 km^2. Its sources are in the Central Tyan Shan Mountains. The Syr Darya is formed where the Naryn and the Kara Darya converge. It is fed by melting glaciers and, to a larger extent, by melting snow. The river is at its fullest in spring and summer, starting in April and reaching its peak in June. Its main catchment area is in Kyrgyzstan, then the river crosses Uzbekistan and Tajikistan and empties into the Aral Sea in Kazakhstan.

Other major inter-State rivers are:

The Chu, 1,067 km, watershed area 62,500 km^2, originating in Tyan Shan in Kyrgyzstan and dissipating in the Asikol depression, in Kazakhstan;

The Talas, 661 km, watershed area 52,700 km^2, originating in Kyrgyzstan and terminating in the Muyunkum sands in Kazakhstan;

The Tarim, 2,030 km, watershed area 1 million km^2, originating in Kyrgyzstan and Tajikistan, and flowing mostly through China; and

The Irtysh, 4,240 km, watershed area 1,643,000 km^2, part of it crossing Kazakhstan in the east and flowing into the Ob river in the Russian Federation.

Extremely important, in terms of their integrated use for the socio-economic development of individual countries, are also the waters of the Ili river in Kazakhstan, Lake Issyk Kul, etc.

In the future, the Islamic Republic of Iran, Afghanistan, the Russian Federation and China may become involved in the regional cooperation on water issues. It would, therefore, be appropriate to expand the scope of any further diagnostic studies to cover the concerns of all those countries.

2.2 Surface water resources

The overall assessment of water resources of rivers in the Aral Sea basin, including the Amu Darya and the Syr Darya, has been made on the basis of the annual hydrological data published by the hydrometeorological agencies for the entire period of surveys within the framework of the WARMIS programme. The arithmetic mean of the total run-off in the Aral Sea basin for the entire period of observations (1911-2000) is 112.609 km^3/year, inclusive of 77.093 km^3/year for the Amu Darya and 34.076 km^3/year for the Syr Darya.

The resulting hydrographs describing the annual flow in the basins of the Amu Darya and Syr Darya for the entire period under review reveal a certain pattern in the annual flow fluctuations. The hydrograph for the Amu Darya basin indicates three 19-year cycles from 1934 to 1992, while that of the Syr Darya basin indicates six 12-year cycles from 1928 to 1997 .

The average long-term run-off for each basin was assessed on the basis of an arithmetic mean of values relating to each complete cycle of water availability fluctuations. Such an approach makes it possible to reflect the trends that existed throughout certain periods – low- and high-water years, the years of lowering and rising water availability, etc. The Scientific and Information Centre of the Interstate Coordination Water Commission (SIC ICWC) recommends that the Amu Darya trends should be assessed using the data from 1934-92 and those for the Syr Darya with data from 1951-74. The resulting average flow is shown in tables 2 and 3. The average annual flow for the Amu Darya basin was thus calculated to be 79.280 km^3/

Figure 1. The Amu Darya River: Run-off by country

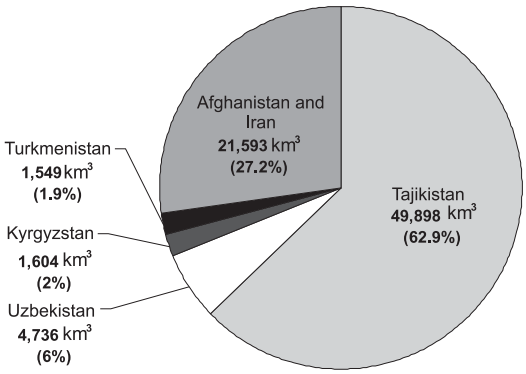

Figure 2. The Syr Darya River: Run-off by country

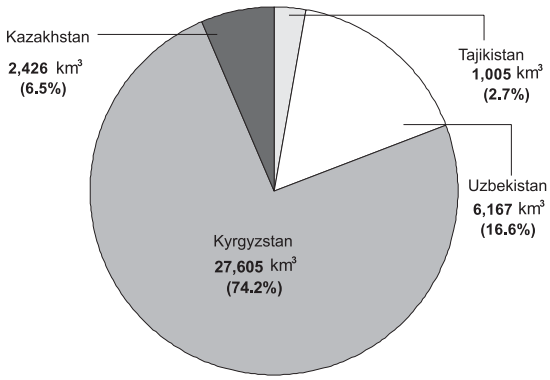

Figure 3. The Aral Sea Basin: Run-off by country

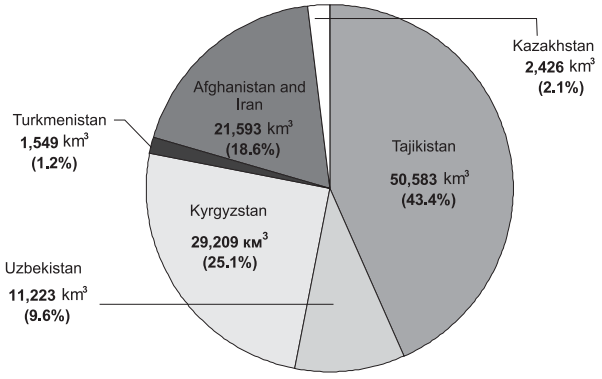

Table 2. River run-off in the Amu Darya basin (average annual run-off over three water availability cycles, 1934-1992)

River basin		River run-off formed within a country, km³/year					Total, the Amu Darya basin
		Kyrgyzstan	Tajikistan	Uzbekistan	Turkmenis-tan	Afghanistan and Islamic Republic of Iran	
Pyandj		-	21.089	-	-	13.200	34.289
Vakhsh		1.604	18.400	-	-	-	20.004
Kafirnigan		-	5.452	-	-	-	5.452
Surkhan Darya		-	0.320	3.004	-	-	3.324
Kashka Darya		-	-	1.232	-	-	1.232
Zerafshan		-	4.637	0.500	-	-	5.137
Murgab		-	-	-	0.868	0.868	1.736
Tedzhen		-	-	-	0.560	0.561	1.121
Atrek		-	-	-	0.121	0.121	0.242
Afghanistan rivers		-	-	-	-	6.743	6.743
Total. the Amu Darya basin	(km³)	1.604	49.898	4.736	1.549	21.593	79.280
	(%)	2.0	62.9	6.0	1.9	27.2	100

Source: SIC ICWC, 2000

year and that of the Syr Darya basin 37.203 km³/year. Hence, the total annual average for surface water (river) resources in the Aral Sea basin is estimated at 116.483 km³/year. This result agrees well with calculations carried out by the Sredazghiprovodkhlopok Research Institute in 1984 for the Amu Darya (79.4 km³/year) and in 1987 for the Syr Darya (37.1 km³/year) under the master plans of integrated water resources use and conservation for the respective rivers.

Annual water resource availability varies – depending on water levels – from low (95% probability) to high (5% probability) within the following range: 58.6 - 109.9 km³ for the Amu Darya and 23.6 - 51.1 km³ for the Syr Darya.

The data in table 4 show that up to 25.1% of the entire run-off in the Aral Sea basin is formed in Kyrgyzstan, 43.4% in Tajikistan, 9.6% in Uzbekistan, 2.1% in Kazakhstan, 1.2% in Turkmenistan, and 18.6% in Afghanistan and the Islamic Republic of Iran.

This assessment requires further verification due to certain inconsistencies between figures contained in the National Reports by Kyrgyzstan and Tajikistan and the Glavgidromet Agency of Uzbekistan. For example, according to Kyrgyzstan's report, 27.4 km³ out of the annual run-off of 46.04 km³ in the Syr Darya basin are formed on its territory, as are 1.93 km³ of the annual run-off of 93.42 km³ in the Amu Darya basin. According to Tajikistan, 64 km³ (55% of the total annual river run-off in the Aral Sea basin) come from Tajikistan, including 62.9 km³ of the Amu Darya and 1.1 km³ of the Syr Darya. The Hydrometeorological Agency (Glavgidromet) of Uzbekistan has argued that the SIC ICWC figures for the Syr Darya run-off in the Fergana Valley, the Arys river and its lower reaches are underestimated and those for the Chirchik overestimated. The Agency estimates the average annual run-off at the Syr Darya at 38.5 km³/year. It also finds that flow values for Turkmenistan (3.16 km³/year) are underestimated, while those for Tajikistan are overestimated. It should be noted that the run-off of the Kara Darya basin is partly formed in China, while that of the Amu Darya partly comes from Afghanistan and the Islamic Republic of Iran, and that these values require further verification.Some inconsistencies have been found between tables 2 and 4 and the draft "Water Strategy Outline for the Aral Sea Basin", prepared within the framework of IFAS in 1997.

These discrepancies can be explained by differences in calculation methods and algorithms, as well as in the statistic samples used by different reports. However, these disparities are well within the limits set for the deviations from the average long-term

Table 3. River run-off in the Syr Darya basin (average annual run-off over two water availability cycles, 1951-1974)

River basin		River run-off formed within a country, km³/year				Total, the Syr Darya
		Kyrgyzstan	Kazakhstan	Tajikistan	Uzbekistan	
Naryn		14.544	-	-	-	14.544
Kara Darya		3.921	-	-	-	3.921
Rivers between Naryn and Kara Darya		1.760	-	-	0.312	2.072
The right slope of the Fergana Valley		0.780	-	-	0.408	1.188
The left slope of the Fergana Valley		3.500	-	0.855	0.190	4.545
Midstream rivers		-	-	0.150	0.145	0.295
Chirchik		3.100	0.749	-	4.100	7.949
Akhangaran		-	-	-	0.659	0.659
Keles		-	0.247	-	-	0.247
Arys and Bugun		-	1.183	-	-	1.183
Downstream rivers		-	0.600	-	-	0.600
Total	(km³)	27.605	2.426	1.005	6.167	**37.203**
for the Syr Darya basin	(%)	74.2	6.5	2.7	16.6	100

Source: SIC ICWC, 2000

Table 4. Total river run-off in the Aral Sea basin (average long-term run-off)

	River basin, km³/year		Aral Sea basin	
	Syr Darya	Amu Darya	km³	%
Kazakhstan	2.426	-	2.426	2.1
Kyrgyzstan	27.605	1.604	29.209	25.1
Tajikistan	1.005	49.578	50.583	43.4
Turkmenistan	-	1.549	1.549	1.2
Uzbekistan	6.167	5.056	11.223	9.6
Afghanistan and Iran	-	21.593	21.593	18.6
Total, Aral Sea Basin	37.203	79.280	116.483	100

Source: SIC ICWC, 2000

run-off of the Amu Darya and the Syr Darya, which, overall, makes existing estimates acceptable.

2.3 Groundwater

Renewable groundwater resources can be divided into those naturally formed in the catchment area and those formed by filtration in irrigated land. Overall, both basins have 339 proven groundwater reserves that have been approved for use. Total regional supply of groundwater is estimated at 43.49 km³/year, of which 25.09 km³ /year in the Amu Darya basin and 18.4 km³ /year in the Syr Darya basin. Groundwater aquifers are hydraulically connected with the surface water bodies, as shown by a drop in surface flow levels in all cases of excessive groundwater withdrawal. National state commissions have, therefore, imposed limits on the withdrawal of groundwater. The total approved abstraction volume is set at 16.94 km³ /year (table 5). At present, actual withdrawal stands at 11.04 km³/year, even though in the early 1990s it exceeded 14 km³/ year.

Some groundwater reserves are formed in neighbouring countries, e.g. those of the Golodnostepsk, Kafirnigansk, Fergana and others. As withdrawal from these reserves increases, so does the need for international cooperation in the regulation of their use and their protection from pollution and depletion.

2.4 Return water

Return flow adds substantial volumes to usable reserves. However, its high mineralization makes it a prime source of pollution of water bodies and the rest of the environment. Nearly 95% of return flow

Table 5. Groundwater reserves and use in the Aral Sea basin

Country	Estimated regional reserves, million km³/year	Reserves approved for use, million km³/year	Actual withdrawal, 1999, million km³/year	By sector (million km³/year)					
				Drinking water supply	Industry	Irrigation	Vertical drainage	Pumping tests	Other
Kazakhstan*	1.846	1.27	0.293	0.2	0.081	0	0	0	0.012
Kyrgyzstan*	1.595	0.632	0.244	0.043	0.056	0.145	0	0	0
Tajikistan*	18.7	6.02	2.294	0.485	0.2	0.428	0.018	0	0.06
Turkmenistan	3.36	1.22	0.457	0.21	0.036	0.150	0.06	0.001	0.112
Uzbekistan	18.455	7.79	7.749	3.369	0.715	2.156	1.349	0.12	0.04
Total, Aral Sea basin	43.486	16.938	11.037	4.307	1.088	4.045	1.409	0.121	0.067

* Data from national reports submitted for the SPECA project.

Source: SIC ICWC, 2000.

comes from irrigated land, with the rest comprised of industrial and municipal effluents (table 6).

Development of irrigation and drainage systems led to a steady increase in volumes of return flow, which peaked in 1960-90. Following 1991, they stabilized and even dropped slightly due to the temporary shrinking of areas under irrigation and a steady decay of drainage systems. Overall, in 1990-99 the return flow was 28.0 -33.5 km³/year. As much as 13.5 - 15.5 km³ of the return flow was formed annually in the Syr Darya basin and 16 - 19 km³ in the Amu Darya basin (table 6). More than 51% of the total return flow is discharged into rivers and another 33% into depressions. Due to pollution only 16% of return flow is recycled for irrigation.

Unrestricted discharge of drainage water into rivers leads to a certain mineralization of the freshwater, making it unsuitable to use for any purposes. As a result of the lack of a systematic approach in the drainage into Water reservoirs in deserts and in the periphery of irrigated lands, fed irregularly by irrigation return flow, have no environmental value. There are several hundred reservoirs of varying size created by return drainage water, e.g. the Aidar Arnasaysk depression with a volume of over 30 km³, the Sarykamysh (around

Table 6. Formation and disposal of return flow in the Aral Sea basin (average over 1990-1999, km³/year)

Country	Drainage water from irrigation*	Industrial and household sewage	Total return flow	Discharge and reuse		
				to rivers	to natural depressions	Reuse for irrigation
Kazakhstan**	1.6	0.19	1.79	0.84	0.7	0.25
Kyrgyzstan**	1.7	0.22	1.92	1.85	0	0.07
Tajikistan** (total)	4.05	0.55	4.60	4.25	0	0.35
in Syr Darya basin	1.05	0.14	1.19	0.92	0	0.27
in Amu Darya basin	3.00	0.41	3.41	3.33	o	0.08
Turkmenistan	3.8	0.25	4.05	0.91	3.1	0.04
Uzbekistan (total)	18.4	1.69	20.09	8.92	7.07	4.1
in Syr Darya basin	7.6	0.89	8.49	5.55	0.84	2.1
in Amu Darya basin	10.8	0.8	11.6	3.37	6.23	2
Aral Sea basin (Total)	29.55	2.9	32.45	16.77	10.87	4.81
in Syr Darya basin	11.95	1.44	13.39	9.16	1.54	2.69
in Amu Darya basin	17.60	1.46	19.06	7.61	9.33	2.12

* includes pumping through vertical drainage wells.

** according to the national reports for the SPECA project

Source: SIC ICWC, 2000.

100 km^3), Dengizkul, Solenoye, Sudochye and a number of smaller ones, each containing a few million cubic metres of water. Most of them are stagnating and cannot be used for fishing, with flora and fauna unable to survive due to unstable water and salinity levels.

Improving the management of the use and environmental maintenance of such water reservoirs and preserving their flora and fauna become, therefore, especially important. Measures to achieve this should seek to restore the ecological balance while providing for additional use of water without causing environmental damage. In this connection Turkmenistan's decision to divert all drainage water currently discharged into the Amu Darya into the "Golden Lake of the Desert" should be noted. The countries of the region reacted differently to this decision, as it would be necessary to take into account a number of factors, such as:

- The trends in water and salt levels, the stability of the Lake's salinity, including losses in the drainage networks, and due to evaporation;
- The need to reach agreement with Uzbekistan on the withdrawal of waters drained from Khoresm Province (about 3 km^3) as the alternative would be to divert them into the Aral Sea and its adjoining areas;
- The changes in the inflow into drainage networks depending on the irrigation efficiency and development of irrigation in Turkmenistan;
- The future of Lake Sarykamysh.

The problem of return flow and reservoirs formed would need a complex solution and decisions should be taken both at the regional as well as at the national levels. In this connection the national diagnostic reports recommend to:

- Improve the control of return flow dynamics, and verify water balances in the respective basins, taking into account the impact of return flow;
- Develop methods to forecast volumes and quality of return flow;
- Develop principles of allocation of return flow according to the three types of its utilization, namely, its discharge into rivers, use at source of origin, and creation of return flow reservoirs;
- Develop principles and methodology to limit discharges of return flow into rivers based on water availability in a river and content of pollutants in return flow;
- Develop optimal models of reservoir conditions to provide for their environmentally sustainable management based on environmental requirements;
- Develop norms for the use of mineralized return flow for irrigation and soil leaching of irrigated land. Flow regulation by water reservoirs.

2.5 Flow regulation by water reservoirs

The Aral Sea basin has over 60 reservoirs with a usable capacity of over 10 million m^3 each. Their total volume is 64.5 km^3, of which 46.5 km^3 is usable capacity, including 20.2 km^3 in the Amu Darya and 26.3 km^3 in the Syr Darya basins. In the countries of Central Asia, there are 45 operational hydropower stations with a total capacity of 34.5 GW, and with individual capacities ranging from 50 to 2,700 MW. The largest are Nurek hydropower plant on the Vakhsh river in Tajikistan (2,700 MW) and Toktogul hydropower plant on the Naryn river in Kyrgyzstan (1,200 MW). Hydropower accounts for 27.3% of the entire power consumption in the Aral Sea basin. However, this value varies between countries, with Tajikistan generating the most (98% of its the total power generation), Kyrgyzstan ranking second (91%), and Turkmenistan last, with just 1%. The region is capable of meeting up to 71% of its potential demand for electric power with hydropower.

The existing reservoirs have brought the run-off control rate to 0.94 for the Syr Darya (i.e. close to its maximum), and to 0.78 for the Amu Darya (i.e. with capacity for further increases). Upstream flow regulation in the Amu Darya basin is provided by three reservoirs: the Nurek and Baypasin on the Vakhsh river and the Tuyamuyun on the Amu Darya, as well as by a network of off-river reservoirs associated with canals, including four on the Karakum Canal, two on the Amubukhara Canal and one on the Karshin Canal,

with a total volume of 6 km^3. These can be filled only where release schedules are closely coordinated with the water-intake limits for their associated canals. Most reservoirs are over 25 years old. During the years of operation, nearly all of them were silted up, gradually losing their useful storage capacity. The above usable capacity values of the reservoirs should, therefore, be reduced by at least 30%, and the actual run-off regulation rate adjusted accordingly.

While the dams and hydropower stations in Central Asia are solid structures with a proven safety record, their age and significant cuts in funding for maintenance give rise to concerns. It is, therefore, essential to develop activities related to checking and upgrading the safety of large dams and providing them with modern equipment.

The problem of the so-called rock-dammed lakes should also be mentioned. The largest of them, Sarez, in Tajikistan, has a volume of nearly 16 km^3. It was formed in the Pamir Mountains in Tajikistan following an earthquake in 1911 at the site located over 3,000 metres above the sea level. This natural dam, 600 m high and 5 km wide, has all but blocked the Murgab river.

In recent years geological processes have considerably complicated the situation in the Sarez lake area. In 1987, 20 million m^3 of rock slid into the lake 12 km upstream from the Usoy Dam creating a 6-metre wave. Seepage through the dam has increased significantly, and the canyon is eroding at a rate of 30-40 metres a year.

The Tajik Government launched an International Safety Programme for this Lake. It calls for:

- Facilitating the development of early-warning arrangements in connection with threats from Lake Sarez;
- Developing and implementing a joint international programme to solve Lake Sarez's problem and also establishing an organizational framework for joint action.

The collapse of rock dams on three lakes in the Shakhimardansay river basin, killing many people in Kyrgyzstan and Uzbekistan, was a reminder of the serious threats associated with natural reservoirs. Difficult access to and poor knowledge of mountain lakes makes it difficult to forecast and prevent bursts which could well develop into a regional disaster. Thus, a burst from Lake Sarez may affect over 55,000 km^2 with a population of 6 million.

2.6 Hydrometeorological network and quality of forecasts

The national hydrometeorological services of Central Asia collect regularly updated hydrological information in the whole region. For some major rivers, hydrometric observations were carried out already at the turn of the 19th century. In the 1980s the monitoring system was in its best shape, while the 1990s witnessed its deterioration due to widespread economic instability. Many observation posts were closed down as they could no longer be maintained or modernized. National agencies currently manage 384 weather stations and 273 hydrometeorological posts, of which only 154 monitor water quality (table 7).

Water levels and discharges are measured with obsolete equipment, generally twice a day, but measurements are imprecise. Water quality is monitored only once a week, yielding haphazard sets of data that can hardly be described as representative. Even more worrying is the practice of using paper documents in transmitting data, which results in delayed deliveries of data to the main water users, including agriculture and water management ministries, and basin water management authorities (BVO) for the Amu Darya basin and the Syr Darya basin. Current distribution methods often lead to the distortion of data, which makes the work carried out through the Global Environment Facility (GEF) project under Component D highly relevant.

This project includes the modernization of 19 existing and the establishment of 7 new hydrometeorological posts with modern equipment and capable of continuous registration of qualitative and quantitative data. Mention should also be made of the work carried out by the Swiss Agency for International Cooperation to modernize four such posts in the Syr Darya basin, as well as the planned United States

Table 7. Hydrometeorological observations of surface run-off in the Aral Sea basin

Year	Number of hydrometeorological posts						
	Total, in rivers	Discharge measurements		Water level measurements		Chemical measurements	
		Water	Suspended particles	in rivers	in reservoirs	in rivers	in reservoirs
Southern Kazakhstan							
1985	80	77	21	80	6	0	0
2000	37	37	0	37	0	0	0
Kyrgyzstan (South)							
1985	147	147	85	147	11	0	0
2000	23	23	0	23	6	0	0
Tajikistan							
1985	139	139	70	137	12	69	6
2000	70	49	20	68	6	25	0
Turkmenistan							
1985	38	24	16	38	8	13	6
2000	23	14	8	23	5	8	5
Uzbekistan							
1985	155	148	99	155	13	144	16
2000	120	120	61	120	9	104	12
Total, the Aral Sea basin							
1985	559	530	291	558	50	226	28
2000	273	243	89	271	26	137	17

Source: Background paper for the Aral-HYCOS project, 2000.

Agency for International Development (USAID) and World Meteorological Organization (WMO) projects on data transmission from these posts to the national hydrometeorological services, ministries and basin authorities by radio and via satellite links.

The networks that used to carry out observations of snow and glaciers in mountains for hydrological forecasting have also deteriorated. Until 1991 they were performed at 250 locations in 24 river watersheds. At present regular observations continue in three basins only, while for glaciers they have almost ceased, bringing to the fore the need for methodological studies on how to use information from satellites for this purpose.

Along with the development of remote sensing methods, representative observation sites should be equipped with automated equipment for monitoring snow cover and glaciers. Such stations should be set up to resume observations of Abramov, Fedchenko and other glaciers, which serve as major indicators of river flow for the Aral Sea basin. It is necessary to restore the technological basis of the national agencies responsible for preparedness for avalanches and mudslides and dealing with their consequences. It would, obviously, cost much less to implement these measures than to deal with consequences of such disasters.

The efforts of WMO and USAID to consolidate the networks of five Central Asian hydrometeorological agencies under the HYCOS Programme, providing for continuous data exchange, should also be mentioned. The NOAA project is setting up a network of permanent automated stations for weather and hydrological observations of the watershed and glaciers.

Most countries in the region recognize the need to resume the exchange of data between hydrometeorological agencies, to set up a single information service, and to carry out observations of the Aral Sea, salt and dust transfers, river estuaries, etc.

In fact, observations of the Aral Sea dynamics have virtually stopped, except for those carried out in a single, recently rebuilt station of the Uzbek hydrometeorological agency (Glavgidromet).

Table 8. Disparities in the distribution of shortages in the Amu Darya basin in the year 2000

Basin part	Shortage as a proportion of the abstraction limit	
	km^3	% of abstraction limit
Upstream	0.7	11
Mid-stream	2.7	17
Downstream	7.7	52
Basin, total	11.1	30

Source: SIC ICWC.

Recent years have witnessed serious problems of the entire water management system of the Amu Darya and Syr Darya basins due to the poor quality of run-off forecasts. According to the Syr Darya basin authorities (Syr Darya BVO), the problems peaked in 2000, a year of low water levels. However, the years of high water levels had their own problems. In 1998 the water levels of the Kara Darya and its tributaries alone were forecast to stand at 80-90% of the norm. The forecast for the other rivers of this watershed was 105-110%, with 120-130% for rivers in the north of the Fergana Valley and in the Chirchik-Akhangaran basin. The actual discharge for the growing season of 1998 was 20-40% higher than expected for the Kara Darya, 15-20% in most of the Fergana Valley, and close to the upper limit or 4-5% above it for the Chirchik-Akhangaran basin and the Naryn-Syr Darya cascade of the reservoirs. A decision was, therefore, taken to fill reservoirs early, and in June 1998 nearly one km^3 of water was additionally discharged into the Arnasaysk depression, an unprecedented move during the growing season.

Incorrect forecasts can make things even worse in low-water years if they are too high. Flow forecasts for the year ahead and beyond do not account for unexpected events. Forecasts are made twice a year. One in October covers the non-growing season and describes probable developments for the rest of the year. It is subsequently updated, most often in April, to cover the growing season. The principal flow forecast for Central Asia is prepared in the first ten days of April. It is based on snowfall patterns during winter and is, obviously, impossible to make with the required degree of accuracy before April. However, the April update comes too late to make any changes in the approved structure and location of crops, or in water allocation patterns, which makes irrigation-based agriculture very risky.

This leads to disparities in the distribution of water, as was the case in the Amu Darya in 2000. A comparison of forecasts and actual values for the key Amu Darya reservoirs from October 1999 to September 2000 reveals a high level of errors in the forecasting. In the growing season of 2000, the shortage of water in the Amu Darya amounted to 11.1 km^3 or 30% of the abstraction limit. Table 8 shows the shortage distribution.

A consequence of these irregularities is an uneven distribution of shortages among the countries of the region. The above data show that during the growing season of 2000 the lower reaches of the Amu Darya experienced the worst shortfalls in supply.

3. Water use in the Aral Sea basin

The use of Central Asia's water resources, primarily for domestic purposes and irrigation, started more than 6,000 years ago. In the 20th century and especially since 1960, the intensity of water use increased as a result of fast population growth, industrial development and, most of all, irrigation. Overall, irrigation accounts for 90% of the region's draw-off. Table 9 shows the trends in water use in the Aral Sea basin since 1960.

In 1960, total withdrawal was 60.61 km^3 and by 1990 it reached 116.271 km^3, that is, increased 1.8 times. In the same period, population in the area increased 2.7 times, while irrigated areas increased 1.7 times, and agricultural production 3 times (table 10).

Since 1994, there has been a clear decline in water use and withdrawal. In 1999, total withdrawal diminished by 11.4 km^3 from 1990 levels, down to 104.955 km^3. The decline was caused not only by

Table 9. Trends in water use in the Aral Sea basin (km^3)

Basin	1960		1970		1980		1990		1995		1999	
	Total	Irrigation	Total	Irrigation	Total	Irrigation	Total	Irrigation	Total	Irrigation	Total	Irrigation
Total, Aral Sea basin	60.61	56.152	94.56	86.837	120.69	106.79	116.271	106.404	105.805	96.72	104.955	94.657
incl. Amu Darya	30.97	28.55	53.22	49.282	66.95	60.345	69.247	65.151	64.392	60.7	66.079	59.568
Syr Darya	29.64	27.602	41.34	37.555	53.74	46.445	47.024	41.253	41.413	36.020	38.876	35.089

Source: SIC ICWC.

temporary stagnation in all countries of the region but also by increased cultivation of cereal crops accompanied by a reduction in areas under water-intensive cotton, rice and feed crops. Another factor is the slow speed of reforms in the agricultural and industrial sectors of some countries, which resulted in large irrigated areas not being used. It has also been noted that weak government controls have resulted in less reliable official statistics on annual water withdrawals and use volumes. Presumably, in countries that have introduced water abstraction charges, actual withdrawal has exceeded levels shown in official statistics. Along with the above negative factors, diminishing water use has, to a certain extent, resulted from efficient water-saving technologies used by independent economic entities in a number of sectors.

Sometimes, water use figures for previous years have been aggregated in national reports in such a way that they fail to describe specifics of each basin, reflecting instead the internal administrative divisions and the status of local water bodies that have no inter-State significance.. This, along with discrepancies in water use figures for different rivers, necessitates further elaboration, by all parties concerned, of their basic calculation methods. Overall, however, all national reports bear out the main trends in water use identified for 1960-2000.

3.1 Water use in the Syr Darya basin

During the Soviet period, water needs of the four republics in the Syr Darya basin were met by the Naryn cascade of reservoirs on the basis of schedules giving priority to irrigated farming.

Today, conflicting economic priorities of individual countries have led to clashes of interest over discharge schedules of the Toktogul Reservoir. Kazakhstan and Uzbekistan have been insisting on giving priority to irrigation, while Kyrgyzstan and partly Tajikistan prefer using water for electric power generation. As a result, since 1993, the Toktogul cascade of reservoirs has been applying schedules characterized by a sharp increase in the volume of the water accumulated in the reservoirs over summer and discharged in winter for the production of hydroenergy by Kyrgyzstan.

Since 1994 the water regime in the Syr Darya basin has been the main subject of negotiations between

Table 10. Basic indicators of water and land use in the Aral Sea basin

Indicator	Unit	1960	1970	1980	1990	2000
Population	Million	14.1	20.0	26.8	33.6	41.5
Area under irrigation	thousand hectares	4510	5150	6920	7600	7990
Irrigated area per capita	ha per capita	0.32	0.27	0.26	0.23	0.19
Total draw-off	km^3/year	60.61	94.56	120.69	116.27	105
including for irrigation	km^3/year	56.15	86.84	106.79	106.4	94.66
Unit draw-off per ha under irrigation	m^3/ha	12.45	16.86	15.43	14	11.85
Unit draw-off per capita	m^3/person	4.27	4.73	4.5	3.46	2.53

Source: SIC ICWC, 2000.

governments. To meet Kyrgyzstan's demands for increased supplies of energy resources and the water needs of Kazakhstan and Uzbekistan in the summer, a decision was made to define mutual obligations of these countries in a fuel and energy exchange agreement. Expert work groups representing water authorities and the power industry of Kazakhstan, Kyrgyzstan and Uzbekistan have drawn up a complex plan of water and energy use for the Syr Darya basin based on the following principles of mutual compensation:

- Electricity generated in the Naryn cascade by Kyrgyzstan in excess of its own (national) needs shall be purchased in equal amounts by Kazakhstan and Uzbekistan;
- Compensation for this quantity shall be made by an equivalent supply of electricity and fuel (coal, gas, etc.) for the winter needs of Kyrgyzstan.

Protocols and agreements on this basis have been signed annually since 1995, with the current agreement between Kazakhstan, Uzbekistan and Kyrgyzstan signed on 17 March 1998. Tajikistan joined the agreement on 17 June 1998.

This approach, however, does not account sufficiently for the environmental problems in the watershed, as the discharges from the Syr Darya will be falling below minimum discharge levels recorded during the past hundred years of observation. On the other hand, the irrigation and water supply concerns of the downstream countries will only be met if the above States fully comply with the terms of signed agreements on fuel and energy supply and the purchases of excess electricity. The slightest non-compliance will undermine sustainable water supply. The implementation of the agreements has revealed that conflicting energy and irrigation needs of the four States have complicated the fulfilment of agreed water allocation terms and necessitate further negotiations.

Thus table 12 indicates that:

- On average, Kazakhstan was the only country where internal water supply was within abstraction limits, while the other countries were constantly exceeding their respective limits, except in low-water years;
- The actual water consumption between 1992 and 1999 was characterized by yearly deviations from the annual long-term average by 5%, i.e. it more or less corresponded to the normative standards for accuracy of estimating water use.

However, according to ICWC data, actual monthly use by individual countries has shown deviations of up to 60% of the multi-year average levels. Obviously, this further complicates the issue of inter-State distribution and efficient use.

3.2 Water use in the Amu Darya basin

Until 1992, the allocation of water from the Amu Darya among the four Central Asian republics was based on the water development master plan for the Amu Darya basin. The allocation plan was approved by resolution 566 of the Science and Technological Council of the USSR Ministry of Land Reclamation and Water Management in 1987. The resolution established the following allocation of surface waters (% of projected flow in the mainstream of the Amu Darya):

- Kyrgyzstan, 0.6%;
- Tajikistan: 15.4%;
- Turkmenistan, 35.8%;
- Uzbekistan, 48.2%.

Table 11. Volumes of inflow to and discharges from the Toktogul reservoir

Indicators	Annual average	1985-1991		1992-1999	
		winter	summer	winter	summer
Inflow the reservoir, km^3	12.06	2.77	9.29	2.98	10.18
Discharges from the reservoir, km^3	11.46	3.53	7.93	7.59	5.73
Water balance, km^3	+0.6	-0.76	+1.36	-4.61	+4.45

Table 12. Abstraction from the Syr Darya mainstream (1992 – 1999)

	1992-1993		1993-1994		1994-1995		1995-1996		1996-1997		1997-1998		1998-1999		Average		% of limit
	km³	%	km³	%	km³	%	km³	%	km³	%	km³	%	km³	%	km³	%	
Uzbekistan	11	50.7	10.36	49.1	9.82	48.1	11.54	51.9	11.95	54.1	11.98	53.99	12.46	54.5	11.3	51.76	50.5
Kazakhstan	8.46	39	8.42	39.9	8.42	41.2	8.48	38.1	8.1	36.7	8.2	36.95	8.32	36.4	8.34	38.32	42
Tajikistan	2.05	9.45	2.15	10.2	1.99	9.75	2.04	9.17	1.87	8.47	1.83	8.25	1.88	8.22	1.97	9.07	7
Kyrgyzstan	0.18	0.83	0.19	0.9	0.19	0.93	0.18	0.81	0.17	0.77	0.18	0.81	0.21	0.92	0.19	0.85	0.5
TOTAL	21.69	100	21.12	100	20.42	100	22.24	100	22.09	100	22.19	100	22.87	100	21.8	100	100
The Aral Sea	7.1		9.25		6.5		3.9		4.9		5.88		7.13		6.38		
TOTAL	28.79		30.37		26.92		26.14		26.99		28.07		30		28.18		
plus diversion to the Arnasay depression	1.30		9.32		4.92		1.00		1.29		2.19		4.12		3.45		

Source: SIC ICWC, 2000.

The quota principle stipulating that Turkmenistan and Uzbekistan are sharing equally the water of the so-called adjusted run-off at the Kerky hydrological post including the diversion to the Karakum Canal, has been applied until now. This provision was reiterated in the bilateral agreement signed by the heads of these two States in Cherdzjev (Turkmenabad) in 1996. Table 13 shows actual abstraction figures, which indicate a regular pattern of deviations from the agreed national quotas in the Amu Darya basin.

3.3 Regulation of water use

In low-water years, even individual countries, in particular Uzbekistan and Turkmenistan, have found it difficult to allocate water between upper and lower reaches due to the time needed for water to cover the distance, fluctuations of losses along the river, and irregular patterns of river depletion and refill. Water use arrangements for the Amu Darya are further complicated by the patterns of refill in the river's reservoirs, as well as by significant withdrawals, outside water reservoirs, during low-level periods (in the Karshinsky, Amubukharsky and Khan-Yan canals, the Takhiatashskaya hydropower station, etc.). All these factors are complicated by unstable riverbed conditions and warrant further targeted studies and refinements in the methods used to forecast and regulate the water flow in the Amu Darya.

In the long run, allocation may get even more complex due to the growing water needs of Afghanistan. In the recent past, economic development of its northern provinces slowed down because of the political instability. At present the country has ample water resources to meet internal demand, which does not exceed 2.0 km³/year. Water relations between the USSR and Afghanistan were based on the 1946 bilateral agreement and the 1958 Protocol.

In the future, Afghanistan may claim a bigger share of water for the socio-economic development of its northern part.This will significantly change the flow

Table 13. Abstraction from the Amu Darya river mainstream (1993 – 1999)

Countries	1993-1994		1994-1995		1995-1996		1996-1997		1997-1998		1998-7999		Average		Ratio to limit, %
	Actual data (from the records of ICWC meetings)														
	km³	%	km³	%	km³	%	km³	%	km³	%	km³	%	km³	%	
Kyrghyzstan	0.15	0.29	0.13	0.26	0.16	0.30	0.17	0.33	0.45	0.84	0.45	0.82	0.45	1.03	0.60
Tajikistan	7.32	14.20	7.01	13.87	7.41	13.93	7.51	14.71	7.03	13.26	7.37	13.45	7.86	17.92	15.60
Turkmenistan	22.76	44.15	21.15	41.84	21.46	40.34	21.02	41.17	21.99	41.47	21.89	39.35	17.23	39.29	35.80
Uzbekistan	21.32	41.36	22.26	44.03	24.17	45.43	22.36	43.79	23.56	44.43	25.08	45.78	18.31	41.76	48.20
Subtotal	51.55	100	50.55	100	53.20	100	51.06	100	53.03	100	54.79	100	43.85	100	100
Plus the Aral Sea	11.2		8.9		3.1		4.9		0.52		8.1		3.29		
Total	62.75		59.45		56.30		55.96		53.55		62.89		47.14		

Source: SIC ICWC, 2000.

patterns for the Pyandj and Amu Darya rivers, calling for a consideration of the following issues that would determine cooperation in water use:

- Possible future requirements of Afghanistan;
- Measures to ensure environmental stability in inter-State water basins, including estuaries and the Aral Sea;
- The impact of return flow on water resources, particularly that of drainage waters discharged directly into rivers or depressions;
- Mutually acceptable decisions based on a review of quota arrangements;
- Strengthening of measures for water conservation at the national and regional level;
- Regulation of water use in the watersheds of small inter-State rivers, such as the Chu and Talas rivers, and others;
- Agreements of water use patterns based on the needs of the population and all economic sectors.

4. Efficiency of water use

In recent years, despite diminishing water use in all the countries of Central Asia, its efficiency should be regarded as inadequate for all economic sectors, especially irrigation farming.

Statistics indicate that the main water losses occur in the on-farm delivery networks and directly in the field. According to WUFMAS, such water losses alone may account for 37% of the total supply to farm contours.

On average, about 21% of irrigation water is wasted directly in the field.

Where groundwater comes close to the surface, almost half of the loss is later recovered through capillary recharge of the root area. This improves the overall efficiency of use, without preventing, in any substantial way, the salinization of soils and degradation of water.

A large share of «excessive» losses in the mountains (nearly 20% of supply to farms) is due to inefficient irrigation methods applied on steep slopes. In the middle part and lower reaches of river watersheds, a large portion of the water loss occurs in the delivery systems between farm head gates and fields. The losses are 15-35% of the supply to farm contours and result from a nearly total lack of water use records and management at the farms as well as inefficient irrigation methods.

Similarly, across the region, water losses have increased in water mains and distribution canals that have not been upgraded in as long as a decade. National water strategies (1995-2001) have defined the following directions for water conservation in irrigated agriculture:

- Introduction of charges for water used in irrigated agriculture, and fines for consumption in excess of the established norms, etc;
- A common methodological approach to tighten control of water use through strict norms for water consumption which primarily seek to satisfy the biological water needs of plants;
- Pilot projects to demonstrate the priority goal of promoting best practices in water use;
- Recycling and other organizational measures to control field loss and non-productive losses;
- Introduction of efficient irrigation methods and technology;
- Lining of canals with impermeable material;
- Complete or partial reconstruction (upgrading) of irrigation systems.

Since most losses occur in the field and in the water distribution to farms, the establishment of water user associations, along with charges, may be an effective approach towards improving the use and conservation of water.

The national reports stress the low efficiency of use also in other sectors, especially in the water supply systems of rural settlements. The trend in industry is toward further decay of return-flow and sequential-

recycling systems of supply, increasing leaks in water mains and distribution network, and a growing number of accidents. Funding shortages are described as the main reason for the neglect of water conservation by government agencies and independent users. Nevertheless, the importance of water conservation is recognized across the region.

5. Estimates of future water use

The SPECA programme is expected to look at future water use in Central Asia in the:

- Short term – (three to seven years, probably until 2005): economic stabilization, with the financial and economic situation of all countries approaching a certain sustainable level. Priority should be given to measures that do not require huge outlays yet establish a sustainable basis for development;
- Medium term (7 to 15 years, probably until 2010): when economic growth is expected to begin. During this period, the economic situation in the region may change for the better, with all economic indicators returning to their 1990 levels. This period should see the development of a sustainable financial potential that would be used to rehabilitate the water sector in the region;
- Long term –(up to 30 years, probably ending in 2025): characterized by stable economic growth. Only a rough estimate of long-term measures is possible, based on the most efficient use of water resources as well as optimal and mutually beneficial arrangements for regional cooperation. This approach is accepted and supported in all reports by national experts.

Table 14 shows estimated demand by countries and sectors within the Aral Sea basin for the three periods defined above. Estimates of demand should be based on national economic development programmes

Table 14. Projected water demand in the Aral Sea basin (km^3/year)

Country	Years	Economic sectors						Total
		Drinking water supply	Water supply in rural areas	Industry	Fisheries	Irrigation farming *	Other	
Kazakhstan	2005	0.08	0.07	0.075	0.065	9.5	0.21	10
	2010	0.14	0.1	0.12	0.15	9.5	0.5	10.51
	2025	0.16	0.12	0.29	0.17	7.45	0.5	9.29
Kyrgyzstan**	2005	0.08	0.09	0.15	0.03	5.54	0.01	5.9
	2010	0.1	0.11	0.2	0.04	6.02	0.03	6.5
	2025	0.14	0.15	0.3	0.05	6.8	0.06	7.5
Tajikistan***	2005	0.5	0.75	0.65	0.1	11.9	0.4	14.3
	2010	0.7	0.9	0.8	0.15	13.15	0.3	16
	2025***	1	1.1	1	0.2	14.5	0.2	18
Turkmenistan	2005	0.37	0.19	0.75	0.025	18	0	19.335
	2010	0.4	0.2	0.9	0.03	20	0	21.53
	2025	0.47	0.25	1.1	0.04	17.65	0	19.51
Uzbekistan	2005	2.65	1.39	1.35	1.05	56.56	0	63
	2010	2.7	1.4	1.39	1.32	52.4	0	59.2
	2025	5.85	1.63	1.46	2.24	48.02	0	59.2
Total, in the Aral Sea basin	2005	3.68	2.49	2.975	1.27	101.5	0.62	112.535
	2010	4.04	2.71	3.41	1.69	101.07	0.83	113.75
	2025	7.62	3.25	4.15	2.7	94.42	0.76	112.9

* Irrigation volumes calculated taking into account efficiency ratios of main canals (on the borders between districts)

** Data from national reports prepared for the SPECA project.

*** In Tajikistan, according to its 2001 Guidelines for the sound use and protection of water resources, expected total water use in 2025 may be about 20 km^3.

Table 15. Estimates of expected water demand in the Aral Sea basin (km³/year)

Country	Expected demand	Reports prepared for SPECA (table 14)		SIC ICWC estimates based on SABAS model	
		Abstraction, total	including for irrigation	Abstraction, total	Including for irrigation
Kazakhstan	2005	10	9.5	6.09	5.5
	2010	10.51	9.5	9.51	8.5
	2025	10.29	8.45	10.29	8.45
Kyrgyzstan	2005	5.9	5.54	3.715	3.5
	2010	6.5	6.02	4.745	4.5
	2025	7.5	6.8	6.64	6.2
Tajikistan	2005	14.3	11.9	12.83	10.8
	2010	16	13.15	12.55	10.38
	2025	18*	14.5	13.89	11.5
Turkmenistan	2005	19.335	18	19.335	18
	2010	21.53	20	21.53	20
	2025	19.51	17.65	19.51	17.65
Uzbekistan	2005	63	56.56	63	56.56
	2010	59.2	52.4	59.2	52.4
	2025	59.2	48.02	59.2	48.02
Total for the Aral Sea basin	2005	112.535	101.5	105.97	95.36
	2010	113.75	101.07	107.535	95.78
	2025	113.9	95.42	109.53	91.82

* see note ***, Table 14

for each country. However, such estimates were made only in the Kyrgyz and Tajik national reports for the SPECA project. Other estimates were, therefore, made from projections made in the draft Programme for the Aral Sea Basin, and from calculations based on a model prepared by the SABAS group for a United Nations Development Programme (UNDP) project.

According to the above data, three countries (Kazakhstan, Turkmenistan and Uzbekistan), in the lower part of the watershed, are aiming to stabilize long-term water use, primarily through water conservation. The other two (Kyrgyzstan and Tajikistan) are planning for long-term growth in water use and are, therefore, proposing to start negotiations on a review of principles and practical arrangements regarding water allocation in Central Asia, in accordance with the decision taken in 1994 by the heads of Central Asian States.

The SIC ICWC offered its own vision of long-term water use development, which is based on a UNDP model and makes the assumption of a positive development of the regional economy (maintenance of low population growth, accelerated GDP growth, and a water use efficiency of up to 80% of its potential maximum).

This forecast is presented in table 15.

It should be noted that this forecast makes assumptions regarding population trends, agricultural output and other products required to assure food security, as well as sufficient supply of water for public needs based on world standards. Such projections are not as yet supported by detailed developed schemes for integrated use of water within each watershed, because the availability of funds for concrete large projects remains uncertain, given the instability of the overall economic situation.

Table 16. Projected water reserves and consumption (%)

Indicators	GFDL	GISS	UKMO	CCCM
Changes in the volume of water resources: for Syr Darya	+1	-2	-15	-28
for Amu Darya	0	-4	-21	-40
Change in water use	+7,38	+1,03	+11,27	+11,10

This is why quantitative estimates of water demand in optimistic, moderate and pessimistic scenarios of economic development differ by 15-20%. Moreover, national forecasts do not envisage reserves potentially made available by the proposed patterns of regional division of labour and production because no political decisions have as yet been made at the level of Heads of State. The reliability of such projections would also depend on expected changes in the climatic conditions of the region that may result in depletion of water resources.

According to national hydrometeorological services, a trend can be observed for higher temperatures in both winter and summer, which would reduce the carry-over reserves of snow and shrink glaciers. In particular, in 1957-1980, the Pamir - Alai glaciers lost 19% of their ice, with the process gaining in intensity.

Quantitative forecasts by various organizations on changes in water reserves and their use yield significantly different results. For example, table 16 provides forecasts based on the water use model «CROP WAT» used by the Food and Agriculture Organization of the United Nations (FAO), and the following models of the development of climate change:

- The Geophysical Fluid Dynamics Laboratory (GFDL) model;
- The Goddard Institute for Space Studies (GISS) model;
- The UK Meteorological Office (UKMO) model;
- The Canadian Climate Center (CCCM) model;

Obviously, forecasts by independent expert organizations presented in table 16 show significant differences, though all imply long-term growth of water use, with a concomitant increase in water shortage across the region. However, nearly all water resources of Central Asia have already been put to use, and the steadily increasing deficit, in the absence of adequate measures, will reduce water quality.

It would, therefore, be necessary for all five countries to adopt:

- A common approach to be applied in the forecasts of water use and a common basis for calculation in the implementation of inter-State water allocation models and procedures;
- General water conservation policies at the national and regional level.

6. Problems of water resource quality

Intensive development of irrigation farming and land drainage in Central Asia together with growing water use for industrial and household needs resulted in increased abstraction of fresh water and discharges of polluted return flow into water bodies. The main pollution sources are agrochemicals that are washed out into drainage systems and are mixed with river water. The second-ranking source in terms of impact on the quality of the water resources is the effluent from municipal and industrial sewers. National reports also note an increased contamination of groundwater due to substandard management of municipal and industrial waste sites, especially in the mining industry.

River quality statistics for the past 40 years confirm trends of an increased mineralization, both over time and in terms of the length of the rivers affected. For instance, in the late 1960s, average mineralization of water did not exceed 1.0 g/l even in the Amu Darya estuary. At present, it varies from 0.3-0.5 g/l in the upper reaches to 1.7-2.0 g/l in the lower reaches (table 17). The possibility of using water for irrigation depends not only on the mineralization but also on the chemical content. Thus, a consistent trend has developed for changes in the ionic composition of salts in the water toward a dangerous increase in alkalinity. Until now, due to a high content of gypsum in soils and CaSO4 in water, the alkalinity (SAR) has remained below the maximum allowable level, yet soil reserves of gypsum are expected to diminish, leading to leaching and increasing concentrations of sodium carbonate.

The increasing mineralization of water in rivers and the intensity of drainage from irrigated land substantially affect the dynamics of salinization and increase the need for reclamation of irrigated areas.

Table 17. Annual average mineralization in the Amu Darya (g/l)

Period	Representative hydrographic sections								
	Termez	Kerki	Ilchik	Dargana-ta	Tuyamu-yun	Kip chak	Chatly	Saman-bay	Kyzyl-Djar
1960-1970	0.51-0.57	0.56	0.61-0.62	-	-	-	0.60-0.65	0.50-0.51	0.54-0.57
1971-1980	0.60-0.65	0.67-0.73	0.70-0.73	0.88	0.68-0.89	1.1	0.72-0.93	0.69-0.84	0.75-0.85
1981-1990	0.57-0.62	0.73-0.78	0.91	1.05-1.15	0.91-1.07	1.08-1.118	1.1-1.15	1.09-1.41	1.17-1.34
1991-1995	0.65	0.70	-	-	0.81	-	-	1.02	0.97

An example is shown in table 17 with the water-salt balance of the Amu Darya. It is shown that only about half of the more than 50 million tons of salt annually ending up in the river stems from a natural run-off, with the rest formed by run-off from the drained return flow. An analysis of the salt balance in rivers and irrigated lands makes it possible to pinpoint salt accumulation areas in terms of reclamation needs of irrigated lands whose productive capacity is either diminishing or remains at the lowest level of safety. In the Amu Darya basin, such areas include, for instance, areas of the Turkmen coast, Tashauz and Karakalpakistan.

The changes in the average annual mineral content by sections of the Amu Darya are presented in table 17.

Similar changes in water content have occurred in the Syr Darya basin. Salt content in its upper reaches of the Syr Darya does not exceed 0.3-0.5 g/l, whereas salt content at the site where the river exits from the Fergana Valley climbs up to 1.2-1.4 g/l, and at the Kazalinsk city site exceeds 1.7-2.3 g/l.

Mineralization has increased from 1960-1970 levels in all controlled sections. Increases in overall mineralization are accompanied by higher concentrations of magnesium, copper, iron, sulphates, chlorides, etc. As a result, not only lower reaches but also the medium course of the Syr Darya contain water that is unacceptable for drinking and its significant pollution quite often leads to increased morbidity of the local people. Prevailing diseases are related to the quality of drinking water and include hepatitis, typhoid and gastrointestinal disorders.

The overall average annual mineralization by representative sections of the Syr Darya are shown in table 18.

National reports indicate that a certain reduction in the mineralization that occurred in the late 1990s in inter-State rivers was due to a temporary slowdown in water use for irrigation and by industries. In the meantime, contamination of groundwater has become widespread. For some pollutants, content levels exceed maximum allowable concentrations by dozens – and, in some areas, by hundreds of times. The highest incidence of groundwater contamination has been recorded around large settlements, chemical, oil refining and non-ferrous metallurgical plants, etc. Statistics for 1995-2001 indicate that, on average, 8-15% of water samples fail to satisfy bacteriological requirements and 20-40% fall short of physical and chemical standards. National experts voice concern over the unsatisfactory technical condition of sewage disposal facilities (in 60-70% of all cases) that fail to provide efficient treatment of sewage and industrial effluent.

The following priority measures have been proposed to address the water quality problem:

- Restricting the volumes of return flow discharged into rivers and the volume of specific pollutants discharge for various points and areas;

Table 18. Annual average mineralization in the Syr Darya (g/l)

Period	Mineralization in representative sections			
	Bekabad	Shardara	Kzylorda	Kazalinsk
1960-1970	0.64-0.97	0.68-0.94	0.70-0.98	0.95-1.01
1971-1980	0.97-1.38	0.94-1.55	0.98-1.74	1.01-1.72
1981-1990	1.38-1.48	1.55-1.46	1.74-1.69	1.72-1.87(2.26)
1991-1999	1.48-1.35	1.46-1.24	1.69-1.33	1.87-1.57

- Introduction of the "polluter pays" principle (for discharge in excess of established limits) as a norm of inter-State relations;
- Strengthening measures for water quality control;
- Identifying levels of environmentally sound discharges in inter-State rivers for different annual water levels and various periods;
- Developing tools and methods for water quality monitoring;
- Participation of the countries concerned in the funding and execution of programmes seeking to prevent, and eliminate the consequences of, the pollution of inter-State rivers.

7. Environmental problems related to water resources

Large-scale development of irrigation and other types of use have changed regional hydrological cycles and led to serious environmental problems. The most dramatic result was the reduction of the Aral Sea and the destruction of its ecosystems, with consequences such as the loss of fish production in the Sea due to increased salinity and toxic pollution of the water; desertification of the estuaries and seabed; a negative impact of the diminished water quality, salt and dust transport on public health; local changes of the climate, etc. However, no less important and dangerous are some of the other consequences:

- Degradation of river and groundwater quality;
- Salinization and waterlogging;
- Desertification of irrigated lands and their periphery;
- Instability of water levels and salt content in water bodies, especially in those fed by return flow from irrigation;
- Decline of bioproductivity and biodiversity in landscapes and water bodies.

The most frequent environmental problems in areas generating run-off relate to the contamination of drinking water sources, land erosion, conservation of glaciers and mountain lakes, and increasing risks connected with industrial, mining and municipal waste storage.

7.1 The Aral Sea

The intensive diversion of water from the Amu Darya and Syr Darya for irrigation over the past 40 years has lowered the sea level by 17-19 metres, and reduced its volume by 75%. In the same period, mineralization of the Sea increased around 6 times.

By the late 1980s, the Aral Sea split in two – the northern Small Sea in Kazakhstan, and the Big Sea with a deep western portion in Uzbekistan. Various schemes were proposed to stabilize the situation. One proposal was to stabilize the Small Sea level at 41-42.5 metres. Attempts to achieve this were made by setting up a temporary dam, but after a short period the dam burst, and water drained into the Big Sea. No similar measures have yet been taken to stabilize the level of the Big Sea. In the meantime, the Heads of State approved on 11 January 1994 "inter-State guidelines" that included both an assessment and a forecast of the situation in the Aral Sea proper and in the Aral region, with approaches that the countries believed were appropriate.

Firstly, it was recognized that the current conditions made it impossible to restore the Aral Sea as such, and the objective was to save not the Aral Sea but its adjoining areas. Part IV of the guidelines reads, in particular, «It is planned to establish an actively managed ecosystem in different zones ensuring sustainable restoration of the impaired process of nature's development in the Aral Region». The establishment of artificial ecosystems in the estuaries and on the drained seabed is seen as a priority, and should include:

- The creation of a regulated system of water bodies on the dry bed of the Amu Darya channel and management of part of the Small Sea for the benefit of the Syr Darya;
- The creation of polder systems on the dry seabed;
- The implementation of phyto-reclamation work aimed at the immobilization of shifting sand;

- Discharges of drainage water to the sea area through the sand-swept areas.

Efforts should include identifying zones for the conservation of the remaining Aral Sea with a high salt content, and forecasting its salt and water balance, water levels, the condition of the surrounding region, with measures to prevent its contamination.

The efforts of IFAS and the Central Asian countries helped plan and achieve improvements with regard to the socio-economic situation of the coastal areas, in particular, to upgrading health services and drinking water supply in the vicinity of Muinak, Aralsk, etc. Part of this work was implemented with support from various donor organizations, especially the World Bank, but most of it was funded by the countries themselves. Over the past six years, the donors between them spent 6 million dollars on solving the Aral problem, with much of it covering administration costs and expenditures of the donors themselves. Allocations from IFAS, in 1999 alone, totalled 5.3 million dollars.

Undoubtedly, this amount is insignificant compared with the damage caused by the decrease of the sea level. Since it is impossible to restore the Sea and estuaries to their former state, the countries concerned are currently attempting to identify priorities and, to the extent possible, organize appropriate protective activities. This is why Kazakhstan has launched a North Sea project that would establish a water surface near the town of Aralsk and, to a certain extent, provide conditions for the restoration of the estuary over an area of nearly 1.5 million hectares. Uzbekistan, with funding from GEF, is working to restore the Sudochye Lake wetlands over an area of 40,000 hectares, and is using its own funds to identify priority steps in the building of facilities that would regulate water allocation in the Amu Darya estuary, and, with support from the German Development Agency (GTZ), to grow, on a pilot basis, protective forest belts on the dry seabed.

Further funding would be crucial in executing a number of fundamental decisions regarding:

- The development and implementation of integrated environmental measures to support and manage the lake and wetland system of the Syr Darya estuaries in conjunction with the North Sea project;
- The development of a project and its terms of reference for developing irrigation on more than 2 million hectares in the southern Aral region to restore the Amu Darya estuary and tugai forests and secure the environmental sustainability of this area;
- The carrying-out of a survey and making a decision on the future of the Aral Sea itself through a study of ways to preserve one of its parts (most probably, the western deep-water section) as a biologically active site, with a similar decision to be made on the future of the remaining part so as to prevent natural disasters of an even greater magnitude.

Certain prerequisites have emerged for addressing the above problems. In 1992-1999, thanks to a high water supply, the Aral Sea and adjoining areas received nearly 110 km^3 of water. All the countries of the region, albeit with certain reservations, are considering proposals on granting the Amu Darya and Syr Darya estuaries the status of an independent water user whose demand for water would be considered on an equal footing with that of any other country. The above water requirements should be based on an approved regional strategy, with due regard for the annual variability of the river flow. All countries have recognized the importance of coordinating their requirements regarding both water quality and maintenance of biodiversity and bioproductivity in the estuary.

For the near future, annual estuary requirements are estimated at 8 km^3 and 5 km^3 for the Amu Darya and Syr Darya basins, respectively. In a more distant future (by 2025), the inflow is supposed to reach a minimum of 11 km^3/year and 8 km^3/year, respectively. While the region has very limited reserves to accomplish this goal, countries have recognized the relevance of:

- Agreements on the use of the Amu Darya and Syr Darya should determine the minimum share of, and schedules for, releases to the estuaries for various levels of flows in different years, in order to ensure conditions guaranteeing the survival of fish and other species of aquatic flora and fauna in years of acute water shortage;

- Ensuring efficient management of economic and environmental activities in the Amu Darya and Syr Darya estuaries.

The countries of the region agreed on the need to establish a reliable economic base for joint execution of environmental measures. Their collaboration led to the establishment of IFAS. Differences persist, however, in national approaches as to what measures would help stabilize the environmental situation in the Aral Sea area. The issue should therefore be addressed together with the problem of joint elaboration of new principles and mechanisms for regional water allocation. For instance, the proposal to have countries pay to IFAS fines for exceeding national water allocation quotas can be implemented only after agreement has been reached on new quota levels and the principle of water charges in inter-State relations.

7.2 Improving irrigated land

The specific impact of the arid climate and hydrological conditions of the region together with poor compliance with the land reclamation technologies lead to the degradation of irrigated land. Between 1990 and 2000, the share of land with high groundwater levels increased from 25% to 35%, with that of medium and highly salinized land (where crop yields are 20-50% lower) rising from 23.4% to 28.5% of the total irrigated area. As much as 60% of irrigated land has been classified as prone to salinization (the basic criterion being the overall content of toxic salts in soil). This may result in a future loss of land productivity due to intensified salinization.

It is, therefore, proposed to implement measures that have been sufficiently well proven all over the world, including:

- Maintenance, cleaning and repair of drainage networks, especially water mains and channels between farms as well as underground drainage;
- Rehabilitation of drainage wells (at present, only 30% of the wells are operational, and in some districts all are out of service);

A balanced management of abstraction and discharge schedules is crucial, and should build on the two main principles of environmental sustainability in watersheds:

- Salt accumulation on irrigated land from water discharges and drainage should be negative with regard to toxic salts, and favour the maintenance of useful salts (gypsum) in the soil layer;
- The concentration of toxic salts in the water of rivers should not exceed maximum allowable levels in any hydrographic section.

In order to apply these principles, joint efforts of Central Asian countries in putting together an organizational framework incorporating improved methods of calculation and modelling as well as information arrangements are needed.

7.3 Environmental problems in areas generating water run-off

The national reports of Kyrgyzstan and Tajikistan stress that a balanced regional approach to solving common environmental problems implies increased attention to the environmental conditions in mountain areas, which generate run-off. The following issues have been recognized as crucial and requiring joint action:

- Conservation of glaciers and the feeding of rivers by glaciers;
- Support to the stability of mountain forests, restoration and expansion of natural forests which play a crucial role in river flow patterns;
- Erosion of mountain slopes, especially in connection with the development of irrigation in alpine valleys and upper valley terraces;
- Waterlogging of land caused by reservoirs and irrigation in areas generating run-off, calling for improved drainage to prevent waterlogging and salinization;
- Land subsidence in areas with loess soils and measures to prevent it;

- Safe operation conditions of industrial and municipal waste dumps, including prevention of leakage of radioactive, toxic and other harmful substances into surface water and groundwater;
- Prevention of mudflows and elimination of their consequences for the environment, industrial and public installations.

8. Organizational structure and legal framework for water management in Central Asia

8.1 National management structure

In the early 1990s, the former common water management system was scrapped, and various attempts were made to transform it, depending on the specifics of national economic development, preferred models of transition to a market economy, as well as the specific political and social processes in each Central Asian country.

In **Kazakhstan**, the transition from centralized planning to a market-based economy took a relatively short time. The reform led to the privatization of nearly all basic industries, the complete denationalization of agriculture and the reorganization of the State management system. Ministries and departments are focused on strategic and emerging issues, with economic functions moved to the level of economic entities.

Economic reform is a long-term undertaking and Kazakhstan is currently undergoing transition with the inevitable cutbacks in State funding for social and economic infrastructure that makes it insufficient for the new economic conditions. The same is true with respect to the water sector administered by the Committee for Water Resources of the Ministry of Natural Resources and Environmental Protection.

Water resource management is based on river basin as well as administrative-territorial principles. Under the Committee's auspices, there are eight basin directorates (BVU) corresponding to the number of main river basins. BVUs are government agencies and, as such, are funded by the State budget.

Maintenance and operation of water management facilities and installations are the responsibility of public water management enterprises (RGP) that operate in each region and are part of the above-mentioned Committee. The economic activities of RGPs are funded by the water users. All water management systems and facilities under the RGP belong to the State. Maintenance and repair of facilities of inter-State and district significance is partly funded from the central budget through contracts commissioned by the State.

During the current transition period, the water sector finds itself in a difficult situation as users lack funds to pay for supply, while budget allocations are not enough to finance operation, repair and restoration. As a result, most facilities and engineering works continue deteriorating, and their operational reliability is decreasing.

Measures to break the deadlock should promote user involvement in maintaining the economic infrastructure. Organizationally, user associations would assume functions that used to belong to public-run networks which, however, are no longer able to exercise them at the level of districts or large water management systems. While such associations are being set up all over Kazakhstan, many organizational issues remain unresolved due to an inadequate legal framework. There is also a need for effective public financial support of supply networks and large water management systems, as well as for domestic and external investment in upgrading and refitting the engineering works of the water management infrastructure.

Kyrgyzstan has been more cautious in its water management reform, with market transition accompanied by a measure of public support in the maintenance and rehabilitation of district and regional networks. The former Ministry of Water Management has been merged with the Ministry of Agriculture to form the Ministry of Agriculture, Water Management and Processing Industry, with most water management functions exercised by its Department of Water Management. It has also assumed direct control of irrigation farming, which has led to certain legal problems over water use. Some management functions have also gone to

such public agencies as the Ministry of Ecology and Emergencies, national agencies for energy, geology and mineral resources, etc. Certain reforms have taken place at lower administrative levels, where the assets have been divided between the State and municipal authorities, and individual economic entities. Basin directorates have been set up but they exercise purely administrative control within their respectives regions. In the future, the State intends to retain its ownership and control over all strategic assets– dams, reservoirs, hydroelectric power stations, main canals, etc. At the same time, it plans to denationalize water management systems by setting up new corporations. Guidelines have been adopted for the privatization of both large and small hydroelectric power stations. Steps are taken to prepare municipal water supply and sewage treatment for privatization, with their operation, maintenance and support transferred to the private sector. While many issues relating to the legal status of water user associations have finally been resolved through domestic laws, their establishment has slowed down. The Kyrgyz report notes a number of administrative drawbacks, including poor coordination of cooperating water-consuming sectors and the lack of clarity in the separation of functions and powers between administrative agencies. Plans exist for a new water code, which is supposed to settle the organizational and legal wrangles in the water management sector. The Government has the additional responsibility for carrying out the administrative reform that would have water management operators withdraw from the combined Ministry.

In **Tajikistan**, water resource control and management functions are divided between different agencies, with the Ministry of Water Management being the main agency. The country has chosen the path of gradual conversion of collective and State farms to private farms and other market-based structures. Tajikistan has abolished State orders in agriculture and other industries, eliminated price controls, and supports small- and medium-size businesses. Water user associations have emerged to assume control over the operation of intra-farm irrigation systems. The Water Code adopted in 2000 gives priority to economic mechanisms to regulate water use.

A national medium-term Programme that is supposed to lead agro-industry out of its crisis contains guidelines for its development until 2005, including measures to rehabilitate capital assets, restructure agriculture and ensure food security despite the current shortage of arable land (about 0.1 hectare per capita). In this context, all problems relating to agricultural reform are considered in conjunction with land and water management reform, with priority given to overcoming poverty, especially in rural areas. Water relations in the country are regulated by water use licences and charges for water supply. No legal framework is yet in place to settle water management rights, especially the rights of domestic and foreign legal persons to operate irrigation systems.

Tajikistan is considering the benefits of the hydrographic (basin) principle of management, with respect to inter-sectoral interests and the privatization of enterprises in various water-using sectors. Economic development programmes focus on expanding hydropower facilities, including the construction of the Rogun hydropower station on the Vakhsh and Dashtidzhum station on the Pyandj, whose water reservoirs would improve water use efficiency not only in the country itself but also across the region.

Turkmenistan has a unique approach to water as a public and social resource, with its water management structure dominated by a single administrative body - the Ministry for Water Management whose powers are similar to those in the USSR period. The State has retained control over centralized and municipal management of water resources in all economic sectors, including irrigation, water supply and hydropower generation. Water, electricity and gas supply are free, and so is irrigation. Consumers pay only for consumption in excess of quotas established by the State, as a penalty for the inefficient use of natural resources. In the irrigation farm sector there are possibilities for privatization through concessions, where users commit, for example, to fulfilling State-fixed production targets for certain crops, while having full discretion to sell their output produced over and above the target. In the water supply sector, opportunities exist for setting up private water supply and sewage treatment services. This is also a possibility in the energy sector.

Like in other economic sectors, **Uzbekistan** proceeds cautiously with its market reform of the water sector, and maintains the practice of quite extensive budget allocations, which however, are not enough to maintain the enormous inherited fixed capital capacity. However, the situation is different between water supply, irrigation and hydropower generation sectors. In water supply, the function of maintenance is generally delegated to cooperative entities and joint-stock companies. In hydropower generation, State control is as firm as ever, except for small hydropower stations, which the Government would like to privatize and develop through public investment. A decision has been taken to restructure the energy sector, dividing it into generation and transmission components. The most critical problems have emerged in irrigation farming. In addition to water user associations already set up at the lowest administrative level, plans exist to start establishing water user federations that will assume responsibility for water supply along with the operation and maintenance of networks at the level of former State and collective farms. In some cases, the functions of water user associations would merge with those of private district-level enterprises, or the associations themselves would outsource services on the basis of trustee contracts. As in Turkmenistan, concessions may be granted to private companies for the use of irrigated land.

Great attention is given to the future transition to the basin-based and system management of water resources (with direct subordination of relevant bodies to the national administration), water user involvement in these processes, and the introduction of integrated management principles that are in accordance with the French or Spanish models.

Although the national reports under the SPECA project present differing views of the existing situation and propose specific approaches to the organization of management, one should note several common drawbacks of the organizational structure in the water sector and irrigation farming:

- The water sector in its present form primarily represents the interests of agriculture rather than all economic sectors.
- The water management organization should be modernized in order to equally represent the interests of irrigation, hydropower generation and other sectors, observe the priority of drinking water supply, water conservation, etc., provide for equality of rights and responsibility for all water users.
- In all stages from the initiation of all water management projects to their implementation, decisions are taken only by State agencies without any involvement of water users. This often results in situations where the cost of maintenance of water management systems and facilities transferred to the control of water users cannot be covered by profits from their operation.
- The policy of transferring a maximum share of costs of the operation and maintenance of the irrigation network to water users without appropriate public support complicates the resolution of issues related to development, restoration and modernization of the irrigation systems. The standard depreciation period has expired for most systems, yet in current circumstances the problem of renovating them has to be addressed by the water users, who often do not feel responsible for this work, whereas State agencies avoid involvement in these problems, referring to restricted budget funds.
- Legislatively and financially, the matters of distribution of responsibility between the water users and the State budget remain unspecified in all the countries. The prevailing view is that the government should not assume the growing financial burden, yet this ignores the fact that reduced efficiency of irrigation and conservation of water may result in declining agricultural productivity, as well as social losses. This represents serious risks in terms of reduced national income and tax payments, and even potentially increased social tensions.
- The establishment of associations of water users and the identification of optimal forms of their activities are two of the most essential measures for improving the efficiency of water use at the former intra-farm level.

8.2 Water management practices in the years preceding independence

The need for integrated management and the protection of water resources at watershed level had been proven long before the countries of the region gained independence. Although the centralized water allocation system run by the former USSR Ministry of Land Reclamation and Water Management (USSR Minvodkhoz) was based on regular consultations with the five republics, the 1974-75 water crises, and especially the one in 1982, showed that environmentally feasible regulation of water supply could be achieved only through concerted action across the region. It was, therefore, suggested to set up basin organizations that would manage resources in accordance with regulations and schedules agreed by the republics and approved by the USSR Minvodkhoz The structure of the basin water management organizations (BVO) was approved in 1986, resulting in the establishment of two such entities: Amu Darya BVO with headquarters in Urgench, and Syr Darya BVO in Tashkent. According to government decree No 1110, basin organizations were responsible for all canal intake facilities on rivers and main tributaries with an intake capacity of more than 10 m^3/sec.

The BVOs received public financing through the USSR Minvodkhoz from the central budget. Twice a year, based on forecasts by the republics' hydrometeorological services, the Amu Darya and Syr Darya BVOs submitted to the USSR Minvodkhoz an annual plan approved in consultation with the republics, which included schedules of water release and supply from reservoirs within the respective basins. Each republic received its share of water in accordance with quotas approved by the USSR State Planning Committee. Annual plans essentially determined water reserves for the main long-period storage reservoirs (Toktogul, Andizhan, Charvak, Nurek) and were approved by the Deputy Minister of the USSR Minvodkhoz.

Allocation depended either on the area under irrigation or relevant demand calculated for each agricultural crop and district. Depending on hydrological forecasts, basin organizations could either reduce or increase quotas for each country by no more than 10%. They did not monitor water quality and were not responsible for water use in each country. The Aral Sea and Aral region basically received the water that what was left over.

8.3 Current status of the inter-State water relations

When the countries in the region gained independence, it became necessary to set up a mechanism for regional cooperation in the organization of water resource management. Based on the principle of equal rights and responsibilities, a number of agreements were signed to regulate cooperation in the joint management, protection and use of water resources.

The first was the Agreement on Cooperation Regarding Joint Management of Water Resources in Inter-State Water Sources. It established the Inter-State Commission for Water Coordination (ICWC) representing the five Central Asian countries. It was signed in Almaty on 18 February 1992 and later endorsed by the Heads of State Decision of 23 March 1993. The operations of ICWC are regulated as follows:

- ICWC has five members appointed by the governments, who have equal rights and responsibilities with regard to joint consideration of national water supply issues, including environmental requirements. Decisions are by consensus.
- The two BVOs became executive bodies of ICWC, whereas part of the Central Asian Irrigation Institute (SANIIRI) was given the status of Scientific and Information Centre (SIC) under the ICWC auspices.
- ICWC members represent their countries' interests within the responsibilities and powers delegated by their government.
- The principles of allocation approved in the USSR period should be retained until new regional and national water management strategies are developed and approved.

ICWC has the following functions:

- Development and coordination of annual consumption quotas for each country and principal water source, and operating regimes for large reservoirs; management of allocation based on actual water availability; establishment of annual supply volumes for estuaries and the Aral Sea, and discharges in rivers and canals; operation and maintenance of water abstraction facilities controlled by the Amu Darya BVO and the Syr Darya BVO ;
- Coordination of regional water management policy, development of its major aspects with due regard for public concerns and economic interests of the founding countries; securing sound use and protection of water resources; elaboration of programmes aimed at increasing water availability in the region;
- Provision of recommendations to governments regarding their common pricing policy and compensation for possible losses from the joint use of water, and regarding the development of a legal basis of water use;
- Coordination in implementing large projects for the joint use of the existing water resource capacity;
- Establishment of a common information base on the status and use of water resources, monitoring of irrigated land and overall environmental monitoring;
- Coordination of joint research in scientific and technological support for regional water management programmes;
- Coordination of the implementation of water conservation technologies, irrigation methods and procedures leading to improvements in irrigation systems and water use;
- Development of joint programmes to increase awareness and prevent emergencies and natural disasters.

Later, in 1993, linked to the expansion of the Aral Sea Basin Programme (ASBP), two new organizations were set up to coordinate it: the Intergovernmental Council for the Aral Sea (ICAS)), and IFAS to accumulate and manage Programme's funds. In 1997, these organizations underwent the following restructuring:

- ICAS and IFAS were merged into a new IFAS, with its chairmanship rotating biannually among the Presidents of the five countries;
- The IFAS Executive Committee (IFAS EC) was set up to provide the general management of ASBP.

The major tasks of the IFAS EC are:

- Implementation of decisions of Heads of State relating to the Aral Sea;
- Implementation of relevant projects and programmes in the Aral Sea basin;
- Coordination of its branches in the founding countries;
- Support for ICWC activities;
- Expansion of cooperation with international organizations, donor countries, environmental and other funds to address environmental problems;
- Accumulation of funds and their allocation for various activities;
- Preparation of documents and meetings of the IFAS Board, as well as conferences and meetings of the Heads of State on Aral Sea issues.

The IFAS Board is responsible for preparing drafts of political decisions. The documents of the Board on the most important issues, following their consideration by the Heads of State, are distributed for implementation.

The 1999 agreement between the Heads of State established the following distribution of responsibilities among regional organizations:

- The IFAS Board comprises the Deputy Prime Ministers of the five countries and is the highest political body responsible for making decisions or, if necessary, preparing decisions for approval by the Heads of State;

- The IFAS EC is a permanent body that includes two representatives of each country and executes all the work required for implementation of decisions adopted by the IFAS Board through the national IFAS branches; the IFAS EC can, on behalf of the Board, set up agencies to execute international or donor-funded projects;
- ICWC is a joint body that coordinates the management of transboundary water resources, allocation, monitoring, preliminary assessment of proposals to improve organizational, technical, financial, environmental approaches and decisions relating to water resources at the inter-State level, based on coordinated decisions of all parties. The BVOs, SIC ICWC and the Secretariat all serve as ICWC executive bodies.

The Amu Darya BVO and the Syr Darya BVO have the mandate to:

- Ensure the timely and reliable supply to all users based on agreed quotas for water abstraction from transboundary sources; control discharges to the estuaries and the Aral Sea in accordance with discharge limits; provide operational control over the discharges and refill of inter-State reservoirs, as well as their water quality;
- Develop plans of abstraction through head gates; facilitate agreements on water quotas for all water users in the Syr Darya and Amu Darya basins;
- Establish automatic water management control systems in the Amu Darya and Syr Darya river basins; measure water levels at head gates and equip them as required;
- Carry out, together with national hydrometeorological services, measurements at control sites for precise river flow assessment at the country's borders;
- Carry out integrated reconstruction and technical operation of head gates, canals, automatic control systems at inter-State facilities;
- Carry out research and provide engineering design for new water management facilities, and rebuild facilities placed under the control of the BVOs.

In addition to existing intergovernmental agreements on water relations and the implementation of ASBP, the regional legal framework also includes other intergovernmental agreements, for instance:

- The 1996 Agreement between the Governments of Kazakhstan, Kyrgyzstan and Uzbekistan on the use of fuel, energy and water resources and the construction and operation of gas pipelines in the Central Asian region;
- The 1998 Agreement between the Governments of Kazakhstan, Kyrgyzstan and Uzbekistan (and later also Tajikistan) on the use of water and energy resources in the Syr Darya basin, environmental protection and the rational use of natural resources;
- The 2000 Agreement between the Governments of Kazakhstan and Kyrgyzstan on the use of inter-State water management facilities on the Chu and Talas rivers; Annual agreements between the Governments of Tajikistan and Uzbekistan, relating to the Syr Darya, etc.

It should be noted that most existing agreements provide just a general approach to solving current water problems, without detailed procedures for their implementation.

Several other draft inter-State agreements are currently being designed or going through their approval stage, relating, in particular, to:

- Strengthening the ICWC organizational structure;
- Developing regional, national and watershed information systems and information exchange;
- Using waters from transboundary sources;
- Planning joint actions on transboundary rivers;
- Water quality for the environmental sustainability of rivers;
- Principles of cost-sharing with regard to the operation and maintenance of water management facilities, joint inter-State use, etc.

Most national and intergovernmental experts concur that agreements on specific issues could be

facilitated through the adoption by the Central Asian States of a regional water strategy that would provide a common perspective on allocation and the rational use and conservation of water resources.

8.4 Approaches toward improving water cooperation

Repeated declarations by Heads of Central Asian States and Governments of their intention to develop mutually advantageous cooperation in the use and protection of water have not yet become a reality for a number of reasons, including:

- Temporary economic difficulties encountered by all five countries in their transition to a market economy;
- A substantial restriction of financial and other measures of public support for the maintenance and development of the water management infrastructure, and the resulting degradation of its technical status;
- An unbalanced development of economic sectors resulting from the dismantling of the production cooperation structure that existed in the USSR;
- The patterns and quotas of inter-State water allocation inherited from the USSR period that fail to account for the priorities of socio-economic development and future water requirements in each country;
- A lack of coordinated economic mechanisms for the rational use of water;
- A legal basis for cooperation that primarily consists of framework agreements which do not cover the entire range of relevant issues and fail to define detailed procedures for the preparation and adoption of decisions, and joint follow-up on commitments assumed by countries.

The national diagnostic reports and various expert assessments include references to the following fundamental contradictions that hamper development of regional collaboration on water-related issues:

- Kyrgyzstan and Tajikistan believe that the development of their irrigation farming was restricted in the past. Consequently, they intend to insist on higher quotas (abstraction limits) for internal water use. The other countries in the region are interested in preserving the status quo in water resource distribution. Achieving consensus on this issue may be complicated if the stabilization of the political situation in Afghanistan results in an increased demand for water in this country.
- The countries situated in the water flow formation zone, especially Kyrgyzstan, are interested in increasing the generation of electricity and therefore seek to establish a regime for water releases from their reservoirs that would be optimal in terms of hydropower generation development. Kazakhstan and Uzbekistan, for obvious reasons, are interested in an operational regime for reservoirs that would primarily meet the needs of irrigation.
- Although the countries in the region recognize the norms of international law known as the precautionary and the polluter pays principles, they demonstrate different approaches to their practical application. The downstream countries on inter-State rivers, being potentially aggrieved parties, insist on the unconditional observance of these norms. Upstream countries believe, however, that they run an excessive risk of causing inadvertent damage to their neighbours and are therefore forced to incur disproportionate expenses to prevent possible damage. In this connection, it is proposed not to use the principle of obligatory compensation for damage caused by water pollution unless all the countries concerned agree to cost-sharing in relevant preventive measures.
- Though official representatives of most countries in the region agree with the need for equitable recoupment of costs for inter-State water management measures, there is no complete list of such measures. Neither is there a regulatory and organizational framework for the operational settlement of unresolved issues, which leads to a certain tension in relations.
- National legislation in all countries in the region recognize their sovereign rights to the water sources within their territorial boundaries and

the water resources contained therein. These provisions conflict to some extent with the norms of international conventions establishing a special status for water resources classified as transboundary rivers or international watercourses

- This contradiction may be eliminated only if a special clarifying provision is is formulated and incorporated either in the regional water strategy or in a relevant agreement, because not all the countries intend to accede, for instance, to the Helsinki Convention on the Protection and Use of Transboundary Watercourses and International Lakes of 1992.
- None of the countries in the region gives sufficient attention to environmental issues, including the conservation of rivers and lakes as natural water bodies. Moreover, there is a discrepancy between the priorities of environmental protection activities. For instance, Kazakhstan and Uzbekistan are more concerned about the situation in the Aral Sea region, whereas Tajikistan and Kyrgyzstan seek to attract attention to the problems of glacier conservation and security of rock-dammed mountain lakes, and the environmental sustainability of the water flow formation zone. This substantiates the need for balanced regional cooperation in environmental protection.

As regards the practical activities of such inter-State structures as IFAS, ICWC and BVOs, their capacities are by far not fully used. In particular, ICWC recommendations regarding agreed-upon conditions of water allocation and water releases to the Aral Sea are not always complied with. The potential of the two BVOs as executive inter-State water allocation bodies is restricted because:

- Part of the inter-State water abstraction facilities, as well as the major hydropower facilities and reservoirs are controlled by national bodies rather than watershed organizations;
- The watershed organizations do not monitor the amounts and schedules of groundwater abstraction and return flow discharge, or the quality of water resources;
- Protection zones have not yet been established for inter-State rivers;
- The sections of the Syr Darya and the Amu Darya witin each country's national borders are under the jurisdiction of respective national bodies, and the mandate of the BVOs to control the situation along these river stretches is practically not fulfilled;
- There is no collaboration between the BVOs and the national hydrometeorological services, which adversely affects the precision of water reserve estimates and forecasts;
- The BVOs and their subsidiary bodies do not have a sufficient technical base for obtaining, processing and transmitting information.

It is currently agreed, at least by Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan, that there is a need to preserve the existing inter-State structures that coordinate cooperation on water-related issues, and strengthen their financial, legal and organizational capacities. At the same time, there are different views regarding the development of the organizational forms of long-term cooperation. The following proposals, in particular, should be mentioned:

- Improvement of national water legislation taking into account norms of international law;
- Clarification of the legal status of inter-State bodies, specification of their functions and mandates;
- A step-by-step involvement of water users associations, as they are being formed, in drawing up decisions on inter-State water-related issues;
- The establishment of a water and energy consortium as a financial mechanism for strengthening interaction among water-using economic sectors of the countries concerned;
- The liberalization of national border crossing, customs and other regulations in relation to officials of the above regional bodies;
- The need to develop information support for the public in the countries of the region on important issues of environment, water conservation, payment for the use of water, emergencies relating to water use, etc.

These proposals are analysed in more detail below.

SECTION B. REVIEW OF ISSUES REQUIRING HARMONIZATION OR COORDINATION BY COUNTRIES OR SECTORS

1. Inter-State water allocation issues

The prospects of social and economic development of all the Central Asian countries are largely dependent on the availability of water resources. The main sources of water in the region are the Amu Darya and Syr Darya with their tributaries, which flow through the territory of several countries and are therefore of interstate significance..

In recent years, there has been growing concern in the region about being able to meet long-term water requirements. Though the statistics of the past decade indicate a temporary reduction in annual water consumption and a relative improvement of water quality, these trends are of a short-term nature. At the same time, such factors as the growth of population, the continuing degradation of the water management infrastructure, the inadequate measures of State supervision over water management and environmental protection, as well as disregard for water-saving requirements, should inevitably result in a growing shortage of water resources.

The changed political, social and economic conditions coupled with unfavourable forecasts of long-term water supply have made it necessary for the Central Asian countries to enhance efforts to achieve an efficient, environmentally safe water use based on new, mutually agreed principles, procedures and terms of water distribution.

The Central Asian countries declared their commitment to the goal of developing inter-State cooperation on water issues at the international conference in Nukus on 20 September 1995. The Heads of the five Central Asian States confirmed in the Nukus Declaration their «commitments to full cooperation at the regional level based on mutual respect, good-neighbourly relations and determination» for the sake of overcoming the consequences of the environmental crisis in the Aral Sea basin and its impact on nature and people. The Bishkek Declaration by the Heads of the Central Asian countries of 6 May 1996 recognized that it was necessary to accelerate the development of a new water allocation strategy and economic methods of management in water and energy resource use.

Reaching agreement about the principles and procedures of water distribution, and measures to optimize the regimes in the use of inter-State water bodies to satisfy the requirements of all sectors with due regard for environmental interests is thus regarded today as the most essential task.

The arrangement for operation and interaction of the fuel and energy and water management infrastructure of all the Central Asian countries that remained in effect until recently requires fundamental amendments to adapt it to the current circumstances. The plan for diversion to the region of part of the Siberian river flow that was developed back in the 1980s and was supposed to solve the problem of the growing water shortage has not been implemented. The strained inter-State relations and complicated joint settlements, the introduction of national currencies, the growing costs of fuel and energy resources shifted the emphasis of the operational regime of the reservoirs in the upper reaches of the Syr Darya and Amu Darya from irrigation to energy generation. This, in turn, led to serious complications in the lower reaches both in winter and in summer.

Despite the declared need to reach agreement on water allocation, the positions of countries quite often remain unchanged. While the countries situated in the river flow formation zone insist on revising the abstraction limits (quotas) for water use previously established by the USSR Government, the downstream countries try to preserve the status quo and prevent the redistribution of water resources that has actually already taken place. Being interested in increasing water use for hydropower generation, the upstream countries, especially Kyrgyzstan, insist on their right to arrange the water release regime accordingly and

demand compensation from the downstream countries for the water resources provided for irrigation.

The current model of using the water and energy resources in the Syr Darya basin based on the 1998 agreement has serious drawbacks (the lack of mechanisms for enforcing unconditional implementation of commitments, complicated joint settlements, etc.) and offers no guarantees of long-term water supply. The cooperation on water and energy use in the Syr Darya basin is based on short-term agreements that primarily take into account the interests of energy resource exchange and do not address the transition to a balanced long-term use of water resources based on the ecosystem approach.

In these conditions, the implementation of commitments assumed by the parties to intergovernmental agreements and the transition to a sustainable long-term legislative regulation of the use of water resources, in particular, the Naryn reservoir cascade, take on special significance.

The following measures are proposed to optimize the water allocation mechanism in the current inter-State relations:

- The signing of an agreement by all the countries on the integrated use of river water resources and the adoption of relevant regulations on water allocation and operational management of water use;
- The gradual transition at the watershed and subregional levels within each country to an integrated (complex) method of water use management focused on equal rights of participation for all sectors, local bodies and representatives of water users in this management;
- The establishment of a water and energy consortium as a financial mechanism regulating the use of the available fuel, electricity and water resources in closest approximation to a schedule of water use agreed upon by the countries. This will be possible if the countries determine precisely who will represent their interests in the consortium and draw up coordinated rules for setting price and for sharing expenditures and profits that would be equally beneficial for all the participants in the consortium;
- The orientation of all the countries on measures for water conservation corresponding to modern technically and economically achievable levels of water use;
- The promotion of public awareness and public involvement in support of measures that concern the interests of the entire population of the region.

The following plan is proposed for activities in water distribution:

- The definition of a common basis for calculating water resources subjected to quotas and water demand over a reasonably long period;
- The development of principles and criteria for inter-State water allocation;
- The allocation of water quotas (abstraction limits) to each country;
- The establishment of abstraction and water supply schedules;
- The establishment of a follow-up mechanism to control compliance with the water supply schedules;
- The regulation of the legal, organizational and economic procedures for inter-State water distribution.

Reaching a water allocation agreement is an objective that calls for gradual integrated decisions taking into account not only environmental and socio-economic changes taking place in the countries, but also the need to establish unified standards for water use and water conservation for each country, including water-saving requirements.

The main measures for water conservation in the region specified in the guidelines for all the national water strategies developed in 1995-96 (see «Guidelines for the Strategy for water resource management in the Aral Sea basin» by IFAS and World Bank, 1997) are as follows:

- Introduction of water charges in irrigation farming and other economic sectors through the establishment of differentiated tariffs, as well as penalties for water consumed in excess of the established norms;
- Elaboration of common technical approaches to stringent regulation of water consumption based on specified norms;
- Establishment of a system of pilot water-saving projects as primary demonstration sites of water use;
- Introduction of reuse of irrigation water and other organizational measures aimed at the prevention of water losses in the field and non-productive water use;
- Introduction of efficient irrigation techniques and technologies;
- Establishment of waterproof lining in canals;
- Complex reconstruction and modernization of water management systems.

All countries basically support the implementation of water-saving measures in the region based on cooperation and concerted actions. In this connection, in particular, it is proposed to set up watershed committees with the authority to regulate water use and water conservation, primarily in agriculture.

Simultaneously, complaints are made by all sides about the inefficient water use by the other countries, which hampers agreement on inter-State water distribution.

In these circumstances it is clear that the issue of water allocation cannot be addressed without each country assuming responsibility for an efficient water use by the economic sectors in its territory through the introduction of water-saving technologies.

2. The current legal framework

The complex of legal issues that need to be addressed is related in the first place to the improvement of the treaty (international legal) framework for inter-State cooperation, and the harmonization of the legal framework of all the countries in the region to achieve the best and most efficient enforcement of inter-State agreements.

2.1 Legal aspects of inter-State cooperation in allocation and management of water use

Improving the efficiency of international legal regulation of water relations among the Central Asian countries is at present a key issue. It requires new approaches to inter-State negotiations on water use. Multilateral and bilateral agreements taking into account norms of international water law and specific inter-State relations in the region, national standards of law, requirements and interests of countries should serve as the legal framework for regional water relations.

Several regional agreements listed in section A of this report, dealing with issues of water use and water allocation and related organizational issues, are currently in force.

Despite the conclusion of regional and bilateral inter-State agreements, it is in this field that there remain the most acute contradictions calling for special attention. They reflect the drawbacks of the existing international legal framework and substantial differences in the priorities of the Central Asian countries, and in their approaches to the legal regime of transboundary water bodies in the region.

There is a view, voiced in particular by Kyrgyzstan and Tajikistan, that at present, in the context of regional cooperation, the problems of saving the Aral Sea quite often prevail over the economic interests of individual countries of the region. There are also differences of opinion regarding the long-term projections of water use - it is argued that they do not adequately take into account the dynamics of population growth and the resulting necessity to increase water use in order to meet drinking water, agricultural, industrial and other needs.

The current water allocation system was established under the USSR within the unified

framework of economic relations when the water resources were allocated asymmetrically to favour the development of irrigation farming in downstream countries. Water regulating facilities were constructed on the territories of the upstream countries to supply water to the lower reaches. Development of irrigation farming in the upstream countries was reduced to a minimum – in compensation, they got energy resources, agricultural and industrial products. After the emergence of sovereign countries in Central Asia, the former principles of water allocation stayed in force yet the upstream countries were deprived of the previous compensation.

Kyrgyzstan and Tajikistan believe that the water allocation system in the region is inequitable and causes them serious harm as it does not make it possible for them to, firstly, develop irrigation farming to satisfy their food requirements and, secondly, use the system of hydropower stations in an optimal mode to cover winter requirements for electricity.

In this connection, there are proposals with regard to the need for concluding new long-term inter-State agreements based on new principles and mechanisms of water allocation among the Central Asian countries taking into account their interests.

Among the most hottest issues is the problem of recognizing the proprietary right of each country to the water bodies on its territory and the water resources contained therein.

These disagreements became most conspicuous with the adoption of the Law on the inter-State use of water bodies, water resources and water management facilities in Kyrgyzstan in June 2001, which evoked an ambivalent response in the other countries of the region. This Law proclaimed a foreign policy of Kyrgyzstan based on the principle of paid water use in water relations with other countries.

The existence of historical conflicts over water-related issues among the countries in the region is the reality one should bear in mind in the identification of compromise solutions that would take into account the interests of all the Central Asian countries. Settlement of issues where the views are conflicting through negotiations aimed at reaching mutually advantageous agreements is the only possible approach. Overall, there is general consent about the need to analyse the new situation and draw up new principles of water resource management. Among the international legal measures proposed for adoption by the countries, the following may be emphasized:

- Harmonization of regional and national legal norms;
- Development of standards and procedures for the use and protection of inter-State water resources, water bodies and water management facilities, including a more precise assessment of the water volumes that can be withdrawn from water sources without causing harm to nature;
- Development of procedures for the settlement of water disputes, including arbitration;
- Joint control of the implementation of commitments assumed by each country;
- Development of unified approaches to liability for damage and to assessment of the cost of damage caused by water management activities, and procedures for the reparation of damage;
- Development of procedures for the implementation of joint water management projects;
- Development of procedures and conditions for the exchange of information and operational mutual notification of accidents, floods, other technological and natural disasters in water bodies and water management systems;
- Development of a legal mechanism for the implementation of the polluter pays principle, in combination with the establishment of a procedure for cost-sharing for water conservation measures among the countries concerned;
- Development of legal, economic and organizational mechanisms for the execution of work and services in water flow regulation, flood control, shore protection, water supply by individual countries for the benefit of other countries in the region;
- More precise definitions of functions and authorities of national and regional bodies;

- Clarification of the status of the personnel of regional bodies.

Separately, the following regional and subregional agreements, many of them in different drafting stages, would require finalization and possible adoption, including agreements on:

- The strengthening of the organizational structure of management, protection and development of transboundary water resources in the Aral Sea basin;
- The establishment and functioning of national, watershed and regional databases on the integrated use and protection of water resources in the Aral Sea basin;
- Environmental approaches to water resource management;
- The main principles of joint use of transboundary waters in the Syr Darya basin;
- The establishment of a water and energy consortium;
- Regulations on the funding of the ICWC executive bodies, and others.

The views of potential parties to these agreements differ both on the many fundamental issues relating to the subject matter and on the feasibility of certain agreements. This is because not only do their national interests differ, but the draft agreements proposed by the different parties are of a framework character and do not address some vital aspects of inter-State cooperation.

2.2 Improvement of the legal framework at the national level

The specifics of national legislation may be characterized by the example of three countries, Kazakhstan, Kyrgyzstan and Tajikistan, which have somewhat different approaches to the formulation of domestic and external water policies.

In **Kazakhstan**, the legal framework for water management policy is found in the Water Code adopted in 1993 and government regulations on water sector development and the management of water use and protection. Under Kazakhstan's Water Code:

- All the waters in its territory constitute a unified reserve of water resources that is owned by the State;
- Water resource management is based on a combination of watershed and administrative-territorial principles ensuring the protection and sustainability of the water resources, optimal conditions of water use, preservation of environmental sustainability;
- The distribution of water resources within basins of rivers, lakes and other water bodies among administrative-territorial units is based on the watershed principle.

The principal objective at the national level is to implement a scientific, technological and investment policy ensuring a rational use of water resources, conservation water resources, fulfilment of water requirements for the national economy and the population, protection of water bodies and small rivers, efficient attainment of inter-State, inter-sectoral and interregional objectives relating to the use and protection of water.

At the watershed and interregional level, watershed directorates have been established, with their main objectives being the regulation of water relations within each basin, distribution of the water resources among water users, interregional water allocation within the basin, issue of permits for special water use, establishment of water use limits and operational regimes for reservoirs, operational control of their observance, elaboration of operational water management plans for the basin, record keeping of State water use, control of technical safety of water management facilities.

The primary level in the water management system is the territorial water management enterprises. It is at this level that territorial problems relating to water supply for the public and the economic sectors, maintenance and operation of water management facilities are addressed. The main task at present is

to transfer the water management facilities of district and inter-district significance and their servicing enterprises to municipal ownership controlled by local executive authorities.

In **Kyrgyzstan**, under the current water legislation, the water resources of natural water bodies are owned by the State, while water resources withdrawn from water bodies may be owned by legal and physical persons. Water consumption from natural water bodies and waste discharge to water bodies were formerly based on licensing. This arrangement basically corresponded to world practices.

In January 2001, the Law on licensing was amended to cancel the water use licensing arrangement. This resulted in a legal vacuum regarding the procedures for using State property, which could have negative legal and factual consequences. In 2001, it was decided to develop a new water code. The preparatory work and consultations conducted to date revealed the following basic approaches to the improvement of water legislation:

- The need to reflect a balanced long-term State water policy adequate to the existing socio-economic situation in the country and formulated in the framework of a national water strategy;
- Elimination of contradictions in existing legal acts and regulations;
- Elimination of parallel legislative norms;
- Development of a law as a direct-action legal normative act decreasing the need for supplementary regulations;
- Adaptation of water relations to market-economy conditions;
- Specification of procedures related to inter-State water relations taking into account provisions of the concluded treaties and international water law;
- Reflection of new principles of management of water use and water management facilities;
- A legal basis for the development of water user associations and denationalization of water management capital assets;
- Development of mechanisms for enforcing the legislation;
- Broadening of the legal regulation of economic activities of water users.

The first version of the new water code was prepared in late 2001.

Tajikistan adopted its new Water Code in November 2000. It strengthened the economic mechanism of water use, defined the organizational system for the regulation of water use and protection, and defined the procedures for the establishment and activities of water users associations. It also tackled the issues of technical improvement of land-reclamation systems, expanded the rights and responsibilities of water users, established legal liability for water-related offences. At present, the legislation is being adjusted to the Water Code. Until completion of this work, the general principle is that the former legislation shall remain in effect as long as it does not contradict the newly adopted Water Code.

In 2001, the national Concept of sound use and protection of water resources was adopted in Tajikistan. It will definitely have a major impact on the development of water and environmental protection legislation, and on the long-term international cooperation of Tajikistan with the other Central Asian countries on water use and protection.

According to the Constitution of Tajikistan, water is the exclusive property of the State, and the State guarantees efficient use and protection of waters for the public benefit. Tajikistan's legislation does not define transboundary water resources though it uses the term "transboundary water bodies". They are defined as water bodies whose waters are used in accordance with international treaties.

A review of national legislation indicates that it needs modernizing with due regard for democratization and market-based relations, guaranteed equal rights of all consumers to water, participation of water users in water resource management, development of organizational forms of water management and water protection.

3. Institutional issues

3.1 Institutional aspects of inter-State cooperation

After gaining independence, the Central Asian countries needed to set up an organizational mechanism for regional cooperation to implement inter-State agreements and arrangements. The new economic and political conditions of recent years require a reassessment of the situation, and the prevailing opinion is that there is a need to draw up institutional principles for the management of inter-State water relations.

Among the issues relating to the development of the organizational structure for regional cooperation, differences arise regarding methods of implementing the principle of watershed management. Though everyone basically supports the principle itself as a basis for the regulation of nature resource use within the river basins, there is difference of opinion regarding its territorial implementation.

On the one hand, some countries propose to apply this principle solely at the national level without extending it over the entire region, at least for a certain time. The argument in favour is the lack of preparedness of the countries to transfer part of their regulatory authority to inter-State structures because they still have unresolved differences with regard to water allocation, and are voicing complaints about the others´ inequitable water use, failure to comply with agreements, and violation of commitments. This result in tendencies to strengthen the sovereignity of countries, which also complicates the reaching of an agreement on watershed cooperation on a regional scale and makes countries focus on the organization of watershed management within national boundaries instead.

There is a different approach that presupposes support for regional integrated management, a broader mandate for the existing regional structures and their improvement on the basis of positive foreign experience. In particular, the following combination of measures is proposed:

- Strengthening of the organizational structures of ICWC, regular rotation of its management;
- Establishment of a basin committee affiliated with ICWC and BVOs as a public organization representing the interests of water users, the local population, social groups, with advisory powers in the initial stage and regulatory powers in the next stage;
- Giving officials of regional bodies diplomatic status, thus applying principles of extraterritoriality and independence from pressure of local executive bodies;
- Establishment of a committee of water reservoir directors;
- Successive expansion of the system for the exchange of and open access to information that would enable this to become a major element of not only openness and equal rights of all ICWC members, but also for improvement of the entire management process;
- Involvement in ICWC activities of bodies of the Ministries of Foreign Affairs , especially to resolve issues of visa issuance and customs control.

At the same time, there are views that radical structural reforms in the institutional sphere should be postponed until the basic principles of regional water relations have been agreed on. It is also pointed out that the establishment of new structures will require additional maintenance expenditures, whereas the already existing structures and international programmes are not fully funded by the participating countries.

3.2 Institutional issues at the national level

In **Kazakhstan**, water management and water use have until recently been determined primarily by economic interests, without taking into account the social and environmental impact of extensive water use. The existing organizational structure of water management failed to address the problems of water conservation, which resulted in its intensified depletion and aggravation of the environmental situation.

Budgetary funding of water management facilities maintenance and centralized allocation of capital investment in the development of the water sector gave rise to the perception that water resources are free of charge, and distorted their economic significance.

The strategic objective of national water policy would, therefore, consist in implementing integrated long-term measures to overcome the adverse impact of the limited resource base and establish conditions for economic growth, and social and environmental improvements.

The main principles of the water policy include the basin approach to the management of water use, reduced abstraction of freshwater and pollutant discharges to natural water sources as well as economic regulation of water use based on a balanced tariff system.

The multi-purpose nature of water use coupled with its shortage makes it necessary to establish priorities. Priority should be given to satisfying the demand of the population for drinking water, reserving groundwater for this purpose. An adequate structure of the water sector corresponding to each management level is needed to address these problems.

The river basins are regarded as the structural basis for the State water resource management bodies. This principle is based on the integral nature of these resources and multiplicity of their use.

The separation of the functions for water resource management and the mechanism for their regulation and integrated use makes it possible to take into consideration the interests of water users both within the entire watershed and in a specific area, and to take efficient measures to protect the watershed waters from depletion. The basin principle is implemented through the basin-territorial structure of the water management bodies.

In **Kyrgyzstan**, the reform of the water management bodies is at present a pressing problem.The objectives of the reform are to:

- Reduce the administrative staff and the share of budget funding allocated for its maintenance;
- Improving the coordination among State administration bodies by eliminating parallel functions, separating their rights and responsibilities and improving the execution of their control and administrative functions;
- Transfer part of the administrative functions to water users associations, especially in the sectors of irrigation farming and rural water supply.

It is considered feasible to separate the functions of control and administration between the two basic administrative bodies – of water management and environmental protection – by legislatively regulating the separation of functions and authority among them. Participation of other ministries and departments in the management of the water resources should be restricted to performing specific functions.

By 2010, the functions of operation and technical maintenance of the privatized water management systems should be transferred to economic entities, water user associations and municipal bodies. At the same time, the State bodies should retain control of strategically important water management facilities also in the longer term.

To ensure equal rights of the population and water users in all economic sectors, it is proposed to separate the water management bodies from the Ministry of Agriculture, Water and Processing Industry and establish a specialized department in the structure of the executive authorities. In doing this, it is necessary to separate the functions of administration and control within this department, detaching them from economic activities. It would also be feasible to entrust this department with managing the State-owned shares in the privatized irrigation systems.

The water management hierarchy should envisage the preservation of the national and watershed administration levels in the future. In the long term, the district level of administration in the irrigation sector may be abolished due to the transfer of operation and technical maintenance functions to water user associations or independent (privatized) water management enterprises, and control and administrative functions to water inspections and

watershed directorates, respectively. Economic entities should be ensured the right to independently establish the administration structure of the water management systems belonging to them.

In **Tajikistan**, the core of the organizational structure of the water sector is the operational hierarchy, from the Ministry of Water Management through regional bodies down to district directorates and end-users – the collective and State farms that have been mostly preserved and that have individual farms being set up on part of their land.

One of the major organizational problems is the need to resume the development of arrangements for the integrated use and protection of water resources. This work has been stopped for over a decade, whereas the former arrangements have lost their relevance due to the changed political and economic conditions.

The establishment of a modern information system is an important organizational link in the system of implementing a common State policy in water use. At present, Tajikistan is still lacking funds for this, and everything is based on extremely obsolete technologies and inadequate techniques. In addition to training specialists at higher educational institutions, it will be necessary to set up a network of training and demonstration centres in all climatic zones of the country. The fundamental issue is to train the teaching staff at higher and secondary educational institutions that would be capable of training market-oriented specialists.

Organizing water use and operation at the intra-farm level is a matter of special concern. The current transformation of collective and State farms and other State agricultural enterprises into individual farms results in the entire intra-farm irrigation system being practically abandoned and deprived of financial support. This is why Tajikistan focuses on the establishment of water user associations that would collectively engage in the operation of intra-farm systems and organize water use management on a semi-autonomous, decentralized basis.

Thus, the national legislation in all Central Asian countries envisages the restructuring of water management. The corresponding institutional reforms are gradually taking place, even though their pace may be different. To date, however, no harmonious collaboration of ministries, departments and municipal bodies regulating various aspects of water relations has been achieved. Water user associationts that are not yet strong enough organizationally and economically are not able to be actively involved in water resource management. All these factors hamper the application of the principle of integrated water resource management supported by legislation and organizational structures.

4. Technical and operational issues

The complex of technical and operational issues that should be addressed at the national and regional levels is primarily related to the need to support and improve the status of water management and energy generation facilities and related infrastructure, rehabilitation and improvement of the technical systems for water monitoring. Resolving these issues is also related to reaching agreement among countries on the procedures for the operation of water management facilities of inter-State and national importance, water monitoring stations, laboratories and observation sites, and procedures for the exchange of monitoring information among countries.

4.1 Rehabilitation and further development of water management systems

There is broad agreement about the technological condition of water management installations of national and inter-State significance in that their rehabilitation, modernization and development are vital for ensuring sustainable water use in the region.

All five countries agree that investment in the renovation and modernization of such installations is necessary if a powerful water management complex is to be maintained.

Installations that are in bad repair may hinder compliance with governmental agreements on inter-State water use, which may be reached.

The lack of repair and modernization of installations operated by watershed authorities and national water management authorities has made it difficult to secure a precise supply for each country and each irrigation system.

To be able to regulate the flow and control the use of the water resources in the Amu Darya and the Syr Darya as well as other inter-State rivers, the hydraulic structures on these rivers should be equipped with modern means of control, management and communications, and repair work should also carried out regularly.

There is a discrepancy in the views taken by individual countries on the share of technical participation in the rehabilitation of the water management systems each country should have, how expenses should be shared, maintenance priorities set, and what rights and obligations each country should have to ensure safe operation of the installations.

More specifically, the following issues should be agreed upon:

- Methods of determining each country's share of participation in the rehabilitation and operation measures;
- Definition of inter-State water management installations that would require such joint participation, as well as definition of national installations whose upkeep should be the responsibility of the country concerned;
- Definition of maintenance priorities at inter-State installations;
- Definition of the legal status of inter-State installations and corresponding authority for their maintenance and operation staff;
- Definition of operation procedures for inter-State installations based on agreed and balanced volumes of water use by all economic sectors of each country;
- Definition of priorities for water use, including ensuring the population´s drinking water and municipal needs; industrial and power industry needs; guaranteed water supply to all sectors of the economy; safety of the infrastructure; prevention of harmful effects on the environment and dealing with such effects; reduction of adverse human impact on the environment.

The main task that needs special attention and cooperation at the regional level is the development of a technological basis for the management of the river basins' water resources that would ensure an acceptable quality of water supply for all water users in the region.

4.2 Technical and operational issues at the national level

Maintenance and operation issues which are given priority in **Kazakhstan** include technological means to be used by industries, as well as by municipal services and agriculture to ensure water conservation; repair and modernization of irrigation systems; reconstruction and repair of water management facilities, equipment of the water management system with water-measuring instruments; construction of new pipeline networks, and modernization and reconstruction of water supply systems

The main problem in **Kyrgyzstan** is the lack of finance. This applies both to the State budget and the economic entities. At the same time other countries that have been recipients of Kyrgyzstan's services in the area of water resources have been lukewarm about joint participation in the financing of water management and water conservation.

In development programmes for the whole sector and individual industries, little attention has been given, because of financial constraints, to the long-term introduction of water conservation and environmentally friendly technologies. Therefore, it would be hard to expect major results in terms of a more efficient use of water resources and improvement in the condition of surface water and groundwater sources in Kyrgyzstan.

In **Tajikistan** about 20% of all irrigated land is suffering from a shortage of water because of the

failure to regulate the flow patterns from the relevant sources. This calls for measures to address their water supply. At the same time there has been more than 50% deterioration of the fixed assets of drainage systems, especially machine-operated ones, vertical drainage wells and accompanying power installations, salinization of soils and transformation of irrigated land into marshland as a result of the deteriorated drainage systems.

Tajikistan's irrigation systems should be rehabilitated and upgraded. The reliability of water resource management and control facilities should be technologically improved. Modern computer hardware and software, microprocessing technologies, water measurement should be introduced. Besides, training programmes should be used to train skilled labour and subsequently upgrade their skills.

The main problem in the improvement of water use and increased water supply to the fields is that irrigation methods need to be improved and new water-saving technologies introduced.

5. Current status of water resources monitoring

Available data indicate a sharp deterioration of flow registration and forecast in the region. There are no data agreed on by national hydrometeorological services of the countries and measurements in transboundary rivers are not checked. This has led to a lack of coherence in water management balances for the basins and increased losses along the Syr Darya and Amu Darya channels. The absence of a joint monitoring system and information on surface and groundwater supply is one of the reasons why the existing agreements on water allocation have not been fully complied with and why complaints regarding actual water allocation have been made.

The lack of finance and cooperation between the State authorities concerned has led to a deterioration of the water condition in nearly all countries of the region, as well as a deterioration of the technological basis for monitoring. This problem can be solved only in conjunction with a reform of water use management and water conservation, upgrading of the economic mechanism for the use of natural resources by introducing an additional payment for the use of water bodies and water resources, as suggested by some countries.

All five countries recognize the importance of agreed monitoring activities in order to:

- Establish the volumes of water supplies in the water bodies of the basin;
- Carry out constant surveillance of water quality;
- Control water allocation and use by each country;
- Restore and develop a long-term forecasting system of water conditions and their harmful effects.

Monitoring, as recognized by all countries, should be carried out under the conditions of an unrestricted data exchange among the countries, provision of information to the population about emergencies and natural disasters, as well as use of unified data collection and processing methods.

Within the framework of the cooperation on joint monitoring, the following priority measures are proposed:

- Registration and inventory by the State of the technological condition of abstraction, purification, anti-flooding, river-bank protection installations and observation networks;
- An increase in the number of sites in the observation network on the surface water and groundwater deposits up to at least a basic level;
- Rehabilitation and modernization of the instrumentation used by the observation network;
- Ensuring the functioning of chemical and biological laboratories at least in every district and all major cities of the region;
- Introduction of water registration equipment at water abstraction and at waste-water discharge sites;

- Construction and modernization of water measurement installations at the control sites for inter-State water distribution;
- Development and implementation of State programmes for determining usable groundwater reserves;
- Complex studies of the impact of waste and return flow on the water management balances in the basins.

Even though there is principal agreement on these issues, their implementation may well cause difficulties, primarily of an administrative nature. Difficulties may well arise in gathering and distributing data and payments for services, or in defining what would be freely available information or classified information, the technological basis for informing the population, choice of locations for inter-State observation sites and their status. These possible contradictions should be eliminated already at the very start, and work in this direction has begun. The text of an agreement on the creation of a database has been drafted. This draft was agreed on by ICWC members in 2001 and sent to IFAS for consideration.

6. Economic and financial issues

6.1 Economic and financial issues at the regional level

At present the region is still in a transition and its economy is in decline. This significantly undermines the possibilities for water authorities to maintain systems and facilities.

This is why the State has taken on itself the regulatory function of the transition process in Central Asian countries. To this end, water management, energy industry, agricultural and other installations have been privatized to a varying degree in the different countries. The reform has already had some positive results by stimulating entrepreneurial initiative. On the other hand, destructive processes have intensified, especially in agriculture. Without support from the State, independent agricultural companies are not in a position to cover the considerable cost of maintaining irrigation and drainage systems. Disorderly water use in agriculture has led to the waste of water. The need to develop new agricultural areas, especially in Tajikistan and Kyrgyzstan, involving the construction of new water supply systems, requires finance, which is scarce.

As a result of the disintegration of the unified economic system, there have been structural changes in the region, which sometimes result in unfounded ambitions on the part of some countries to develop inefficient and unprofitable ways of production, primarily in agriculture. The lack of a regional division of labour and economic cooperation, which indirectly leads to an increase in water use at the national level, gives rise to complaints and accusations that some countries' demand for water is artificially high. The present practice of fuel and energy exchange has also been subject for criticism.

Without additional external subsidies to their budgets, the countries of the region simply have to follow this destructive path. This applies both to the upstream countries, which are trying to add to their budget by intensifying the development of the hydropower production industries, and to the downstream countries, which encourage the development of agriculture and agricultural water use. All countries try to save money by restricting capital investment in repair, maintenance and purification of canals, irrigation systems of national importance, river bank and water protection.

Each State, depending on its national interests in the development of water-using economic sectors, formulates its own position with regard to cost distribution for water management facilities and water bodies. To legitimize these decisions, a legal basis for the country's policies is created. In all countries water bodies have been declared State property. In Kyrgyzstan State ownership also includes water resources in the same way as State ownership covers mineral resources, e.g. fuel, in other countries. On this basis a concept of water sales has been developed for water formed on the territory of Kyrgyzstan to be sold to other countries as a commodity. This concept,

which is reflected in the Law on the inter-State use of water bodies, water resources and water management facilities in Kyrgyzstan of 2001, has been negatively received by the downstream countries. These argue that in the broad practice of international cooperation water in a transboundary body of water is regarded as joint property of all countries of the watershed and therefore cannot be sold.

Notwithstanding all conflicting opinions, there is a common understanding that the solution to each country's financial problems lies in inter-State cooperation, particularly on matters of joint financing of the upkeep of water management facilities, monitoring systems, etc. No principal objections have been recorded in the following areas:

- Definition of methods and procedures of cost reimbursement for the maintenance of water management facilities according to the required technological standards;
- Joint development of reimbursement mechanisms for the joint use of inter-State abstraction facilities and reservoirs;
- Evaluation of the countries' expenditure and incomes with regard to water use for agricultural purposes, energy and other industries in order to define each country's share in the activities aiming to maintain inter-State water management facilities and water bodies;
- Development of a harmonized evaluation method for damage resulting from water use and compensation procedures, including damage resulting from the violation of water allocation regimes, flooding of low-lying land and insufficient energy supply;
- Definition of rights and responsibilities in the prevention of water pollution and other forms of water degradation and their harmful effects;
- Establishment of agreements on the division of labour and a balanced development of economic sectors for the entire region based on the needs of each individual country;
- Introduction, where possible, of economic mechanisms of water use at national levels, which would reduce State funding for water management activities by attracting funds from water users;
- Development of protection mechanisms for the countries if agreements are breached, including a legal protection mechanism.

It is against this background that discussions are continuing about disputed initiatives by some of the countries applying market conditions to inter-State water relations. In the first place this applies to the main premise, i.e. recognition of water as a commodity. However, there are other disputed issues, such as:

- Introduction of penalties for exceeding agreed quotas of national water consumption;
- Application of what would be a precedent in international relations that one country could sell its own water consumption quota to another;
- Introduction of payments for water as a natural resource belonging to a country;
- Introduction of payments for seasonal or long-term flow regulation in favour of other countries.

It goes without saying that these proposals should be further discussed by the countries concerned. Payment for water use is each country's own business. However, it should be noted that without a sensible and fair economic mechanism the countries would find it difficult to stimulate water conservation and, particularly, to introduce state-of-the-art technologies.

6.2 Economic and financial issues at the national level

In **Kazakhstan**, with new market relations emerging, it has become necessary to further develop the State system of control and distribution of irrigation water and to set up additional structures. In the course of the privatization of the agricultural sector and the splitting of former collective and State-owned farms into smaller private farms, the status of canals and other installations has been transformed from on-farm to between-farm installations. These facilities cannot be divided and are used collectively. However, in some

places they do not appear to have been assigned to anybody.

Protection of private property rights with regard to water use and the operation of jointly used irrigation and drainage systems were ensured when water user associations were set up. The main problems of these associations are their economic weakness, numerous legal and registration fees, compulsory payments and an undeveloped legal framework.

In the area of internal water policies, **Kyrgyzstan** favours the principles of a market economy providing for a payment-for-use in the implementation of water relations. This ideology manifests itself also in its relations with the other countries of the region.

The development strategy for water management resources foresees a gradual easing of the State budget burden with regard to the fixed assets in water management by optimizing tariff and tax policies and taking into account the real purchasing power of the polluting and water-consuming economic entities. In this regard the policy of targeted support by the State budget of development programmes for prioritized water-using economic sectors and water protection should be maintained.

It has been suggested that tariff policies with regard to water relations should be based on a cost-recovery principle and a gradually raising of tariffs to the level ensuring the profitability of both State-owned and independent water companies. Privatization projects in State-owned water management systems planned for the near future provide for the introduction of legalized tariff differentiation principles for water supply services, whereby different rates will apply depending on the specifics of the individual water system.

Payment for the use of water resources and water bodies has also been proposed. This would partly make up for the State's expenditure on the protection and improvement of water resources, the upkeep of strategically important infrastructure, water resource monitoring, inspections and other activities, which are the monopoly of the State.

Tariff regulation of the use of water and water bodies, the imposition of tariffs for excessive use, as well as penalties for violations of water legislation should in the long run remain in the competence of the highest institutions of State authority. The power to establish differentiated tariffs for water supply services should be handed over to special authorities, selected in the course of the reform of the water management system.

On the other hand, the transformation of the water management sector into a fully self-sufficient sector is considered to be unrealistic. Considering the extremely poor technological condition of the fixed assets in this area, current prices of equipment, material and resources used, as well as the actual purchasing power of the water users, the discontinuation of State support may well result in an irreversible degradation of the sector.

In the short term, attention should be given to tariff policy regulation with regard to such factors as depreciation of fixed assets, shortage of water in low-water years, and tariff differentiation by water-use category for the introduction of water conservation technologies. Tariffs and tax breaks provided for in the legislation but until now not implemented should be further specified.

The basis of **Tajikistan's** agriculture is irrigated farming, accounting for 90% of total production. Its development is defined and at the same time restricted by a shortage of available land and water resources, which are costly to deliver to the fields.

Because of the shortage of land, the country has had to develop land that would be considered wasteland in other countries. Such wasteland requires high inputs of energy and resources in the development period as well as for production. In the 1980s Tajikistan had the highest yield from irrigated land in Central Asia.

The reform in the water management sector in Tajikistan was initiated by presidential decree № 460 on the Introduction of Paid-for Services to Supply Water from State-owned Irrigation Systems to Users of 8 April 1996. This was just the first step in the direction of market relations in the water management

sector, since the payment rate set by the State does not cover all water supply costs, to say nothing of the cost of water as a natural resource and compensation for violations of water legislation and environmental damage. Because of the difficult economic conditions, only 15-17% of the projected payments were actually collected in 1996-99, while in 2000 they reached 40%, part of which was covered by agricultural produce.

It is necessary to introduce differentiated tariffs on water in Tajikistan depending on the climatic zones, type of water supply (natural or pumped flow), profitability of the water sector, etc. The absence of a clear payment mechanism between the supplier and the consumer because of the seasonal nature of agriculture, as well as between different parts of the irrigation chain, poses a serious problem. So far the maintenance of irrigation systems has been partly financed by the State and local budgets, as well as insignificant allocations from the land tax. The combined financing from these sources amounted to 50% of the required funds, i.e. 13.5 times lower than in 1990.

The organization of the water market and the market for services should facilitate privatization of fixed assets in the water management sector. So far the management of the water system, despite the introduction of market elements, is primarily based on principles inherited from the former command-and-control system. The surviving central budget funding and State ownership of water and irrigation systems of both on-farm and between-farm nature serve as a basis for this system.

It has become clear that the development of regional cooperation in the interest of mutually advantageous solutions to common financial problems calls for efforts to be made at the national levels. The following measures could guarantee a certain degree of financial stability in the region:

- Increasing the administrative and legal responsibility of water users for an inefficient use of water for irrigated farming, hydropower industry and other economic sectors;
- Defining the share of the State budget that could be allocated to cover internal maintenance costs for water management installations and monitoring systems;
- Making water users responsible for the upkeep of water management installations and water bodies of national importance;
- Development of the economic structure, elimination of unprofitable production and stimulation of economically viable industries;
- Economic stimulation of water conservation;
- Promoting the idea of socio-economic values of water.

7. Conservation of aquatic ecosystems

7.1 Environmental problems at the regional level

An environmentally destructive water use pattern inherited from the USSR period, a decline in the effectiveness of water use in recent years, deterioration of the technological basis of water management activities, less regulation and control on the part of the State to ensure compliance with relevant laws – all these factors have brought about a significant deterioration of the environmental situation throughout the whole of Central Asia.

The most catastrophic consequence has been the decline of the level of the Aral Sea, destruction of its ecosystems and drying-up of lakes in estuary areas, as well as secondary socio-economic and environmental consequences of these processes. Loss of fish production in the sea, mineralization and pollution of soils, estuary transformation to deserts and climate changes are only some of the environmental problems. As a result, the health of the population has been deteriorating, biological diversity has been disrupted and natural water supply to the population has been reduced.

All countries recognize that they are faced with environmental problems. The necessity to solve them is also recognized, as well as the need to take into account environmental interests in regulating

water use in the river basins both at the national and regional levels. Thus a principal agreement has been reached on the need for sanitary and environmental discharges in inter-State rivers. However, there are strong disagreements on each country's priorities and financial contributions for its implementation.

There is also some disagreement between Kyrgyzstan and the downstream countries about each country's contribution to the conservation of ecosystems in the estuaries and parts of the Aral Sea. This disagreement is due to different interpretations of the reasons, and consequently, the responsibility for the Aral Sea crisis. Accordingly, each country's contribution, including by liberating a part of their water quota is disputed. On the other hand, Kyrgyzstan and Tajikistan are trying to draw the other countries´ attention to their internal environmental problems, which they have so far had to solve on their own.

The downstream countries are advocating a joint solution. They argue that the real reasons for the Aral crisis lie in the ecologically unsound economic development of the region, which prevailed under the conditions of a unified State, the former USSR. Hence the problem should be solved jointly. Besides, the intended transfer of the Siberian rivers into the region was never fully implemented. Finally, the conservation of water ecosystems should be in line with the environmental and economic interests of all countries. Ignoring this problem is bound to lead to further intensification of the environmental crisis and may result in even graver ecological, economic and social consequences.

There has been a growing disagreement about the countries' responsibilities to ensure water quality. Each individual country should carry the main burden of controlling sources of pollution. However, there have already been allegations that some countries are polluting inter-State water bodies. In this regard a complex legal and technical work should be performed to establish joint criteria for evaluating water quality, methods of damage evaluation and procedures for damage compensation and the settlement of inter-State disputes.

Regional solutions are also required for the problem of return flow leading to secondary soil salinization and other types of soil and water degradation. This has been recognized to be each country's internal responsibility. Yet, non-compliance or only partial compliance in this regard may have a cross-border environmental impact. To solve this problem coordinated efforts are required for a joint collection and treatment of the return flow, as well as the introduction of legal responsibility for non-compliance.

The protection of Tajikistan's mountain lakes is often perceived by the other countries as an exclusively national issue of Tajikistan. However, flooding caused by bursts in the natural dams poses a threat to all countries and should be addressed collectively.

7.2 Environmental problems at the national level

In **Kazakhstan,** the main environmental problem is an increase in water mineralization and salinization, water pollution caused by pesticide and municipal waste-water discharges, as well as almost full exhaustion of surface water resources. The main reason for this is an increase in areas under irrigation and in discharge of drainage water, as well as the use of chemical fertilizers and pesticides at cotton and rice plantations.

Increased water mineralization has badly affected the rate of salinization of irrigated land causing a decline in crop yield. Surface water downstream as well as upstream cannot be used for drinking. The same applies to the groundwater, which is hydraulically connected with the surface water. An increase in the pollution of the Syr Darya river, which has traditionally served as a source of drinking water, has led to higher incidence of disease among the local population.

The condition of water resources in **Kyrgyzstan** has deteriorated. This has been caused by degradation of the technological aspect of water management, water abstraction, riverbank protection, water treatment and anti-flooding facilities. Deterioration of municipal water supply and waste-water management, as well as lax State control of water users' compliance with environmental standards are also to blame for this. There is a special point of view in the country about how the Aral problem should be solved. Responsibility

for the crisis should be taken by those countries whose economic activities led to the disaster in the first place, and which should now be responsible for overcoming its consequences.

In **Tajikistan**, in contrast, there has been a decrease in the pollution of water bodies as a result of a decline in industrial production and a general economic recession. A reduced use of pesticides and chemicals has had a beneficial effect on the quality of waste water, as well as drainage water.

However, there is concern in the country about the environmental situation. An anticipated economic growth will cause an increase in water use. With new water management facilities being commissioned and industrial production being stepped up, measures should be taken to protect the water bodies and prevent damage to the environment.

Development of the hydropower industry has already had a negative impact, such as soil erosion, flooding, deterioration of the condition of water bodies, changes in their hydrochemical and temperature regimes.

An inadequate development of drainage systems has resulted in lands transforming into marshlands, as well as an increased mineralization of groundwater. Waste and drainage water discharges have led to a considerable increase in mineralization of surface water. The majority of the centralized sewerage systems have effectively ceased to exist. Most water treatment facilities in Tajikistan are characterized by worn-out equipment. Discharged waste water does not meet sanitary standards. Soil erosion and deforestation have been spreading as a result of excessive cattle grazing. Migration to the cities has resulted in problems with drinking water supply and land pollution by solid waste. Natural disasters, the probability of which has risen, pose a great threat for the condition of the water bodies as Tajikistan is situated in a seismic zone. Besides, there is a high occurrence of torrential rains causing avalanches and mud slides.

Another major problem, which has not yet fully manifested itself, is the melting of glaciers. This process is capable of disrupting the hydrological regime and causing unpredictable environmental disasters. Another specific problem of Tajikistan, which, however, is relevant for the whole region, is protection of the mountain lakes. These are not only valuable natural assets but also potential sources of risk in case of disruptions of the hydrological regime or natural disasters in the mountains.

Conclusions

Over the past decade the condition of water resources in Central Asia has become critical. Their quantity and their quality have been declining. This has resulted in disagreements between the region's countries about the sharing of resources in inter-State water bodies, imbalances in the long-standing relations between the countries and a change in orientation towards addressing national, predominantly economic requirements, and away from regional environmental requirements. It appears that these disagreements have been caused by the economic difficulties experienced by every country to a varying degree.

The situation might not have worsened so much if the countries had developed economies producing competitive products and allowing them to allocate sufficient funds for the upkeep of water bodies and water installations on their territories.This is why the task of reconciling their positions in the area of water resource use cannot be solved separately from the development of an effective economic model for every country. In practice this amounts to ensuring the sustainable development of the whole region, of which water policies are a major part.

The problem of ensuring sufficient water resources for the needs of every country cannot be solved without regional cooperation. Only by constantly looking for compromises and by making joint decisions on water use issues can the potential of the inter-State rivers be used to everybody´s advantage.

The necessity to maintain and further develop regional cooperation between the countries is recognized in the region despite the fact that there are still some radical selfish views. Representatives of all

the countries have put forward substantiated arguments in favour of coordinated actions and collective settlements of the remaining disagreements.

It should be noted that issues requiring joint decisions by countries are of an inter-sectoral nature and, therefore, call for complex solutions. For example, technological issues are often related to financial, economic and management issues. Issues regarding the setting-up of optimal legal structures require legal solutions.

The disputed issues requiring joint solutions by the countries of Central Asia can be summed up as follows:

1. Issues regarding the establishment of long-term water allocation procedures to accommodate the water requirements of different sectors, the water requirements of upstream and downstream countries, as well as economic and environmental interests:

- Property rights for water resources;
- Principles and criteria for water allocation and the practice of exchanging water for energy;
- Lack of procedures and mechanisms for long-term inter-State cooperation and the problems linked with violations in agreeing and distributing water use quotas.

2. Issues pertaining to the inter-State management of water use:

- The mandate of relevant authorities and institutions, e.g. ICWC, watershed authorities, IFAS;
- Lack of cooperation among such authorities and institutions;
- The inadequacy of the legal framework for inter-State decision-making;
- Disagreements on the further development institutions for inter-State cooperation;
- The lack of agreed procedures for the effective functioning of inter-State institutions;
- Disagreement on whether water resources can be regarded as a commodity and the introduction of payment for water use into the practice of inter-State water allocation.

3. Issues regarding the inter-State legal framework for cooperation on water use, including water sharing and protection:

- The absence of an agreed list of issues requiring legal regulation at the inter-State level;
- The inadequate implementation of agreements;
- Inadequate negotiation procedures for the development of obligatory inter-State agreements;

4. Issues regarding maintenance and upgrading of water management and energy industry facilities and ensuring their safe operation:

- Disagreement on how the financial burden of the upkeep of inter-State water management facilities should be shared.

5. Issues regarding the monitoring of water resources:

- Disagreement on cost sharing for the technical maintenance of the technical side of the monitoring systems;
- A lack of agreement on terms and procedures for monitoring data exchange.

6. Issues regarding the protection of water resources:

- Disagreement on joint participation in the protection of the Aral Sea estuary and its ecosystems;
- A lack of agreement on solving water pollution problem, including the problem of return flow water;
- Disagreement with regard to the implementation of the polluter pays principle;
- Different understanding of the importance of individual environmental problems and priorities;
- Inadequate attention to the protection of valuable ecosystems such as mountain lakes.

SECTION C. RECOMMENDED APPROACHES TOWARDS FINDING AGREED SOLUTIONS

To eliminate differences over water use management and create a long-term basis for balanced water use and sustainable socio-economic development, a number of interconnected measures are recommended. While developing a strategy for the sound use of water resources, together with its associated action plans, the measures can be further developed into specific tasks where implementation dates can be set and responsibilities determined.

The recommendations with regard to the solution of regional and national problems of water use and protection can be summed up as follows:

1. Development of water allocation principles, including economic instruments

Countries have agreed on the need for urgent action in this area and proposed to:

- Develop a mutual understanding based on compromise solutions for the most disputed issues, i.e. ownership of water resources, valuation of water as resource having a monetary value, and payment for water use in inter-State relations;
- Specify quantities of potential reserves of water resources in the region;
- Provide long-term estimates of the water requirements of individual countries;
- Agree on quotas for water use in each country taking into consideration the projected development of water-using sectors and household needs, and also the implementation of water conservation measures;
- Agree on schedules for internal water use from inter-State water sources that will provide for a complex use of water resources and observance of environmental norms;
- Agree on quality standards for water resources to be applied by inter-State water bodies;
- Agree on inter-State water allocation procedures and a mechanism for its joint control with the application of integrated management of water resources.

The following principles for water allocation have been recommended:

- Establishment of a water use quota for each country;
- Division of water resources into quotas;
- Establishment of schedules for water supply to each country;
- Establishment of water quality criteria;
- Establishment of procedures for agreeing on decisions on water allocation and control measures;
- Development of economic mechanisms for the countries' waters;
- Development of procedures for joint participation of countries in mutually advantageous water management;

Considering that the issue of water allocation is difficult to solve, Central Asian countries would benefit from studying the international and foreign experience of sharing the natural flow of transboundary rivers, as well as groundwater and return flow water.

2. Development of national water use policies taking into account agreed national and regional interests

Considering that the region shares the hydrological and water management systems, the countries should strive to use water as has been agreed. Otherwise, they will always experience difficulties with water supply.

To this end, each country should define and evaluate its economic priorities and water requirements

of the economy and the social infrastructure, engage in inter-State negotiations in order to eliminate mutually exclusive and non-viable requirements, develop and constantly upgrade the national schemes of water use in different sectors, and, if necessary, develop a document defining their national policies of water use and protection.

Targets set for water resource management need to be legally secured. Such legislation would legitimize implemented and planned actions. Legislation can also speed up, or on the contrary slow down the achievement of set targets. All Central Asian countries have already upgraded their water legislation to a varying degree. However, it should be noted that this has so far failed to play any significant part in improving the condition of water resources.

Given the intentions and the necessity to reform the water use relations at both the national and inter-State levels, it is necessary that each country's legislation should be changed accordingly. Among other things, the watershed principle of management, equal rights for water users, procedures for access to monitoring data, economic instruments, the direction of management structure reform, inter-State cooperation should all be included in the legislation.

Considering the need to develop inter-State cooperation, the countries should harmonize their national water legislation to ensure compliance with international agreements.

3. Improvement of inter-State cooperation on integrated water resources management

Even though there are conflicting opinions about the forms and methods of cooperation, the necessity to maintain and broaden cooperation is not questioned. The general sentiment is that the introduction of new cooperation patterns requires thorough work in terms of developing legal, administrative and financial mechanisms.

Under these conditions, while not yet taking decisions on far-reaching reforms of the existing system, it would make sense to start coordinating activities of all relevant institutions and improving their functioning, as well as to start gradually developing an inter-State cooperation system in the area of management of water resources. In this regard, effective coordination of SPECA, IFAS and other projects should be pursued and all countries of the region should be engaged in active cooperation.

The necessity to develop an inter-State legal basis, as a foundation for regional cooperation is not in question. However, there is disagreement as to what the content of future agreements should be and what legal power they will have. It appears that most disagreements, especially those of economic nature, can be settled while setting dates and establishing procedures for the implementation of specific disputed proposals.

In this regard, the parties could start with defining an agreed list of issues requiring settlement at the inter-State level on the basis of the inventory of existing agreements. This could be a single complex agreement on the legal regime of water agreements or several linked agreements on specific issues, e.g. water allocation, maintenance of water management facilities, monitoring system management, gathering and exchange of data, organization of inter-State cooperation, regional and basin-wide water use management, mutual notification of emergencies, etc. General approaches to the content and structure of such agreements should also be defined. They may either thoroughly regulate inter-State relations or be of a framework character requiring additional protocols, action plans, etc.

To ensure a high degree of their implementation, the agreements should not include declarative elements. While developing the agreements the parties would do well to set clear targets, define implementation procedures and to make provisions for dispute settling mechanisms and responsibility.

4. Introduction of the river basin principle for water resources management

This principle has proved to be effective and is maintained all over the world. It is common knowledge that the condition of rivers and other water resources does not only depend on water use but also, to a large extent, on economic activity on the adjacent land. Therefore, such activities should be regulated so as to take into account their impact on bodies of water. This can be achieved most effectively within the framework of integrated watershed management.

It is recommended that the countries should, where necessary, reform State management at the national level so as to introduce integrated management of water use within individual basins, as well as to define procedures of allocating the use of water and other resources. By integrated management of water use we understand a joint decision-making mechanism dealing with allocating water or other resources so as to preserve the resource potential of the entire watershed and to protect it from harmful effects, e.g. pollution, exhaustion, etc. Integrated water use at the national level implies setting up watershed authorities and handing over to them the authority to negotiate and take economic and other decisions in the watershed providing for the balance of interests of all water users, as well as control functions pertaining to economic activities and nature use including the authority to take legal actions against violators. Integrated water use at the international level normally implies setting up inter-governmental or inter-ministerial authorities with regulating, advisory and coordinating functions with regard to all types of use of water sources of regional importance. The extent of such mandates is subject to specific agreements. By mutual consent such authorities may also be given the mandate to manage water management facilities of national importance.

5. Improvement of water use infrastructure

There is broad consensus in Central Asia on this issue. All countries have agreed to contribute towards maintenance of water management facilities of inter-State importance. All countries are interested in the proper functioning of these facilities and it would be unfair to put the financial burden of their upkeep on the countries on whose territories, for historical reasons, they are located. In this regard it is recommended that a mutually agreed procedure for an inventory should be developed and an agreed list of facilities of inter-State importance should be drawn up. It should be noted that some work has already been done by international donors and national authorities in the area of evaluation of the technological condition and running costs of facilities, in order to avoid unnecessary costs.

As large amounts of water are wasted as a result of the poor technological condition of installations such as internal and external irrigation canals, drainage systems, etc., each country should be obliged to upgrade their technological condition. Given the considerable investment required, the countries should define their national and regional priorities for financial aid application, should this be necessary.

6. Creation of a joint system for monitoring the status and quality of water resources

There is broad consensus that without a unified database on the condition and quantities of water and without control of abstraction and discharge sources, it would be impossible to take adequate decisions, be it at the national or regional level. To implement this task, technological requirements for monitoring should be defined and their costs estimated. Obviously, in many cases it would actually pay to develop new means of monitoring based on recent technological developments rather than try to rehabilitate old facilities. At the same time, the countries should agree at government levels on new cost sharing for their upkeep and operation.

It is important that evaluation methods for water quality and quantity should be unified, and procedures for the exchange of inter-State monitoring data established. The main premise here should be that such data may have universal importance and may also be used for commercial, strategic and other purposes. In this regard the countries should agree on what should be defined as open and classified data, and ensure an open exchange of open data.

7. Establishment of agreed environmental requirements relating to the protection of aquatic ecosystems

Countries have proposed to solve their national and regional problems by:

- Defining the countries' responsibilities in protecting the Aral Sea basin and other ecosystems, including the coordination of sanitary and environmental discharge schedules in the rivers of inter-State importance;
- Unifying environmental requirements to prevent water pollution;
- Developing coordinated measures on the issues of inventories and use of groundwater and return flow water;
- Defining responsibilities and unifying transboundary damage evaluation methods;
- Establishing dispute settlement procedures between States;
- Developing measures for protection of valuable water ecosystems, including mountain lakes.

8. Establishment of mechanisms for coordination and further development of foreign aid

Central Asia is included in the scope of activities of various international organizations and donors addressing various aspects of water resource management. Some of these have a considerable experience in the implementation of various projects. However, surprisingly, the activities of international organizations are not always well received. In fact these organizations are often subjected to criticism for what is deemed to be destructive activities. Often such activities lead to discontent on the part of some countries because of how the aid from the donors is distributed. The projects are not always well coordinated; they often overlap or are too short-term to have any lasting significance.

To remedy this situation, the procedures and principles of aid distribution applied, as well as the results of completed projects should be re-evaluated. Some international organizations have already done technological evaluations of water management facilities and it is, therefore unnecessary to allocate time and resources for this purpose. However, not all relevant authorities have been informed about it. It is therefore vital that data exchange and coordination procedures should be put in place. To address the issue of discontent with regard to the distribution of international aid, the countries of the region would do well to establish procedures, criteria and mechanisms for such distribution together with donors.

Given a huge amount of work to be done in various areas of water use management and water protection in Central Asia, international donors should consider further participation in solving the region's water-related problems and improve coordination of their activities. The problems and suggested solutions highlighted in this report may serve as a basis for the planning of donor and other international aid.

Conclusions

The critical situation of water resources, environmental problems, and the deterioration of the technical situation in the water management sector and its monitoring systems make it imperative that Central Asian countries should reach agreement on all disputed issues. The development of a regional strategy for the rational and efficient use of water and energy resources in Central Asia is a decisive move in this direction. It will facilitate the conclusion of the necessary agreements on different issues. Only in cooperation based on a legal foundation can the countries solve their national and regional problems.

In the preparation of the regional strategy for water resource management in Central Asia, the main accent should be placed on working out approaches that would ensure equal and satisfactory conditions for a sustainable development of the socio-economic potential of the region's countries based on regulated and controlled water use procedures, operation of all

facilities and definition of responsibilities in the area of water protection, including the ecosystem of the Aral Sea. The strategy should make provisions for geographical, economic, social and other features of each country, reconcile the positions of individual countries, define water allocation principles, as well as the administrative and legal aspects of the cooperation in the area of water resources.

This cooperation, including the drawing-up and signing of a regional strategy, should be developed according to the following principles:

- The willingness on the part of the Central Asian governments to pursue integration and coordination based on common interests, as well as to introduce favoured economic status;
- The consensus among the countries of the region, an open dialogue between donors and recipients, as well as with the international community.

The water resources of the Aral Sea should serve to accommodate all current water uses in Central Asia, as well as future ones. The water resources should be used according to the principles of reasonable and equitable use with the aim of achieving optimal and sustainable economic gain, while ensuring proper protection of the water sources. When using water resources on their own territories countries should take all necessary measures to prevent inflicting damage on other countries.

III. DIAGNOSTIC REPORT ON ENERGY RESOURCES IN CENTRAL ASIA

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Introduction

The study (Diagnostic report) "Rational and Efficient Use of Energy Resources in Central Asia" is proposed to be the basis for elaboration of a Cooperation strategy to promote the rational and efficient use of energy and water resources in Central Asia.

The study, *Rational and Efficient Use of Energy Resources in Central Asia,* analyses:

- the current economic situation of the region, its development prospects and potential in terms of production and consumption of, and trade in, energy resources, together with an assessment of different approaches to energy security;
- current policies and future trends in energy conservation;
- energy development scenarios for individual countries and the whole region;
- the need and potential for enhanced cooperation across the region towards efficiency gains in fuel and energy usage;
- investment needs of the fuel and energy complex up to 2020 and feasible investment solutions.

Unfortunately, experts from Turkmenistan have not taken part in the research. This has affected the scope of the study and scenarios of energy developments up to 2020, and hindered comparison between regional power industries. Nevertheless, data and analytical materials gathered and processed while preparing this diagnostic report, form a solid basis in drawing up a strategy for the rational and efficient use of energy and water resources in Central Asia.

1. Current economic situation and prospects for development

1.1 Principal economic trends since acquisition of independence

Central Asia has a total area of around 4 million sq. km and a population of 55.35 million (1999). Kazakhstan is the largest country in the region, occupying 67% of its area while Uzbekistan is home to 44% of its population.

During 1992-99, and especially in the first years of independence, i.e. in 1992-95, the region's GDP was shrinking by an annual 3.15%. The decline was brought on by a sharp drop in industrial output, largely caused by the break-up of the USSR and its long-standing economic relationships, leading to widespread and increasing hardship that undermined purchasing power, as well as other factors. By mid-nineties, Central Asia's GDP reached an all-time low. This was followed by a relative stabilisation in 1996-97, and a quickening of growth as confirmed by an annual 2.7% increase in the region's GDP throughout 1997-99.

In 1999, regional GDP (in terms of purchasing power parity in US$, 1990) stood at US$ 125.11 billion, or US$ 2,260 per capita against the world's average US$ 5,720 (International Energy Agency).

The GDP per capita, representative of people's living standards, tended to decline in 1992-99 in all five countries.

Macroeconomic data for individual countries and the whole region are presented in Table 19.

Industrial production accounts for nearly a third of Central Asia's GDP. The fact that agricultural production accounts for 36.6% in the GDP of Kyrgyzstan and 30.4% in the GDP of Uzbekistan proves the agricultural orientation of Central Asian economies (with the exception of Kazakhstan). Service sector accounts for a relatively low share of the region's GDP. In leading industrial countries services contribute over 50% of the GDP and the growth in the share of the service sector has been found to be clearly correlated with diminished energy intensity of GDP.

One of the most important economic trends in Central Asia in the recent years has been implementation of market reforms, active privatisation and growth of entrepreneurial activity. Thus, statistics for the year 2000 show that the share of the private sector in of the economy of Uzbekistan climbed to 70%. The main goal of reforms is to create a socially oriented market economy integrated into the global economic system. Market reforms have impacted on the fuel and energy sector in Central Asian countries and will be discussed later on.

Commodities, and in particular energy resources account for a significant part of foreign trade conducted by Central Asian countries.

1.2 Development prospects of Central Asian economies

Recent years have seen a trend towards economic growth in Central Asian countries. Economic growth serves as a point of reference in forecasting development trends for the power industry.

According to updated national estimates, consequences of the economic crisis in Central Asian countries will be completely overcome in 2000-2003 and industrial production will stabilise.

In 1999-2020 the region's GDP will be growing by 2.5-3% annually. These assumptions were used in the calculation of GDP and GDP per capita for individual countries and for the whole region (Table 20).

Overall, in 1999-2020 the region's GDP may grow by 2.37-2.47 times. The GDP per capita in the same period would increase by 84-92%.

At this stage in market reforms, the principal economic goal for Central Asian countries is to reinforce economic stabilisation and secure economic growth that would help solve social problems and implement far-reaching economic reforms. Speeding up the liberal reform of macroeconomic policies and the entire economy would play a key role and would imply more freedom and economic independence for businesses and removal of barriers to entrepreneurial activity.

2. Current situation and outlook for energy production, consumption and trade

2.1 Current status of energy resource production, consumption and trade

2.1.1 Main trends in the development of the fuel and energy complex (CFEC)

In Central Asia, integration of the FEC has always been and will remain a vitally important issue. This was the case when the region was still part of the former USSR, and constituent republics, including those in Central Asia, were highly dependent on each other for energy production and supply. The same logic should apply today following the disintegration of the USSR and the concomitant disruption of complex economic

ties which have not been restored in the beginning stages of restructuring and market reform. Following independence, Central Asian countries had to find their own solutions to the problem of energy security and reliable and uninterrupted fuel and energy supply. They have always been and will be characterised by the following common underlying factors affecting their FECs:

- low efficiency of fuel and energy use resulting in significant losses at every step of the energy chain from mining and generation to consumption in all economic sectors;
- extreme obsolescence of fixed capital in the fuel and energy sector, which greatly impedes further efforts at achieving stable and reliable operation of energy supply systems;
- severe lack of investment in the power industry;
- dearth of construction projects to build new energy facilities and insignificant number of reconstruction projects aimed at existing facilities;
- declining reliability of external energy suppliers and inadequate carrying capacity of cross-border transport and communication links and power

Table 19. Macroeconomic indicators

Years	1992	1994	1995	1996	1997	1998	1999
GDP in terms of purchasing power parity, billion US$ (1990)							
Kazakhstan	71.5	56.7	52.1	52.2	53.1	52.1	52.99
Kyrgyzstan	4.0	2.8	2.6	2.8	3.1	3.2	3.32
Tajikistan	9.3	6.5	5.6	5.4	5.5	5.9	6.12
Turkmenistan	17.7	12.9	11.9	11.0	8.0	8.4	7.14
Uzbekistan	53.9	50.5	50.0	50.8	52.1	53.2	55.54
Central Asian region	156.4	129.4	122.2	122.2	121.8	122.8	125.11
Population, million							
Kazakhstan	16.45	16.22	15.96	15.68	15.8	15.6	14.9
Kyrgyzstan	4.48	4.7	4.48	4.55	4.6	4.7	4.9
Tajikistan	5.57	5.62	5.79	5.88	6.0	6.1	6.2
Turkmenistan	4.0	4.22	4.48	4.59	4.7	4.7	4.7
Uzbekistan	21.2	22.1	22.56	23.0	23.7	24.1	24.6
Central Asian region	51.7	52.86	53.27	53.7	54.8	55.2	55.3
GDP per capita, thousand US$/person							
Kazakhstan	4.35	3.5	3.26	3.33	3.36	3.34	3.56
Kyrgyzstan	0.89	0.6	0.58	0.62	0.67	0.68	0.68
Tajikistan	1.67	1.16	0.97	0.92	0.92	0.97	0.99
Turkmenistan	4.43	3.06	2.66	2.4	1.7	1.79	1.52
Uzbekistan	2.54	2.29	2.22	2.21	2.2	2.21	2.26
Central Asian region	3.03	2.45	2.29	2.27	2.22	2.22	2.26
Energy consumption, tce/person							
Kazakhstan	6.26	5.83	4.86	4.25	3.83	3.65	3.67
Kyrgyzstan	0.96	0.66	0.76	0.77	0.70	0.60	0.66
Tajikistan	1.17	1.19	1.04	0.93	0.88	0.85	0.84
Turkmenistan	6.13	4.31	3.88	3.75	3.44	3.34	3.3
Uzbekistan	2.89	2.84	2.63	2.65	2.64	2.71	2.74
Central Asian region	3.86	3.51	3.07	2.86	2.70	2.64	2.64
Electric power consumption, kWh/person							
Kazakhstan	5890	4895	4605	4190	3614	3397	3376
Kyrgyzstan	2187	2451	2143	1758	1435	1511	1533
Tajikistan	3232	3203	2591	2721	2700	2689	2790
Turkmenistan	2025	2085	1875	1852	1681	1702	1915
Uzbekistan	2311	2172	2128	2130	2025	1950	1870
Central Asian region	3516	3135	2900	2741	2478	2382	2353

Sources: 1,3,5

Table 20. GDP forecast for 2020

Country. region	Population. million	GDP. billion US$	GDP per capita. US$/ person
Kazakhstan	17.67[1]	89-99	5037-5580
Kyrgyzstan	6.072	5.6-6	919-1018
Tajikistan	11.0	10-11	935-1035
Turkmenistan	5.1[2]	12-13[2]	2353-2608
Uzbekistan	31.3	180	5750
Central Asian region	71.142	296.6-309	4169-4343

Source: 1, 5, 14

[1] extrapolation of population growth rates over 2010-2015
[2] extrapolation of population growth rates and GDP in 1992-1999

networks including those used to export energy resources from the region;

- lack of information on the overall availability of energy resources throughout the region.

It is therefore safe to assert that recent years have seen a decline in the energy security for the region and that large-scale measures are needed to reverse the trend in individual countries and the entire region, including through extensive and far-reaching integration in the power industry. Recently, the main trends in the power industry of Central Asian countries have included:

- policies seeking to increase self-sufficiency through the intensive economic use of domestic energy potential, construction of new fuel and energy processing facilities, enhancing the energy efficiency of the economy;
- vigorous efforts by Central Asian governments and their FECs to involve foreign investors in prospecting and developing new hydrocarbon deposits, building pipelines and power grids, building new generating facilities for oil and gas networks and overhaul of existing ones together with their infrastructure;
- the search for partners and new transport routes for energy exports from the region;
- market reform of energy;
- strengthening of cooperation in energy across the region.

Both the FECs and the entire economy of the region face a major task of steering their efforts towards sound and efficient use of available fuel and energy. The rational and efficient use of fuel and energy, that we have set out to analyse in terms of its current status and likely development, implies, first and foremost, the optimisation of the regional balance of fuel and energy and, more directly, enhanced efficiency of fuel and energy use at all stages of the energy cycle from the extraction of raw materials to the consumption of final energy in all economic sectors.

Optimum use of the resource potential of the FEC with due regard for the interests of each Central Asian country can and should be achieved through broad intra-regional cooperation in the energy sector. This condition is unavoidable in any efforts seeking to strengthen the self-sufficiency of Central Asia in terms of energy supply, increase its energy export potential, save investment resources for further increase in the production capacity of fuel and energy complexes and for fuel and energy imports, and to reduce environmental pressures both regionally and globally.

2.1.2 Energy resource base

Central Asia possesses a significant and diversified resource base for its power industry although they are unevenly spread throughout the region. Apart from vast volumes of proven recoverable resources of hydrocarbon raw materials, the region has huge hydro-power capacity, large deposits of uranium, and favourable conditions for the development of non-conventional renewable energy.

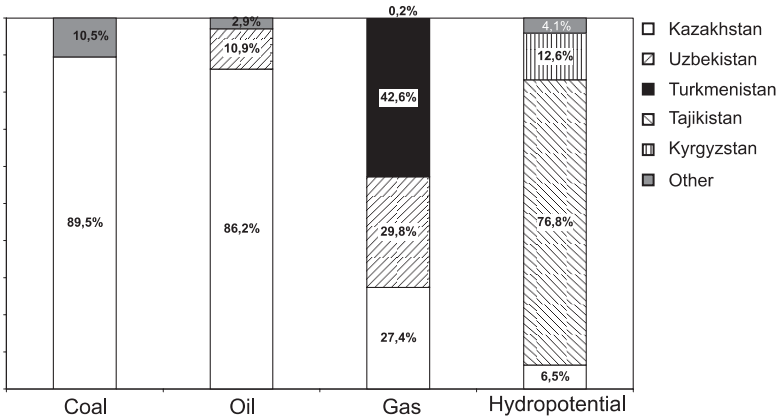
However, the level of knowledge about the resource base of the power industry leaves much to be

desired, due to lack of funds for research. Data on the resource potential of the region's power industry for 2000-2020 is shown in Table 21.

The ratio between the natural resource potential and the volume of mined/generated energy indicates the time of availabity for a particular resource in a country or the whole region (self-sufficiency). In 1998, this indicator for proven recoverable coal reserves stood at more than 600 years; for oil, 65 years, and for natural gas, nearly 75 years. On the other hand, just over 10% of the hydropotential are currently utilised, which provides ample opportunity for satisfying the growing demand of this region for electric power through the use of relatively cheap hydro-power resources, provided this does not conflict with the irrigation needs of the region's countries.

A large part of proven recoverable coal and oil reserves is found in Kazakhstan, while Kyrgyzstan and Tajikistan are the best endowed in hydropower, with natural gas reserves more evenly divided between Turkmenistan, Uzbekistan and Kazakhstan (figure 4).

Figure 4. Distribution of proven reserves of hydrocarbon fuel and economically viable hydroelectric potential in Central Asia



Source: 1,2

2.1.3 Production and consumption of primary energy

In 1992-1999 the total production of primary energy in Central Asia declined by 21% or by 55 million tonnes of coal equivalent (tce) (Table 22), while their consumption dropped by 27% and in 1996 reached 146.1 million tce (Table 23).

The main factors explaining the declining production and consumption of fuel and energy include the economic downturn which reduced solvent demand for energy, the break-up of long-standing economic links including in the power industry of individual countries and limited access to foreign markets.

The geographical structure of the fuel and energy production and consumption in Central Asia is presented in Figures 5 and 6. Kazakhstan and Uzbekistan are shown to account for almost 81% and 83% of the total production and consumption,

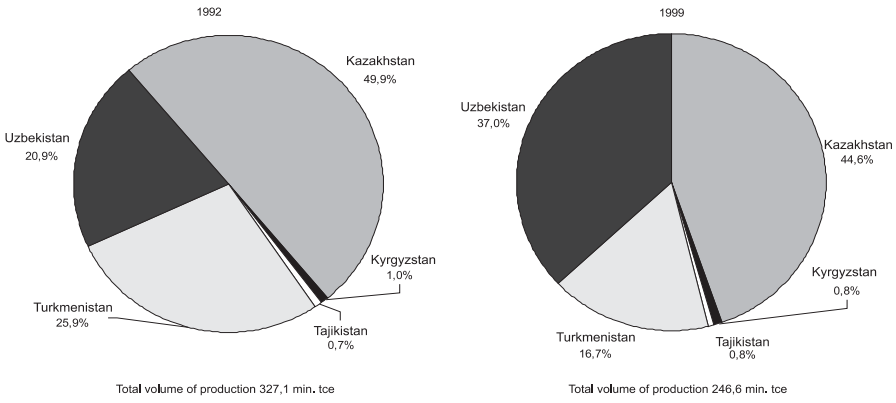
Table 21. Energy resource base in 2000 and beyond

	Kazakhstan		Kyrgyzstan		Tajikistan		Turkmenistan		Uzbekistan		Central Asian region	
Energy resources	2000	2020	2000	2020	2000	2020	2000	2020	2000	2020	2000	2020
Coal*, billion tons	34.1	34.1	1.34	1.27	0.67	1.0	Insig.	Insig	2	2	38.11	38.37
Oil*, million tons	2760	2760	11.5	10.2	5.4	10	75	75	350	350	3261.9	3205.2
Gas*, billion cu.m	1841	1841	6.54	6.2	9.2	10	2860	2860	2000	2000	6716.74	6717.2
Uranium**, thousand tons	601	601	Insig.	Insig.	Insig.	Insig	Insig.	Insig	83.7	83.7	684.7	684.7
Hydropower***, bln kWh/year	27	27	52	99	317	317	2	2	15	15	413	460
RES, incl. small hydro, bln kWh/ year	66	66	Insig.	Insig.	18.4	18.4	n/a		n/a	n/a	84.4	84.4

* Figures for coal, oil and natural gas refer to proven recoverable resources.
** Uranium resources estimated by the World Energy Council with mining costs at below US$ 130/kg
*** Economically viable potential (for Uzbekistan – technological hydroelectric capacity)

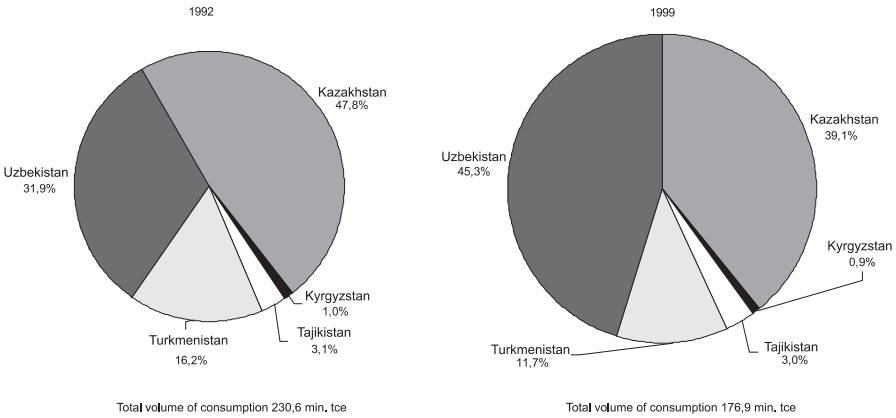
Source: 1, 2

Figure 5. Share of Central Asia countries in the production of primary energy, 1992 and 1999



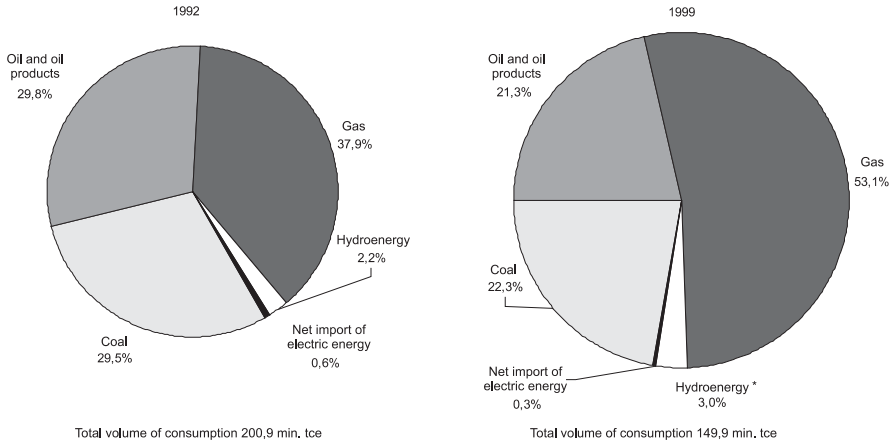
Source: **1, 3**

Figure 6. Share of Central Asia countries in the consumption of primary energy, 1992 and 1999



Source: **1, 3**

Figure 7. Product structure of primary energy consumption in Central Asia, 1992 and 1999



* converting for furl is implemented by coefficient 1 kWh = 0,123 mln.tce

Source: **1, 3, 4, 5**

respectively, with Kazakhstan being the largest producer of primary energy in the region, and Uzbekistan topping the list of consumers.

Availability and accessibility of certain categories of primary energy in Central Asian countries have largely determined their consumption structure. Thus, Kazakhstan mostly consumes coal, Kyrgyzstan and Tajikistan, hydro-power, and Turkmenistan and Uzbekistan, oil and natural gas. Consumption structure for the whole region by type of primary energy resource is shown in figure 7.

Natural gas accounts for more than half of total primary energy consumption in Central Asia, with three fourths of it consumed by Uzbekistan. Coal comes second, with 93% consumed in Kazakhstan. The region's hydroelectric energy resources are concentrated in Kyrgyzstan and Tajikistan which produce and consume nearly two thirds of all hydropower.

The energy self-sufficiency of a country or region depends not only on its primary energy base but also on the ratio between its annual generation and consumption. The ratio for 1999 exceeded 1.0 for the whole region (1.43), with Kazakhstan achieving 1.67 and Turkmenistan, 2.33. Kyrgyzstan and Tajikistan, who are net importers of energy resources, are obviously less self-sufficien, while Tajikistan had the lowest rating (0.4).

Available data on per capita consumption of primary energy exhibit declining trends in 1992-1999 for the entire Central Asian region, which was explained both by reduced consumption and a simultaneous increase in population. Thus, in 1992

Table 22. Dynamics of primary energy production

Years	1992	1994	1995	1996	1997	1998	1999
Total primary energy production, million tce							
Kazakhstan	127.0	101.4	89.5	89.6	92.7	90.8	91.5
Kyrgyzstan	2.8	2.1	1.9	1.9	1.8	1.6	1.9
Tajikistan	2.2	2.2	1.9	1.9	1.8	1.8	2.0
Turkmenistan	76.0	47.0	43.3	46.5	22.5	20.9	36.2
Uzbekistan	57.2	64.9	66.9	69.3	72.2	76.7	78.2
Central Asian region	265.2	217.6	203.5	209.2	191.0	191.8	209.8
Coal production, million tons							
Kazakhstan	127	105	83.3	76.8	72.6	69.8	58.4
Kyrgyzstan	2.2	0.8	0.5	0.4	0.5	0.4	0.4
Tajikistan	0.2	0.1	0.03	0.02	0.02	0.02	0.02
Turkmenistan	0	0	0	0	0	0	0
Uzbekistan	4.7	3.8	3.1	2.8	2.9	3	3
Central Asian region	134.1	109.7	86.93	80.02	76.02	73.22	61.82
Oil and gas condensate production, million tons							
Kazakhstan	25.8	20.3	20.5	23.0	25.8	25.9	30.1
Kyrgyzstan	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Tajikistan	0.06	0.03	0.03	0.03	0.03	0.02	0.02
Turkmenistan	5.2	4.4	4.5	4.4	4.8	5.5	7.0
Uzbekistan	3.3	5.5	7.6	7.6	7.9	8.1	8.1
Central Asian region	34.46	30.33	32.73	35.11	38.63	39.62	45.32
Natural gas production, billion cu.m							
Kazakhstan	8.1	4.5	5.9	6.5	8.1	7.9	9.9
Kyrgyzstan	0.1	0.04	0.04	0.03	0.02	0.02	0.03
Tajikistan	0.01	0.03	0.04	0.05	0.04	0.03	0.04
Turkmenistan	60.1	35.7	32.3	35.2	13.7	11.4	22.8
Uzbekistan	42.8	47.2	46.8	49.0	51.2	54.8	55.6
Central Asian region	111.2	87.47	86.88	90.78	73.06	74.15	88.37
Hydro-energy production, billion kWh							
Kazakhstan	6.86	9.18	8.31	7.32	6.5	6.14	7.58
Kyrgyzstan	9.28	11.75	11.11	12.3	10.9	9.9	12.14
Tajikistan	15.9	16.7	14.56	14.8	13.7	14.1	15.43
Turkmenistan	0.4	0.42	0.4	0.5	0.49	0.48	0.47
Uzbekistan	6.28	7.16	6.18	6.5	5.8	5.76	6.58
Central Asian region	38.72	45.21	40.56	41.42	37.39	36.38	42.2

Sources: 1, 3, 5.

per capita consumption were 3.86 tce /person, and by 1999 it declined by 23.2% to 2.64 tce /person.

2.1.4 Coal industry

In the period under review, coal production decreased by more than half (Table 22), with most of decline taking place in Kazakhstan. Apart from Kazakhstan, coal mining on a more or less widely practised only in Uzbekistan.

Notwithstanding reduction in its coal exports, Kazakhstan remains the biggest supplier to external markets, especially to Russian power stations.

Power stations and boiler units are the biggest consumers of coal in the region. In Kazakhstan, they currently account for about 63% of total coal consumption; in Kyrgyzstan, for 35%; in Uzbekistan, for over 90%; in Tajikistan, nearly the entire volume goes to boiler units.

Table 23. Primary energy consumption

	1992	1994	1995	1996	1997	1998	1999
Consumption of primary energy resources (million tce)							
Kazakhstan	102.9	94.5	77.5	66.6	60.5	56.9	54.7
Kyrgyzstan	4.3	3.1	3.4	3.5	3.2	2.8	3.3
Tajikistan	6.5	6.7	6.0	5.5	5.3	5.2	5.2
Turkmenistan	24.5	18.2	17.4	17.2	16.2	15.7	15.5
Uzbekistan	61.3	62.8	59.3	60.9	62.6	65.4	67.4
Central Asian region	199.5	185.3	163.6	153.7	147.8	146.0	146.1
Electricity (billion kWh)							
Kazakhstan	96.9	79.4	73.5	65.7	57.1	53.0	50.3
Kyrgyzstan	9.80	11.52	9.60	8.00	6.6	7.1	7.51
Tajikistan	18.00	18.00	15.00	16.00	16.2	16.4	17.3
Turkmenistan	8.10	8.80	8.40	8.50	7.9	8	9
Uzbekistan	49.00	48.00	48.00	49.00	48	47	46
Central Asian region	181.8	165.72	154.5	147.2	135.8	131.5	130.11
Gas (billion cu.m)							
Kazakhstan	17.3	10.6	9.1	6.5	6.6	6.2	4.5
Kyrgyzstan	1.9	0.8	0.6	0.8	0.992	0.8	0.6
Tajikistan	1.8	0.9	1.9	1.3	1.7	2	2.27
Turkmenistan	10.8	10.6	10.0	10.7	7.4	8.3	7
Uzbekistan	41.3	44.5	42.3	44.4	45.1	45.7	46
Central Asian region	73.1	64.7	63.9	63.7	61.792	63	60.37
Oil and petroleum products, (million tons)							
Kazakhstan	17.37	11.5	12	10	9	8	6
Kyrgyzstan	1.73	1.30	0.90	0.40	0.12	0.10	0.2
Tajikistan	1.17	1.10	0.95	1.00	0.70	0.60	0.50
Turkmenistan	6.84	5.20	5.50	5.00	4.70	4.60	5.20
Uzbekistan	9.22	8.00	6.80	7.20	7.50	7.60	7.90
Central Asian region	36.33	37.1	26.15	23.6	22.02	20.9	20.7
Coal (million tons)							
Kazakhstan	86.00	74.00	63.00	58.00	56.00	52.00	50.00
Kyrgyzstan	4.00	2.00	1.60	1.10	0.72	0.54	0.40
Tajikistan	1.00	0.70	0.60	0.10	0.08	0.04	0.02
Turkmenistan	0.70	0.50	0.20	0.10	0.00	0.00	0.00
Uzbekistan	6.00	5.00	3.00	3.00	3.00	3.00	3.00
Central Asian region	97.7	82.2	68.4	62.3	59.8	55.58	53.42

Sources: 1,3,5

2.1.5 Oil industry

In 1992-1999, the relative increase in oil production in the region was 31.2%, with the absolute volume reaching 45.32 million tonnes in 1999 (Table 22).

Kazakhstan accounts for about two thirds of the total oil output of the region. Over the same period, consumption of oil and petroleum products in the region decreased by 43% to 20.7 million tonnes in 1999. In Kazakhstan, demand for oil and petroleum products fell by almost 2.5 times.

Due to small volumes of output, oil extraction has no major role to play in the fuel and energy mix of Kyrgyzstan and Tajikistan. In Kyrgyzstan, internal self-sufficiency for oil stands at 0.3; in Tajikistan, at 0.073.

Turkmenistan and Uzbekistan are oil- rich countries, which enables them to satisfy all domestic needs for liquid fuels from their own sources and also to export it.

Inadequate capacity of oil transportation lines, extreme obsolescence of plant and lack of investment

that would be required to curb these problems and develop new oil fields are among the main challenges facing the oil industry in this region.

Faced with these problems, Central Asian countries have intensified their efforts to attract investment. These have included a liberal reform of investment legislation which has already produced results.

Thus, the government of Kazakhstan has opened access to domestic oilfields to foreign companies that implement their projects through joint ventures based on production sharing agreements, and concessions. American company Chevron is actively involved in the development of Tenghiz oil field which has estimated reserves of around 750-1,150 million tonnes.

In Turkmenistan, "Mobil" and "Monument Oil" companies are active in oil production. Foreign investors participated in the construction of the Turkmenbashi oil-processing complex that cost approximately $1.5 billion.

The Uzbek state oil and gas company "Uzbekneftegaz" confirmed its participation in a joint project with the company Baker Hughes to raise oil output in North Urtabulak field.

In Kazakhstan, petroleum products are mostly consumed by industrial enterprises, whereas in Kyrgyzstan, Tajikistan and Uzbekistan the main share of consumption falls to transport.

2.1.6 Gas industry

The region pins special hopes on expansion in its gas industry which would imply further development of proven gas-fields and identification of new ones. Active prospecting for hydrocarbons continues in the Caspian area, and some of its results have already transformed it into a prominent oil and gas province. However, proven gigantic gas fields, such as Karachaganak, Kashagan, Tenghiz and Shakh-Deniz, would need to be brought up to their real capacity. One outstanding problem is that these gas resources have yet to find their market.

In 1992-1999, natural gas production in Central Asia declined by 20.5%, with absolute volumes reaching 88.37 billion cu.m in 1999 (Table 22). In the period under review, the most significant absolute reduction in natural gas output occurred in Turkmenistan where it shrank by 37.3 billion cu.m.

Since the second half of the period under review, gas output has been growing in Kazakhstan. Over the past 8 years significant growth rates were recorded in Uzbekistan. As a result, a shares taken by leading producers of natural gas have changed. In 1992 Turkmenistan emerged as the leader, with its absolute volumes dwarfing the output by all other countries of the region. In 1994 it yielded leadership to Uzbekistan which now accounts for the lion's share of the Central Asian gas output.

In the period under review, consumption of natural gas in the region decreased by 17.4%, down to 60.37 billion cu.m in 1999. Internal production is currently more than double its consumption in Kazakhstan and more them three times as high in Turkmenistan. By contrast, in 1999, the share of internal production in natural gas consumption was only 5% for Kyrgyzstan and as little as 0.6% for Tajikistan.

Overall, the region may well be described as having a surplus of gas reserves since figures for 1999 put its self-sufficiency in natural gas at 1.46. Moreover, the local resource base of the gas industry allows further significant growth, provided, of course, that new markets are found and access gained to them.

Local gas industry faces the same challenges as its oil sector, which include lack of investment, inadequate infrastructure, etc.

2.1.7 Electric power industry

In the period under review, generation and consumption of electric power in Central Asia decreased by approximately 28%. The most significant reduction in power generation among the countries in the region was registered in Kazakhstan. Nevertheless, Kazakhstan, along with Uzbekistan, remains the regional centre of power generation.

According to 1999 statistics, total generation capacity of power stations in the region (Turkmenistan excluded), was 37.7 million kWh, with coal-fired thermal power stations accounting for 45% and hydroelectric power stations for another 29%. Coal and natural gas are the basic fuels in the fuel mix of the region's electric power industry.

In the period under review, generation capacity of power stations satisfied the overall internal requirements of the economy and public for electric power. Electric power consumption per capita stood at 2,353 kWh/person in 1999, which is close to the world average.

The following critical issues are worth mentioning with regard to the electric power sector:

- widespread obsolescence of equipment (both generating and electric grid);
- significant losses of electric power in transmission and distribution;
- lack of investment;
- decline in solvent demand and failure to pay for electric power supply.

Coal is the basic fuel used by power stations in Kazakhstan, accounting for over 70% of the total power generation. Electric power sector in Kyrgyzstan and Tajikistan is based on hydropower, while natural gas is the main input in the electric power stations of Turkmenistan and Uzbekistan. Industry and public are the main consumers of electric power in the region.

Central Asian republics attach great importance to improving their tariff policy. Thus, according to experts from Tajikistan, most investment projects in the republican electric power industry could be implemented through tariff optimisation alone, even if foreign investors are not involved.

2.1.8 Trade in energy resources

2.1.8.1 Trade in energy resources among Central Asian countries

As mentioned above, Central Asian countries are so dependent on each other for different forms of energy that efficient and mutually advantageous trade in energy resources becomes a vital necessity. Already, Central Asian countries are widely resorting to swapping water and hydroelectric power for organic fuel in their mutual supplies.

As is well known, Kyrgyzstan and Tajikistan possess considerable water and hydropower resources but very limited reserves of organic fuel, whereas Kazakhstan, Turkmenistan and Uzbekistan lack water resources but are well endowed with organic fuel.

Both Kyrgyzstan and Tajikistan get almost all of their energy resource imports from neighbouring countries in the region.

Mutual supplies of water and energy among countries in the region are mostly based on intergovernmental agreements.

As shown in Table 24, these agreements have been repeatedly violated, due both to natural causes (dryness of a particular year) and the vicissitudes of their financial and economic relationships (failure to pay).

It should be noted that breaches of agreements have had their negative repercussions in the economic development of all parties concerned. Failure to supply organic fuel to the Bishkek and Osh combined heat and power stations in Kyrgyzstan has led to increased drawdown from the Toktogul reservoir for electric power supply needs with concomitant reduction in drawdown for the irrigation needs of downstream countries.

Other evidence of active trade in energy resources includes:

- recent purchases by Kazakhstan of electric power in Turkmenistan and Uzbekistan, and its imports of natural gas from Uzbekistan;

Table 24. Compliance with intergovernmental agreements on water and energy usage, 1995-2000

Indicator	Year	1995		1996			1997	1998	1999		2000			
Volume of Toktogul reservoir (billion cu.m)	As at 01.01.	17.7		13.9			13.0	10.2	13.5		14.5			
	01.04.	14.2		10.4			9.8	7.3	10.4		11.0			
	31.12.	15.6		15.2			11.8	15.1	14.5		13.7			
Drawdown Toktogul reservoir, growing season (billion cu.m)	Plan	6.5		6.5			6.5	6.5	6.5		6.5			
	Act.	6.3		6.2			6.1	3.7	5.06		6.5			
Electricity export to Kazakhstan, Uzbekistan, (million kWh)	Plan	2200		2200			2200	2200	2200		2485			
											580	1905		
		Uzb	Kaz	Uzb	Kaz		Uzb	Kaz	Uzb	Kaz	Uzb	Kaz	Uzb	Kaz
	Act.	928	782	1077	995		709.5	1615	468.6	489	585.3	970	661.1	1924.2
Supplies to Kyrgyzstan: Natural gas	Billion. cu.m	Plan	200	-	500	-	-	630	-	772	-	500	-	652
		Act.	200	-	476	-	-	632	-	748	-	331	-	252.9
Karaganda coal	thousand tons	Plan	-	985	-	600	-	-	566.7	-	566.7	-	362.5	-
		Act.	-	450	-	202	-	-	150.4	-	572	-	331.1	-
Fuel oil	thousand tons	Plan	-	-	-	-	-	-	-	20		-		60
		Act.	-	-	-	-		-		23.8				25.5

Source: 1

- purchase by Uzbekistan of electric power from other countries (according to 1999 statistics, total electric power imports from Kyrgyzstan, Turkmenistan and Tajikistan to Uzbekistan exceeded its exports by 1 billion kWh);
- mutual electric power deliveries between Kyrgyzstan, Tajikistan and Uzbekistan.

Again, it should be noted that while energy resource requirements of Central Asia (including their future increase) may, in principle, be satisfied internally – provided, of course, that existing capacity is efficiently utilised – any further increase in fuel and energy exports cannot be absorbed by intra-regional markets.

2.1.8.2 Trade in energy resources with third countries

Russia is the biggest importer of coal from Kazakhstan. The Pavlodar oil refinery receives its raw materials supplies via pipeline from West Siberia.

Kazakhstan sends its oil to destinations in Poland, Finland and China, with nearly 2.5 million tonnes transported by rail in 1999, as well as to Ukrainian ports of Odessa and Feodossia. Kazakhstan exports coal to the Ukraine. More than half of total oil exports by Kazakhstan is estimated to be for countries outside the ex-USSR.

Kazakh company “KEGOC” cooperates with the RAO “EES Russia” in supplying electric power to northern and western regions of the country. Kazakhstan also exports large quantities of uranium. In 1998, as much as 1,250 metric tonnes of uranium were produced and exported to Russia, Western Europe and South Korea.

Alongside its long-term partners in energy resource trade in Central Asia and other CIS countries (especially Russia and the Ukraine), Turkmenistan started supplying gas to Iran (in 2001, supplies were to total 5 billion cu.m, to increase to 13 billion cu.m the next year). Plans also exist to supply electric power to Iran.

Uzbekistan oil refineries have received raw materials via pipeline from Omsk (Russia). Recently, Uzbekistan started supplying natural gas to Russia.

2.2 Outlook for energy resources production, consumption and trade (national estimates)

According to national energy forecasts, the next two decades will be characterised by the following trends:

- an increase in energy resource production;
- further growth in internal energy resource demand conditioned by economic growth;
- increasing levels of energy self-sufficiency;
- development of fuel and energy transport infrastructure
- market-oriented reforms in the energy;
- further attempts to attract foreign investment.

However, consolidation of regional forecasts would hardly be possible due to lack of national statistics.

2.3 Energy transport and transit

2.3.1 Current status

Slightly less than two thirds of total Kazakh oil exports was via pipelines, with more than 80% of it going through Russia, primarily via the Atyrau-Saransk-Samara pipeline. Oil production is concentrated in the west of Kazakhstan, with two pipelines taking it for processing and on to Russia's export pipelines. On the other hand, liquid fuel is mostly consumed in the east of Kazakhstan which has few pipeline links to oilfields, necessitating oil imports from Russia.

In terms of gas transport, Kazakhstan forms part of a corridor linking Turkmen gas-fields to Russia and Europe. Electric power grids operated by KEGOC company are tied in with the Russian grid, as well as those in Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan.

Kazakhstan coal export routes are oriented toward Russia (the Urals), the Ukraine and several other countries.

In terms of energy transport from Turkmenistan, it is necessary to mention transport of natural gas through Kazakhstan, Uzbekistan and Russia (the latter also buys it, despite its own vast gas reserves) towards the Ukraine and Europe. Among existing routes for gas transport, the gas pipeline commissioned in late 1997 makes it possible to supply gas from fields in western Turkmenistan to northern Iran.

Uzbekistan (apart from its electric power grid) also represents a critical link in the gas transport corridor Middle Asia – Center. Uzbekistan provides transit for natural gas from Turkmenistan.

2.3.2 Outlook for, and routes of, energy transport from Central Asia to energy markets in north-east Asia and Europe

Following the disintegration of the USSR, Central Asian exporters of fuel and energy faced face the need to develop export markets. Apart from traditional markets, particularly in Europe, several new promising and potentially huge markets have recently emerged. Gaining entry to these would replenish Central Asian budgets. This should serve as an incentive for exploring new routes and setting up supply lines for energy transport.

Kazakhstan intends to increase by 70% its oil transport through the Atyrau-Saransk-Samara pipeline. Moreover, oil produced by joint venture Tenghizchevroil will be exported by CPC to outside markets via a 900-mile pipeline to Novorossiisk. All things considered, Kazakhstan annual oil exports via pipelines may reach 47-49 million tonnes.

Various new transport options may facilitate an increase in Kazakhstan oil exports to Asian markets. One such option implies oil transit from Kazakhstan through Turkmenistan to Iran and other Persian Gulf countries. Should a Central Asian oil pipeline become reality, it may facilitate supplies of Kazakh oil to Pakistan and some other countries.

Kazakhstan also looks towards China as a promising market for its oil. Supplies by rail have already been tried, and in June 1997 Kazakhstan and China signed agreement on building up a 1,800-mile pipeline linking Kazakh oil fields with Chinese oil-consuming centres. The Chinese party will act as investor. In fact, most of the above oil transport projects are at a discussion stage, with Kazakhstan intending to take final decisions after a more detailed assessment of Caspian oil export capacity.

Many large Kazakh gas-fields, particularly Tenghiz, Zhanazhol and Uritau, have no access to export pipelines. Export from these fields would imply developing and expanding the existing network of pipelines towards Russia or seeking new routes, for instance to China. In their discussion of gas exports, Kazakhoil and Philips companies have agreed to study the feasibility of building a gas liquefaction plant in Atyrau that would cost $500 million. The plant would be built in 2004. Conoco has plans for annual transport of 1.5 million tonnes of liquefied gas via Turkmenistan and the Caspian Sea to Baku and through Georgian ports to Turkey and some Mediterranean countries. The company has already invested $600 thousand to build technical facilities at the Georgian port of Batumi.

Turkmenistan faces a serious lack of export routes and supply lines for energy transport. Foreign companies and financial institutions are very active in exploring and setting up new routes for primary energy transport out of the republic. They are prepared to invest and are already investing in the development of local energy export infrastructure. In March 1998 Monument Oil company (UK) signed an agreement with Iranian National Oil Company on oil supplies from the Burun oilfield in western Turkmenistan to the northern border of Iran and substitution of Persian Gulf oil for these supplies.

One essential element of the long-term energy strategy of Turkmenistan is to identify export routes for its natural gas that would replace those through Russia. In December 1997, a 250-km pipeline was commissioned, linking the Korpeje gas field in western Turkmenistan with the town of Kurt-kui in northern Iran. The project costs $190 million, with current carrying capacity standing at nearly 4 billion cu.m with a potential increase to 8 billion cu.m by 2006. In the first three years of operation, some 65% of gas going through the pipeline will be used to compensate for the construction costs. It is the first Central Asian pipeline bypassing Russia. The project allows Turkmenistan to start natural gas exports to Turkey via Iranian pipelines.

In February 1998, Royal Dutch/Shell and Turkmen authorities signed a protocol of understanding to study the feasibility of building a pipeline linking Turkmenistan with Turkey via Iran. It would cost an estimated $4 billion to build the pipeline with an annual capacity of up to 30 billion cu.m. The cost of building a pipeline of similar capacity around Iran is estimated at $5 billion. Uzbek oil industry, despite its focus on satisfying internal demand for liquid fuel, has plans of involvement in large international oil export projects. A memorandum of understanding has been signed with Turkmenistan, Afghanistan and Pakistan regarding the possible building of a pipeline to take oil from Central Asia to Pakistani ports. The Afghan situation, however, has cast doubt on this project. Finally, Uzbekistan seeks involvement in the construction of an oil pipeline from Kazakhstan to China.

3. Energy security at the national and regional levels

3.1 Providing for energy security at the national level

Following the disintegration of the USSR, the independent Central Asian countries met with unexpected serious challenges to their energy security. At the top of the agenda facing fuel and energy importers was the search for ways of financing energy purchases in outside markets while ensuring maximum supply from domestic sources and increasing the volume of proven fuel reserves. For exporting countries, the priority concern was to attract sufficient investment allowing their fuel and energy sector to achieve sustainability of energy supply for the economy and the public and economically viable levels of energy exports that provide an essential contribution to the state budget.

Apart from lack of investment that was the inevitable result of a sharp economic downturn, the following factors affected the energy security of Central Asian countries:

- disruption of energy links that existed in the USSR, and limited capacity of transport routes which could be used for energy exports and imports;
- high dependence on imports of power equipment that can be explained by the previous division of labour;
- obsolescence of a large portion of capital equipment in the fuel and energy industry;
- increasing share of energy in the cost of industrial output of Central Asian countries, resulting from growing costs of energy and leading to a loss of competitive advantage in both external and domestic markets;
- the difficulty of finding staff for the fuel and energy industry and the power engineering industry;
- high energy intensity of economy and, as a result, significant waste of fuel and energy across sectors.

Current situation and outlook for energy security are discussed below for each of the Central Asian countries.

Kazakhstan. This republic has a history of economic development based on raw materials extraction and energy-intensive industries. Despite its significant self-reliance in terms of energy, the Republic imports petroleum products, natural gas and electric power due to the geographical isolation of energy-rich and energy-deficient regions. Its western gas fields have no links to consumers in the densely populated Southeast and industrial North, which is why Kazakhstan now has two separate gas supply networks.

The electric power industry operates two virtually independent power grids in the north-west and south-east of the country.

With low levels of consumer solvency, market transition led to a sharp increase in energy prices (increasingly edging towards their world level), undermining the efficiency of power supply and the investment capacity of its fuel and energy enterprises. Republican authorities are therefore planning to enhance energy security through a number of large-scale and long-term internal and external activities.

These include:

- forming a single national energy resource market with domestic producers as the only suppliers, which would meet the entire energy demand from the national economic sectors and population. This would require the building of long-distance oil and gas pipelines, power transmission lines, as well as additional energy processing facilities;
- providing national fuel and energy producers with access to international markets which is currently hampered by the geographic location of the republic. This would be achieved through close collaboration with neighbouring countries, particularly in Central Asia, in construction programs and in securing access to potential energy markets for transport networks operated by national companies or joint ventures;
- renewal of economic ties and cooperation with the CIS countries, particularly in the joint operation of electric power networks and oil and gas facilities based on market principles.

In order to ensure sound and efficient use of fuel and energy and attract additional domestic and foreign investment in the power industry, the local parliament has passed the “Energy Conservation Act”, the “Electric Power Industry Act”, and the “Oil Act”.

Kyrgyzstan. The fuel and energy balance of the Republic largely depends on imports. In 1991-1998, national outlays on energy imports totaled $600 million.

A sharp rise in prices and cost of fuel imports coupled with a decline in coal production have recently led to an abrupt increase in electric power consumption. Broad-based transition to electric power has allowed to compensate for a reduction in coal demand while undermining the survivability and sustainability of the national power supply system.

The growth in internal electric power consumption is accompanied by a slowdown in the development of energy base resulting from insufficient funding. All of these have undermined energy security in Kyrgyzstan and the whole of Central Asia, in particular, by making it difficult to adjust peak loads in hydroelectric power stations.

Apart from the need to improve the overall energy efficiency of the economy, energy security implies maximum use of domestic fuel and energy in meeting the local demand, and balanced and consistent international energy initiatives which include working with Kazakhstan and Uzbekistan on a range of issues relating to mutual supplies of fuel and electric power linked to the efficient use of hydropower in the Syr Darya basin, and a long-term coordinated policy in the sphere of water use and fuel and energy.

Tajikistan. For Tajikistan, with its limited energy resource base, a major challenge in the sphere of energy security would consist in satisfying the energy needs of the national economy and community at large.

The Republic would have to derive maximum benefits from its hydropower capacity and water resources, as well as other, albeit less significant sources of supply, in particular its non-conventional renewable energy. Thus, authorities are actively working to promote the construction of small hydroelectric power stations.

The low solvency of energy consumers (despite the very low tariffs) hampers investment build-up in the energy sector and remains a very serious issue. This problem would hardly be resolved unless energy consumers become more solvent and the system of energy payments is streamlined (first and foremost, by eliminating barter).

Turkmenistan possess huge energy resources and, being a large net energy exporter, hardly has any security problems with regard to sustainability of energy supply for internal consumption.

The main challenge consists in managing its existing energy export capacity with maximum efficiency.

Inadequate energy transport infrastructure impedes growth of its fuel exports. Turkmenistan's economic future would to no small degree depend on the final allocation of the gigantic energy resources of the Caspian Sea to which this republic has direct access. In the context of energy security, one would inevitably mention the recent commissioning of the modernized Turkmenbashi oil refinery.

Energy security in terms of fuel exports would thus imply a more efficient use of existing export routes and a search for new ones, as well as outside investment into the development of oil and gas fields and the requisite infrastructure.

Uzbekistan. The main challenge, in addition to the already mentioned lack of investment and high energy intensity of economy, is the remoteness of this country from major international commodity markets.

The government of the Republic has vigorously addressed these problems. Foreign investors have been more active of late and their contribution was crucial in any single project relating to energy.

Modernization and expansion of oil refineries is promoted as a way of strengthening the country's energy security. The country is pursuing a policy of complete self-sufficiency in liquid fuel.

Like any other Central Asian country, Uzbekistan faces an uphill task of modernizing the operational fuel and energy networks.

3.2 Providing for energy security at the regional level

Energy security in the whole Central Asian region would comprise the following several critical components:

- Provision of guaranteed and economically feasible supply of required amounts of energy to meet the needs of the economy and population of the region;

- Joint funding of projects involving the exploration and development of new fuel deposits, building new hydroelectric power stations (and modernising existing ones) as well as identifying and establishing new energy transport routes;
- unimpeded and non-discriminatory transit of energy through the region for intra-regional and external needs;
- efficient intra-regional energy exchange as a prerequisite for the utilization of available energy capacity at maximum efficiency;
- synchronous operation of Central Asian power grids that would enhance reliability of power supply at national and regional level;
- Elaboration and implementation of concerted policies in external energy markets;
- Implementation of wide-ranging energy-conservation programs on a national scale and development of intra-regional cooperation in this sphere (harmonisation of laws and regulations, information exchange, etc.).

Central Asian countries have taken some steps and are planning to do much more to provide better access to power supply and improve its reliability by strengthening international cooperation and integration in the energy sector.

In mid-1999, the executive heads of Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan signed an Agreement on the parallel operation of power grids. Establishment of a unified power grid for the Central Asian region would allow to:

- ensure balanced operation of electric power stations and joint use of thermal and hydroelectric power stations;
- increase reliability of electric power supply under normal and emergency conditions;
- improve the countries' balance of foreign trade;
- safeguard the fulfilment of inter-governmental agreements on water and energy regulation;
- increase the carrying capacity of electric power grids;
- maintain standard frequencies and voltage levels, minimise losses of electricity caused by equipment failure, optimise power grid structure, maintain the static and dynamic stability and other technical parameters in the parallel operation of the countries' power grids.

In their efforts towards more efficient cooperation in the joint use of water and energy Central Asian countries should pay priority attention to the following long-term issues:

- development of legal framework for such cooperation, and harmonisation of their laws relating to the use of water and energy;
- establishment of a joint data base and a mechanism for the exchange of operational information among the national water and energy departments;
- reorganisation and optimisation of management in water and energy sectors at national and regional levels;
- establishment of a single customs area.

4. Status and outlook for energy conservation policy

4.1 Energy intensity of GDP

In 1999, energy intensity of Central Asia's GDP was reduced to 1.16 tce / $1,000 which is several times higher than in major industrialised countries and regions (fig. 8). The reduction throughout 1992-1999 was by 9% (Table 25). In the period under review, Tajikistan, Turkmenistan and Uzbekistan have seen an increase in the energy intensity of their GDP while it decreased in Kazakhstan and Kyrgyzstan.

A decrease in the energy intensity of the regional GDP was achieved mostly through reductions in Kazakhstan where initial consumption levels were high and comparable to the total primary energy consumption in the other four Central Asian countries. Between 1992 and 1999, energy intensity of Kazakhstan's GDP fell by 29%. In the same period, Turkmenistan recorded highest rates of growth in GDP's energy intensity (57%).

It should be noted that above-mentioned reductions occurred mostly as a result of a decline in industrial output and freight and passenger turnover in the public sector, as well as a fall in energy consumption for defence needs, and the not infrequent ”energy starvation” of industry, households and the communal sector through disruption or stoppage of energy supply, rather than through efficient energy-saving policies of Central Asian countries. In other words, these reductions cannot yet be seen as resulting from sound and efficient use of fuel and energy by the economy and population but are a consequence of a decline in economic development and living standards.

Figure 8. GDP energy intensity in Central Asia and industrialized countries and regions, 1999

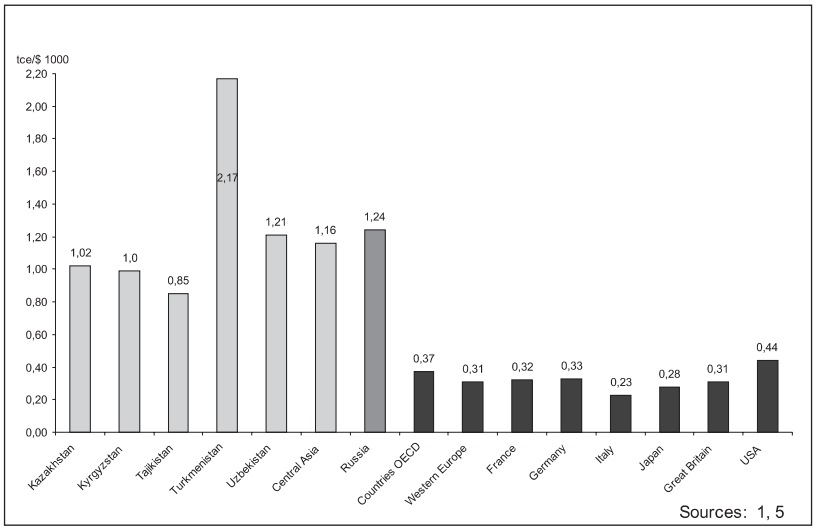


Table 25. Energy intensity and electric power intensity of economy

	1992	1994	1995	1996	1997	1998	1999	2000
Energy intensity of a unit of GDP (purchasing-power parity, tce/US$1,000 (at 1990 US$ rates)								
Kazakhstan	1.44	1.67	1.49	1.27	1.14	1.09	1.02	
Kyrgyzstan	1.08	1.12	1.30	1.24	1.04	0.88	0.99	
Tajikistan	0.70	1.03	1.07	1.02	0.96	0.88	0.85	
Turkmenistan	1.38	1.41	1.46	1.56	2.03	1.87	2.17	
Uzbekistan	1.14	1.24	1.19	1.20	1.20	1.23	1.21	
Central Asian region	1.28	1.43	1.34	1.26	1.21	1.19	1.16	
Electricity intensity of a unit of GDP (purchasing-power parity), kWh/$ (year 1990)								
Kazakhstan	1.36	1.39	1.48	1.3	1.14	1.06	0.96	
Kyrgyzstan	2.45	4.11	3.69	2.86	2.13	2.22	2.26	
Tajikistan	1.94	2.77	3.35	2.72	2.7	2.69	2.79	
Turkmenistan	0.46	0.68	0.71	0.77	0.99	0.95	1.26	
Uzbekistan	2.31	2.17	2.13	2.13	2.03	1.95	1.87	
Central Asian region	1.16	1.28	1.29	0.96	1.14	1.09	1.04	

Sources: 3, 5

Table 26. Energy conservation potential, million tce[1]

	2000						2010						2020					
	Kaz	Kyr	Taj	Tur	Uzb[2]	Reg.[3]	Kaz	Kyr	Taj	Tur	Uzb	Reg.	Kaz	Kyr	Taj	Tur	Uzb	Reg.
Total	38.5	0.29	3.38	4.65	10.73	57.55	22.2	0.56	1.84			24.6	6.9	1.0	0.8			8.7
including:																		
Energy sector	6.6	0.11	1.5		1.83	10.04	3.8	0.23	0.5			4.53	1.5	0.42	0.3			2.22
Industry	27.5	0.04	0.35		6.29	34.18	15.7	0.08	0.25			16.03	4	0.14	0.15			4.29
Households and communal services	n.a.	0.06	1.2		2.33	3.59		0.09	0.8			0.89		0.16	0.1			0.26
Transportation	0.4	0.01	0.03		0.43	0.87	0.4	0.02	0.04			0.46	0.3	0.03	0.1			0.43
Agriculture	4	0.07	0.3		1.68	6.05	2.3	0.14	0.25			2.69	1.1	0.25	0.15			1.5

Source: 1.

[1] In this table only, the 2010 and 2020 figures for the whole region are shown and added up only for those three Central Asian states for which they respective data were available.
[2] For Uzbekistan, figures for energy sector are included under “industry”
[3] For 2000, total figures for energy saving do not include Turkmenistan.

4.2 Potential for energy conservation

Central Asian countries have built up significant potential for energy conservation and need to proceed to its objective assessment and efficient implementation so as to facilitate development through conservation of energy, stimulate economic growth and reduce environmental tensions.

Across the region, economically viable potential for energy conservation in the region currently stands at nearly 40-45 million tce, representing almost 30% of the overall primary energy use (Table 26).

4.3 Main options in enhancing energy efficiency

Energy efficiency in Central Asian economies could, in particular, be improved through:

- the recording and monitoring of fuel and energy consumption;
- modernisation and upgrading of energy-consuming equipment.

Significant savings of fuel and energy could be achieved through economic restructuring that would focus on increasing the share of less energy-intensive production units. Other avenues in raising the energy efficiency of Central Asian economies should include such internationally recognised practices as:

- improving the location of production networks by reducing the distance from the producer of energy to its consumer;
- reducing the material and energy intensity in manufacturing, including through improvements in the quality of raw materials and large-scale recycling of production waste;
- using more efficient and environmentally clean technologies in final consumption.

The above measures would require sound investment and a solid legal framework as well as trained and competent personnel and broad-based information campaigns to facilitate participation in conservation measures of both consumers and producers of fuel and energy.

4.4 Legal framework

Successful implementation of energy-saving policies would require a coherent and flexible legal framework that conforms to international standards. Central Asian leaders are well aware of the need for solid legal framework, as evidenced by the adoption in these countries of national energy conservation acts.

Despite the already mentioned specifics of each Central Asian economy and their energy sectors, conservation acts are broadly similar in their structure and the way they define:

- organisation structures, their terms of reference, basic rights and responsibilities;
- funding sources;
- economic incentives;
- types of energy consumption and the range of equipment covered by energy-efficiency regulations and standards;
- economic sanctions for breaches of consumption standards, and liability for violating legal provisions.

The main drawback of the Central Asian regulatory framework lies in the fact that conservation acts have no direct effect and their enforcement depends on the adoption of subordinate regulatory instruments. The acts do identify economic incentives but countries have yet to prove that these incentives work and, indeed, help build up investment potential in support of conservation policy.

Further development of legal framework stresses better arrangements facilitating efficiency and improvements in existing incentives and funding of projects and programmes executed by enterprises and organisations. Maximum benefits from energy conservation may and must be achieved through stronger international co-operation. The Draft Law “On

energy conservation" for CIS countries elaborated by the CIS Secretariat provides a good basis for reinforced cooperation among Central Asian countries.

4.5 Main obstacles to conservation-based economic development

Main obstacles to conservation-based policies of economic development in Central Asian countries include:

- lack of effective management of conservation policy within governments;
- failure to record and monitor consumption;
- lack of viable incentives;
- lack of investment conditioned by incoherent pricing of energy;
- significant share of obsolete and therefore energy-intensive equipment;
- lack of qualified personnel;
- slow introduction of latest technology;
- insufficient information support.

5. Scenarios of energy development until 2020

5.1 Scenario approach. Background

The highly uncertain outlook for the Central Asian energy led experts to use "scenario approach" in their development forecasts for the fuel and energy complex until 2020 as a most appropriate method in charting the possible dynamics and trends in a system of indicators describing a key area of economic, social and political concerns for the region.

A scenario for a country and the whole region means a "tool used in formulating and identifying a set of ideas on potential future energy situations in which currently adopted decisions would take effect".

Each scenario comprises a set of typical baseline assumptions subjected to detailed analysis to assess the impact of various national energy policies and obtain different sets of quantitative and qualitative indicators describing development outlook for the economy, social sphere, energy sector and environment.

The approach may be described as combined because it involves collection of data for individual countries on the basis of major agreed intermediate indicators used in scenarios covering the whole region (group of countries). Feedback is assessed at the level of individual countries. Selected scenarios are researched in a set of models. Results of model calculations are subsequently adjusted (verified) by experts in a series of steps (Fig. 9).

The main requirement is coherence and consistency of indicators in each scenario and each alternative. This is achieved through accurate identification and description of reported and forecast data at the national and regional level. Scenarios are generated in several stages.

The first step is to determine rates of countries' economic growth in terms of gross domestic product using purchasing-power parity in constant US$ prices. Living standards of each country are described by the integrated indicator of per capita income. It reflects, albeit indirectly, consumption of food, consumer durable and non-durable goods, supply of housing, services and transport (including private cars).

The second step is to determine possible alternative levels of energy consumption. The dynamics of changes in the specific consumption of main types of energy is forecast from assumptions on the speed with which conservation and efficiency measures are implemented. Energy export commitments are also included at this stage. The level of commitments may vary depending on the status of export project or the degree of its elaboration.

The third step would be to estimate the extent to which the above requirements can be met domestically or through imports. The principal tool used in verifying the convergence of assumptions is the system of consolidated and specific energy mixes. Where

appropriate (if at least one balance fails to converge), calculations are repeated.

The main strength of the technique applied in forecasting the development of the energy sector for individual Central Asian countries is that it helps establish a coherent and internally co-ordinated system of forecasts regarding economic development, consumption and production of basic fuel and energy and the funding that would be available for individual branches of a fuel and energy complex.

In this system, iterative matching is based on energy mixes for the whole region and individual countries, as well as on balances for separate branches of national fuel and energy industry, and for inter-regional energy flows. Two levels of forecasting are applied here. The upper level is for scenarios of social and economic development in the entire Central Asian region. These generally include optimistic ("favourable"), probable and pessimistic macroeconomic expectations (growth rates for GDP, income and final household consumption, etc.).

Each scenario offers a model of interaction between the economy and energy sector comprising energy consumption forecast and the initial version of the total energy mix for an individual country linking estimated energy demand to the potential for its production.

The main parameters of the energy mix for an individual country serve as reference (target) indicators and are used in lower level tasks which add detail to consumption scenarios.

The latter help forecast the development of production base in separate branches of fuel and energy industry, including: optimal consumption levels for different fuels in each country; production volumes for principal deposits and watersheds, optimal structure of electric power generating capacity; optimal fuel supply conditions for power stations, investment constraints by industry and investment category. The development of production base in every branch of the fuel and energy industry is determined, together with the forecast on its financial status (using the same modelling tools) which includes a study of the potential for investment programmes based on available funding, and a forecast of fuel and energy prices in individual countries.

Baseline assumptions regarding economic development are adjusted for improvement or deterioration (depending on the rate of growth and economic structure as conditioned by energy conservation, efficiency of energy production and export, investment, pricing and taxation policy in the energy sector, etc.). One or two refining iterations performed in this type of forecast help produce scenarios that describe the capacity of each republic to use its available energy for strengthening and expanding its economy and improving the living standards of the population. The iterative matching of development patterns for the economy and the energy sector would therefore help describe the formal effects of scenarios but also to verify their correctness and gradually improve them.

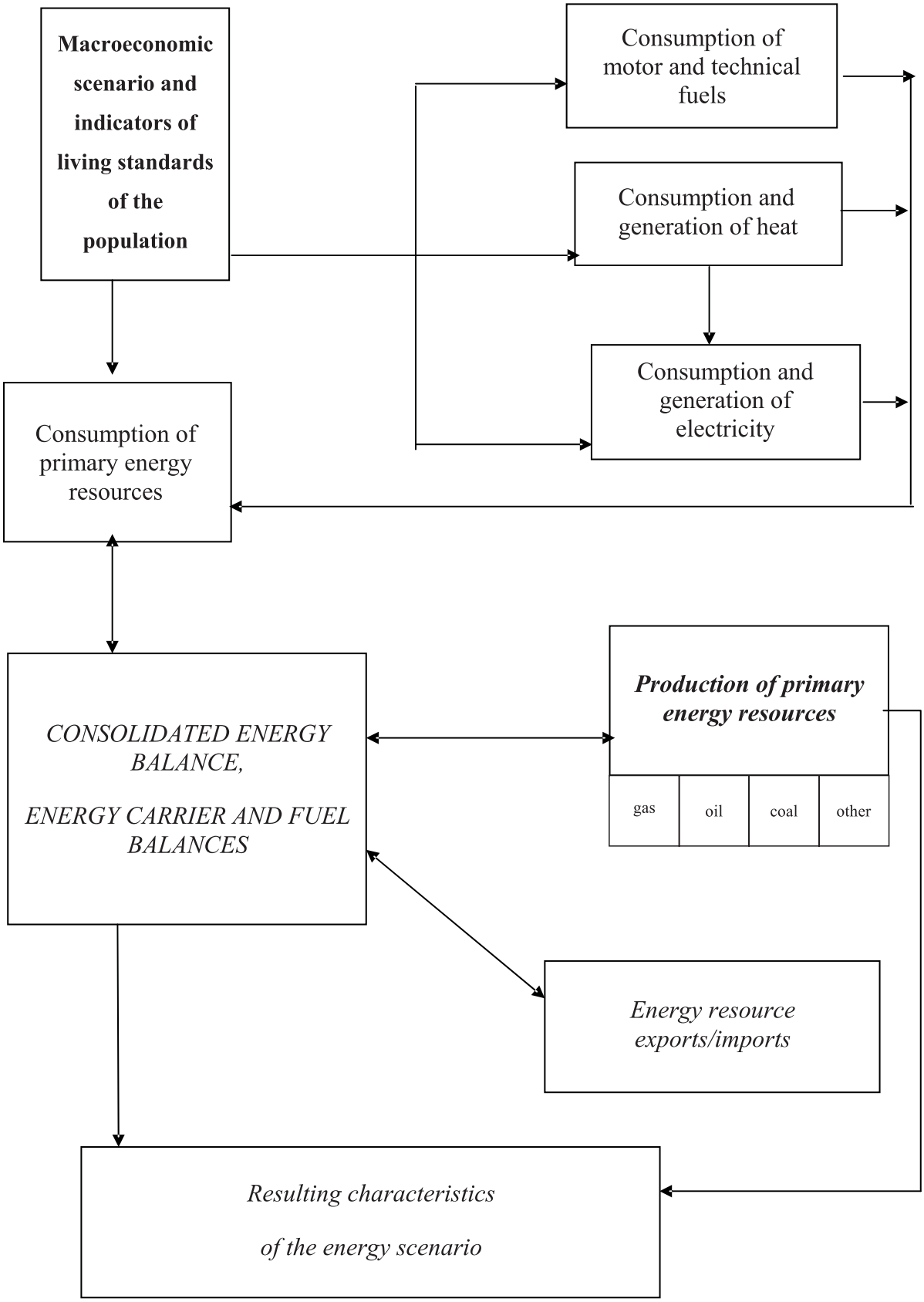
The above methodology is similar to the one applied in elaborating the Energy Strategy for the Russian Federation and the approach used in the forecasts of the European Commission.

5.2 Consolidated model of energy sector development in Central Asian countries (ECentral-Asia)

ECentral-Asia is a fully aggregated simulation system used in forecasting the energy sector development for Central Asia. It helps provide balanced scenarios for the principal parameters of the main components of the energy sector in each country - from economic development and related energy requirements to the potential for the production of basic fuels as well as requirements for the reproduction of the respective raw materials base, and environmental impact.

Modelling starts with fine-tuning the macroeconomic unit, by repeated matching of principal macroeconomic parameters. This helps identify the values of main economic development indicators and describe the living standards of the population, to be introduced in energy consumption forecasts for a specific scenario.

Figure 9. Outline of consolidated economy- energy model for Central Asian countries



The main feature of Ecentral-Asia is the consumption forecast unit that revolves around projected total demand for basic and primary energy. Calculations are based on indicators of economic development and living standards, and the aggregate specific consumption of energy that reflects its use throughout the intersectoral chain of production of specific goods and services.

The primary energy production component uses data on the status of, and growth in, proven fuel reserves, and the standard production dynamics for the entire period of developing a deposit, to verify production options for basic fuels in each year under review.

The energy mix component includes the consolidation and iterative matching of energy consumption and production forecasts for basic types of energy and individual fuels and for the entire volume of primary energy. Subsequent consolidation of energy balances and further adjustment of production and consumption forecasts help determine potential volumes of import and export (to the CIS and beyond it) for basic fuels and energy.

5.3 Elaboration of energy scenarios

Forecasting includes the formulation of fundamental ideas, a crucial component which, objectively, is hard to formalise. While being fully aware that different assumptions may be employed, the working group decided to focus on four scenarios:

1. Business as usual
2. Natural gas
3. Hydro-coal (two options)
4. Energy efficiency.

Table 27 presents combinations of baseline assumptions and their priority ranking in individual scenarios. Ranks describe the rate of change in the composite indicators and their mutual correlation in initial iterations. Subsequent adjustment of numerical values was based on data received from national experts and other participants.

Baseline assumptions used in each scenario are described below.

5.3.1 Business-as-usual scenario

This scenario assumes that current trends of world economic development and that of Central Asia will continue, with lack of stability in world energy prices and high investment risks for Central Asia. In economic terms, Central Asia and the entire Commonwealth of Independent countries (CIS) remains a loosely organized entity, economic conflicts between states continue unabated, while their allegiance to world power centres is unstable. The threats to the national

Table 27. Ranking of alternative baseline scenario assumptions (1 to 4)

Factors	Business as usual	Natural gas	Hydro-coal	Energy efficiency
GDP and living standards growth rates	Minimal (4)	Above average (2)	Average (3)	High (1)
Development of fuel and energy complex	Slow (4)	Fast (1)	Average (3)	Above average (2)
Level of energy prices	Low (4)	Above average (2)	Average (3)	High (1)
Energy efficiency growth rates (factor leading to lower energy intensity)	Low (4)	Above average (2)	Average (3)	High (1)
Rates of growth in power consumption per unit of labor; workplace facilities, etc. (factor leading to higher energy intensity)	Low (4)	Above average (2)	Average (3)	High (1)
Foreign investment	Low (4)	High (1)	Above average (2)	Average (3)
Level of regional cooperation in energy	Low (4)	Average (3)	High (1)	Above average (2)

and economic security of the countries in the region persist. The rates of their economic development reflect the trends that emerged over the last three years. The scenario also includes trends outlined in available national and sectoral economic development programmes. Since they do not contain any forecast on world oil prices, the scenario assumes US$ 18-20 a barrel, which is in line with moderate estimates by leading international organisations. Implementation of reforms in the power industry will be uneven, while domestic and international energy prices will not be aligned (as per net-back price calculations) until 2010.

5.3.2 Natural-gas scenario

The scenario assumes stable development of the world's and Central Asia's economy and is favourable for the resource-rich countries of the region. Anticipated increase in global demand for hydrocarbon raw materials would be accompanied by fairly high and stable prices of energy resources.

Central Asia's oil and gas producing countries would receive an influx of foreign investment seeking, first and foremost, to boost export projects in the fuel and energy sector. Due to favourable situation in foreign markets, Russia would emerge as an economically and politically stronger power and would prevail in its active efforts to promote further economic and political integration of the CIS, to stabilise political situation in the region and on its borders, especially in the south.

The scenario assumes high rates of economic growth. The risks related to long-term investment in the region would sharply diminish. Exports of hydrocarbon raw materials would therefore rise, with large volumes going through Russia, which will frequently act as a buyer of energy resources, in particular from Kazakhstan and Turkmenistan. Governments would actively pursue resource-saving programmes through more efficient use of energy and water, while seeking to protect the region's environment. Countries with a energy resource surplus would succeed in reducing their internal demand thereby releasing additional resources for export. Resource-deficient countries would, as a result, shed some of the financial burden resulting from energy imports and enhance their energy security.

The international price of a barrel of oil would stand at US$ 25-28.

5.3.3 Hydro-coal scenario

This scenario assumes low foreign demand for Central Asian oil and gas. Foreign investment in oil and gas industry is lower than in the previous scenario. Major industrial countries and Russia show little interest in the region. Meanwhile, Central Asian subregional economic space would vigorously take shape and regional energy resource markets would emerge. Economies of the region's would develop at a moderate rate and seek fuel and energy co-operation by streamlining their domestic markets for these resources and weakening their focus on export projects.

Programs promoting energy conservation and the use of local energy (coal and, sometimes, hydro-power) will be pursued at fairly high rates. The scenario assumes an oil price of US$ 15-18.

The survey revealed the need to evaluate the impact of Kyrgyzstan's and Tajikistan's water reservoirs on hydro-power generation structure, and the prospective energy balance structure of these two countries. At this stage of research electric power consumption levels in the region were assumed as the same for different options of this scenario. The option of maximum use of reservoirs for hydro-power generation was designated as well as the option of maximum irrigation and minimum power generation. The shortfall in electric power would be compensated by solid-fuel thermal power stations.

Due to a lack of data, it was not possible to establish a stable correlation between changes in electric power demand and fluctuations of the runoff.

5.3.4 Energy-efficiency scenario

This scenario assumes that the region's economies and the power industries give priority to the efficient use of primary energy. The scenario assumes that the overriding goal for the countries of the region would be to achieve in their GDP, by the end of the period under review, energy intensities of 0.45-0.55 tonnes of coal equivalent (tce) per US$ 1,000, which would be comparable or close to those of the industrialised nations. Are these targets achievable in Central Asian countries? The scenario assumes fast economic growth in the region accompanied by structural reform in the countries' GDP, including the growth of their service sector and an increase in the low energy intensive industrial production as well as a technological restructuring of industry, agriculture, transport and communal services (upgrading of technology to be completed by 2020). Growing competition in all economic sectors, including fuel and energy, would raise the efficiency of the power industry. Demand for energy-efficient technologies will grow because consumers would seek to reduce their spending on fuel, and improve management.

5.4 Main forecasting outcomes

Economic Development According to above scenarios, the years 2000-2020 will be marked by intensive economic growth in Central Asian countries. Their combined GDP will increase by an average of 2-3.2 times depending on the scenario in question. Living standards would steadily increase and by 2005-2010 will reach their pre-crisis levels. Depending on the economic successes of a country in domestic and foreign markets, living standards are expected to rise by a factor of 1.4-2.3. In Kazakhstan, Uzbekistan and Turkmenistan, successful export contacts would contribute to a rise in living standards by bringing in funds for domestic programs.

As frequently noted above, the extremely inefficient use of energy resources makes conservation a priority issue for this region. Active energy conservation efforts, including the development and implementation of national and regional programmes, along with establishment of appropriate financial and economic conditions and incentives could result in 25-30% savings of energy throughout the region by 2010 (Gas and Energy Scenarios).

By 2020 the energy intensity of the countries' GDP is expected to drop from its 2000 level of 1,17 tce /US$ 1,000 down to:

- 0.79 tce/US $1000 for Business-as-usual scenario;
- 0.66 tce/US $ 1000 for Natural Gas;
- 0.87-0.89 tce/US $ 1000 for Hydro-Coal;
- 0.45 tce/US $1000 for Energy Efficiency.

The expected decrease in the energy intensity of GDP, especially according to the Energy Efficiency scenario, would take slightly less time than that in other countries (e.g. those of the European Union in 1978-98) but it would be less dramatic than in Russia, at least according to the new version of the Russian Federation Energy Strategy for up to 2020, and considerably more modest than what is officially intended to achieve in other CIS states.

In 2000, primary energy consumption per capita in Central Asia stood at 2.69 tce/person per capita, i.e. lower than those of Russia and the European Union. Due to high population growth and sluggish development (Business-as-usual) this figure would reach by 2020 to an average of 2.76 tce per capita in the Energy Efficiency scenario or, in case of large-scale conservation efforts (Efficiency scenario), to 2.54 tce per capita. The other scenarios predict that regional power consumption will climb up to 3.0-3.5 tce per capita, i.e. to the level of the early 90s. These predictions tally with data recorded for several developed countries of Europe and Asia.

Energy consumption forecasts for Central Asia show that, depending on the development scenario, total primary energy demand would increase by 2020 by 30-82% from the year 2000, while electric power consumption would grow by 43-53%.

Domestic primary energy consumption would steadily grow. However, following the year 2000

energy intensity of GDP will steadily decrease across the region.

As noted earlier, the years 1990-2000 saw significant changes in sectoral consumption structure, with an increase in the communal and household sector and a corresponding decline for industry, agriculture and transport. Future consumption patterns will be broadly similar to the new sectoral balance, with a slight increase in industry, a recovery for transport back to its pre-crisis (1990) levels, and a slight decrease for households and communal sector.

The structure of domestic primary energy consumption would undergo major transformations with natural gas expected to play an increasingly important role in the energy mix. Its share might vary between scenarios but development prospects would in any case depend on the issue of optimum amounts of natural gas consumption. In any single scenario a search for alternatives to natural gas acquires a special importance.

While at present natural gas in the region accounts, on average, for 47.2% of total consumption, its share by 2020 may rise up to 53-56% due to its growth in Kazakhstan where it will inevitably and increasingly replace coal.

Demand for coal in the HC-min scenario (minimum use of hydro-power stations) will reach 96.5 million tonnes in 2020, its highest value in all scenarios. By comparison, the lowest value (Energy-efficiency scenario) would be 44 million tonnes. It is noteworthy that every scenario makes allowance for possible coal exports, particularly to Russia.

The problem with any attempts at changing the structure of primary energy consumption lies in the fact that their energy mixes are hugely dissimilar and consumption volumes are too different to allow comparison. Thus, Kazakhstan and Uzbekistan, between them, currently account for 88% of total primary energy consumption and 72% of electric power consumption in the region, with Kazakhstan alone, in 2000, accounting for 93% of coal consumption in the region, etc. Obviously, consumption structures in individual countries will change to varying degrees.

However, main regional trends in the consumption structure of primary fuel and energy resources can be summed up as follows:

- The region has ample energy resources to secure stable power supply for domestic needs and considerable oil, gas and coal exports for the entire projection period;
- Growth rates in the regional market for natural gas would depend on preferred policies of fuel supply to power stations and further extension of networks supplying gas to industry and households;
- Development of oil and gas industry in some Central Asian countries, increasing number of private cars and growing viability of agriculture will further boost demand for oil and oil products;
- Coal consumption will largely depend on the choice of fuel policy with regard to power stations in Kazakhstan.

Demand for electric power is expected to grow faster than in some other CIS countries, including Russia. Hence, the acute need to rebuild and expand power generating capacity and create conditions for the parallel operation of power grids in Central Asia and its neighbours.

Hydro-power makes an important contribution (over 30%) to the power production in the region. Kyrgyzstan and Tajikistan, where hydro-power stations in some cases contribute over 90% of all electric power, in the long run are to become major suppliers of hydro-power.

Optimum use of the hydro-power potential would, therefore, require:

- finding an overall solution to the issue of power supply for all countries of the region, including exports to Russia, China and other neighbouring states;
- a more efficient use of energy resources in conjunction with a faster economic development of the Central Asian countries;
- finding overall solutions to the use of hydropower potential both in the power industry and for irrigation

and water supply purposes. A more detailed study is quite in order to account for direct and indirect financial, labour and resource development costs, including energy resource inputs.

6. Cooperation between Central Asia countries in promoting the rational and efficient use of energy resources in the region

Cooperation between Central Asia countries in promoting the rational and efficient use of energy resources in the region would include:

- maintaining the practice of annual governmental agreements which play an important part in coordinating the volumes of hydro-power generation, mutual energy supplies and operation of reservoirs in the Syr Darya basin;
- fulfilment of annual governmental agreements on the volumes of energy resource supply;
- drawing up and signing of long-term governmental agreements on the use of water and energy resources in the Naryn and Syr Darya reservoir network, which would establish economic mechanisms to govern relations between countries regardless of the hydrometeorological situation in the above basin;
- synchronised operation of regional power grids as a main pre-requisite for successful implementation of agreed water and power regulation procedures, and the sound use of water resources in the Syr Darya basin;
- joint efforts in further optimisation of the use of water and energy resources of the Aral Sea basin, including for irrigation purposes;
- regulation of flow in the Syr Darya basin on a long-term basis; Development and implementation of mathematical optimisation models;
- development of a legal framework for co-operation between Central Asian countries in the joint fulfilment of optimum water and energy use arrangements and energy trade, including the creation of a single customs area, providing for safe transport and transit of energy throughout the region, co-ordination of policies in outside markets and in matters relating to energy conservation;
- establishment of a joint data base and facilities for expeditious exchange of data between water and energy authorities;
- restructuring and optimising water and energy management at national and regional levels;
- defining the range and scale of frequency regulation services for national power grids and adjusting the market price of such services;
- introduction of market-based terms and arrangements in relations between Central Asian countries with regard to the power industry, notably in cases where one country operates a facility in another country. This would apply, in particular, to the lease by Uzbekistan of facilities (power grid lines) located in the Leninabad Region of Tajikistan;
- introducing interstate compensatory payment arrangements based on market prices for water and fuel and energy resources.

Conclusions and recommendations

1. The economic and energy ties that evolved between Central Asian countries over a period of decades, the comparable basic levels of their economic development, the complex web of their import and export transactions with both primary and other energy, their mutual interest in achieving optimum water use, and the interdependence between this problem and that of energy supply all call for a sound and effective approach to the use of fuel and energy and water resources based on reinforced regional integration.

2. In recent years Central Asian countries have witnessed a transition from centralized economic planning to an economy based on market principles. Market reforms aimed at enhancing economic effectiveness have found their way into the FEC of the region. Market transition led to a fall in industrial output, a drop in the living

standards of the people, shortage of investment, etc. In this situation the FEC can and should become a driving force helping the countries to overcome the consequences of the economic crisis and secure their long-term sustainable economic development.

3. Central Asia has a vast and varied resource basis for the FEC, which, however, is unevenly distributed throughout the region. The bulk of water and hydropower resources are concentrated in Kyrgyzstan and Tajikistan, while fossil fuel resources are mostly located in Kazakhstan, Turkmenistan and Uzbekistan.

4. The fuel and energy industries of Central Asian countries are experiencing serious technological and economic difficulties. The wear and tear of machinery is extremely high. Ineffective pricing and tariffs policies with regard to energy, a drop in solvent demand and massive failure to pay for energy supply by domestic and foreign consumers all are undermining the capacity to invest in the maintenance and development of fuel, generation and transport facilities that form the basis of the power industry. Solutions to the economic problems of fuel and power industries directly depend on enhancing the economic stability and creating a favourable climate for investment in the region.

5. The region as a whole has ample energy resources to ensure stable power supply to the domestic market and significant volumes of oil, natural gas and coal (and to a certain extent, electric power) for export over the entire projection period.

6. Development forecasts for the FEC carried out by national experts from Central Asian countries envisage a considerable rise in domestic energy demand and increasing exports of these over the next two decades.

7. The main strategic task for Central Asian countries is to attract large-scale investment into different branches of the FEC for prospecting and development of new fuel resources, modernisation and construction of new power plants, construction of new pipelines and electricity transmission lines and maintenance of existing ones, as well as implementation of energy conservation projects.

8. The varying degree of availability of primary fuel and energy and water resources and their uneven distribution across Central Asia make it imperative that the countries of the region cooperate in improving their trade in, and exchange of, such resources within the region. Some countries are able to fully meet their demand for scarce resources through imports from inside the region, with some insignificant imports from Russia. Most of the regional trade in water resources and energy is in the form of exchange where water resources for irrigation + hydro-power from Kyrgyzstan and Tajikistan are bartered for fuel and power from other republics.

9. The main obstacle to further increase in exports of fuel and energy from the region is the insufficient carrying capacity and inadequate diversification of supply channels for oil, gas and electric power. At present, energy exports from Central Asia are mostly go through Russia. However, some net exporting countries, with support from foreign investors, are currently looking for and building new energy transport lines. Iran, China, Pakistan, Turkey and other countries have been identified by Central Asian exporters as promising and potentially lucrative markets.

10. The regionalization of Central Asia's energy markets has a bright future. However, it would be unwise and wasteful to restrict trade in energy resources to Central Asia already because its power production potential and vast resources exceed the requirements of its economy and population.

11. In the past few years, all Central Asian countries have felt the need to enhance energy security. For those of them who are largely dependent on energy imports the main concern was to ensure uninterrupted supply at acceptable prices, whereas countries with a surplus of energy have been constrained by the limited capacity of fuel and power transport channels. Other potential security threats include:

- lack of investment in the FEC explained by inefficient pricing and taxation policies, declining purchasing power of domestic consumers and importers, large-scale failure to pay for fuel and energy supplies and other factors;
- high wear and tear of principal equipment in the fuel and energy complex;
- sharply reduced prospecting for new fuel resources with concomitant depletion of the raw material base for the industry;
- lack of fuel and energy supply links between producing (mining) and consuming centres, e.g. in Kazakhstan, which creates the need for energy imports from neighbouring countries.

12. Energy intensity of Central Asian economies is unacceptably high, exceeding several times that of leading industrial nations. Fuel and energy losses in all branches of economy are significant. However, Central Asian countries have substantial and economically viable potential for energy savings, which can be tapped through economic means and represents 25-30% of total energy consumption in the region.

13. For Central Asian countries energy conservation is a major factor in:

- raising their self-sufficiency and export potential;
- reducing their outlays for energy imports, for building new mining and generating capacity and respective infrastructure, and for environmental protection;
- fostering competitiveness of their industrial and agricultural output, services and the whole economy.

14. To ensure high efficiency of fuel and energy use, which is seen by Central Asian leaders as an imperative, it would be necessary to remove several obstacles, including:

- lack of investment;
- inadequate legal framework for energy conservation;
- lack of domestic energy-saving technology and equipment;
- inadequate information of energy producers and consumers.

15. Central Asia possesses enormous potential for energy savings, which, if tapped, would greatly contribute to economic recovery and release significant investment resources for further development of mining and generating capacity, pipelines and networks that form the basis of the FEC, as well as to the easing of regional and global environmental pressures.

16. Lack of investment makes it imperative to devise an accurate and purposeful conservation strategy, and evaluate the capacity for energy savings as well as the costs and potential benefits relating to conservation. Such a strategy should proceed from a study of specific energy consumption in a maximum range of disaggregated areas (industrial processes, types of agricultural produce, passenger and freight transport, heat and electric power consumption per unit of apartment and office area, etc.).

17. This is the only way to measure the gap between technology and equipment currently used in Central Asia and its power-efficient equivalents of foreign make and assess the economically viable potential for energy conservation and ways of tapping it.

18. The problem of sound and efficient use of fuel and energy as researched in this study lies not only in the formulation and execution of conservation policies, but rather in securing an optimum structure of water and energy use. The share of hydropowere in the region's fuel and energy mix is not significant and by 2020 will not exceed 4-5%. However, electricity production by hydro-electric stations is the most important development factor for Kyrgyzstan and Tajikistan. These countries have a surplus of hydro-power, while their neighbours are suffering from shortage of water for irrigation, industrial, communal and household purposes. The lack of fossil fuel resources in Kyrgyzstan and Tajikistan and the difficulty of importing them

are increasing pressures on their water reservoirs, which are used to generate electricity. Hence the conflicts that acquire dangerous intensity in the basins of Naryn, Syr Darya River and other rivers both in summer and winter. The most acceptable way out of this situation would be to fully restore the former Central Asian Unified Power Grid with its extensive network of super-high-voltage transmission lines, including those in Kazakhstan. Of particular importance is the development of hydro-power industry which should be seen not only in the context of water resource use but also in terms of difficulties facing the emerging regional market for natural gas.

19. The rate at which this market develops would depend on the choice of fuel to be supplied to power stations and on further extension of networks supplying natural gas to industries and households.

20. The development of oil and gas industry in some Central Asian countries, as well as increasing number of private cars, and the rising agricultural demand for motor fuel all lead to a situation in which growth in demand for oil and oil products would outstrip demand for other energy.

21. Coal consumption will entirely depend on the choice of fuel to be supplied to power stations in Kazakhstan.

22. Fuel and energy resources, as well as power companies of the region may create significant interest among foreign investors. Despite the current unfavourable climate in the economy of the region and its individual countries, foreign fuel and power companies, as well as financial institutions, have been carrying out or, together with their Central Asian partners, are intending to carry out quite a few strategically critical investment projects in the power industry. Foreign investment in the Central Asian power industry can only be welcomed. Obviously, as economic stabilisation continues and investment laws get better, foreign investment will significantly increase. However, to remain independent in terms of energy supply, Central Asian countries should, like other countries, and regulate foreign ownership in their FECs.

23. Integration of Central Asian countries in the sphere of energy and regionalization of their energy markets will enhance intra-regional energy security and efficiency of fuel and power exports.

24. The current use of barter in mutual fuel, water and power supplies between Central Asian countries is not compatible with market principles and often results in breaches of agreements. It would therefore be appropriate to develop methods facilitating mutual payments based on market prices for water and fuel and energy resources or, more precisely, for services in supplying them.

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