CHAPTER VI
PROSPECTS OF IMPLEMENTING IWRM IN THE REGION

6.1. Developing the National Water Policy

(V.I. Sokolov, V.A. Dukhovny)

The World Summit on Sustainable Development (WSSD) held in Johannesburg in 2002 called upon all countries to adopt integrated water resources management and water efficiency strategies by the end of 2005 particularly, in support of developing countries. Although the concept of integrated water resources management was repeatedly discussed at many international conferences in 1990s and in the beginning of the 2000s, the crucial step towards IWRM was made at the abovementioned World Summit, where the special directive was adopted with the following provisions [31]:

«Develop IWRM and water efficiency plans by 2005, in support of developing countries, through actions at all levels to:

a) Develop and implement national/regional strategies, plans and programs with regard to integrated river basin, watershed and groundwater management and introduce measures to improve the efficiency of water infrastructure to reduce losses and increase recycling of water;

b) Employ a full range of policy instruments, including regulation, monitoring, voluntary measures, market and information-based tools, land-use management and cost recovery of water services, without cost recovery objectives becoming a barrier to access to safe water by poor people, and adopt an integrated water basin approach;

c) Improve the efficient use of water resources and promote their allocation among competing uses in a way that gives priority to the satisfaction of basic human needs and balances the requirement of preserving of ecosystems and their functioning;

d) Develop programs for mitigating the effects of extreme water-related events;

e) Support the diffusion of technology and capacity-building for non-conventional water resources and conservation technologies, to developing countries and regions facing water scarcity conditions or subject to drought and desertification;

f) Support, where appropriate, efforts and programs for energy-efficient, sustainable and cost-effective desalinization of seawater, water recycling and water harvesting from coastal fogs in developing countries through such measures as technological, technical and financial assistance and other modalities;

g) Facilitate the establishment of public-private partnerships and other forms of partnership that give priority to the needs of the poor, within stable and transparent national regulatory frameworks provided by Governments, while respecting local conditions, involving all concerned stakeholders, and monitoring the performance and improving accountability of public institutions and private companies.

The WSSD Directive gives five clear indications [31]:

1. Countries have to transform IWRM principles into the action plan;
2. Countries have to complete the IWRM action plans by the end of 2005;
3. All countries should prepare the action plans; whether they are rich or poor, and whether they have excessive available water resources or water deficit;
4. Support to developing countries in preparing the action plans should be provided;
5. A content of these plans should be comprehensive, covering institutional, financial and technological aspects.

What the WSSD Directive actually means? This is only the preparation of the national action plan or the first step on the long way of institutional reforms, or everything taken together? What is a practical value of preparing the IWRM plan? How this plan will correlate with everyday activities aimed at promotion of national economic and social development?

In order to answer all these questions, each country in our region has to develop its own concept of preparing the national IWRM plan, as a minimum.

Organizing the process of national IWRM planning

The national plan of implementing IWRM should include, as minimum, the following key components:

a) analysis of the destabilizing factors and their influence on social and economic situation;
b) general status of IWRM within the country and its specific aspects in some areas;
c) IWRM action plans both at the national and basin level; and
d) mechanisms of introducing IWRM

A diagram of IWRM planning process for the river basin is given in Figure 6.1 below, representing the logical sequence of necessary phases and measures, as well as public participation stages. In addition, the sequence of implementing the key IWRM principles is demonstrated in the right part of this diagram. IWRM introduction plans have to be aimed at the followings:

- establishing the certain institutional framework at the national and basin level, and co-ordination of all water resources management organizations over horizontal cross-sectoral links and over vertical links between hierarchical levels of water resources management;
- joint management of all available water resources (surface, ground and return water);
- integrating water and land resources, irrigation and drainage systems and correspondingly water and drainage management organizations, and the latter with water users and land owners;
- accounting and satisfying the water demand in social and economic spheres;
- specifying ecologically permissible water diversion from rivers;
- measures for water conservation;

- establishing databases and the information network in the basin organizations, covering not only information on water resources but also on all factors affecting water resources management and use, as well as economic, social, and environmental impacts on water users and nature; and
- prioritizing the social mobilization of water users and water management organizations and involving them in IWRM activities as driving force of IWRM introduction

In addition, the base of national IWRM plan should consists of three components:

- plan of technical improvements in water use and water demand management;
- plan and the institutional framework for training all water stakeholders; and
- plan of establishing pilot projects in all specific areas

6.2. The IWRM Introduction Process and a Role of Strategic Planning

Putting IWRM into practice is the quite complicated process, which, first, should involve scientists, water practitioners, policy-makers and their planning agencies that are preparing the important decisions, and water users, taking into consideration the complicated system of their relations and links. When and how to start the IWRM planning depends on the following key prerequisites:

- the appropriate level of public awareness concerning the need of radical changes to the existing approaches of water supply to the population and nature;
- specialists of water management organizations and conservancies, as well as scientists working in such areas as economy, ecology and social development should be familiar with the IWRM experiences all around the world particularly, in countries with similar conditions and recognize the need of introducing IWRM in their own country as the path of solving painful problems. They have got the opportunity to disseminate this experience in their own country and to raise the public awareness concerning the advantageous effects of the IWRM introduction; and
- government agencies and policy-makers in various public authorities (parliaments, ministries, and provincial administrations) should be ready to establish the "governance" system that was described in Chapter 2, which will be aimed at developing the national IWRM framework

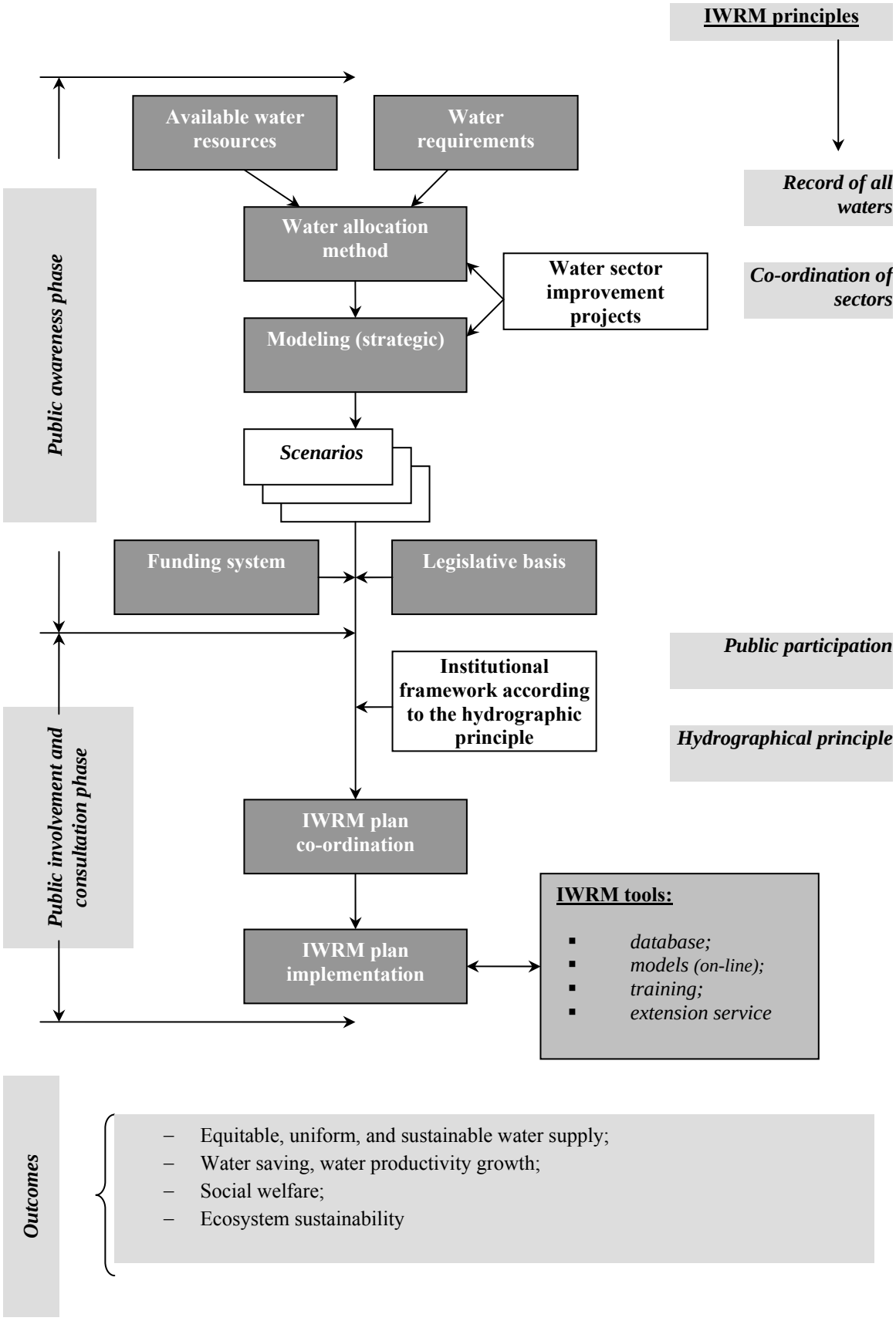


Figure 6.1 Phases of National Planning and Implementing IWRM

The IWRM introduction process goes through the following phases:

- initiating the process and creating the enabling environment for the introduction of IWRM;
- strategic planning;
- planning the work processes;
- pilot projects; and
- dissemination of the experience gained over river basins and countries in the region.

At each phase the following activities are implemented:

- analysis and elaboration of recommendations;
- social mobilization and involvement of appropriate stakeholders and decision-makers for each phase; and
- training of decision-makers, executors and stakeholders that would have a specific role in each phase

These activities are in permanent interaction, supplementing and enriching each other, facilitate a feedback and improvements, and therefore one cannot consider each of them to contribute separately to complete the IWRM introduction process or even to initiate its progress. These activities require driving forces, and, in turn, driving forces can be effective only if there are "brains" and "conductors" of these activities. The process of introducing IWRM can be initiated with establishment of the governance framework and distributing the roles among actors:

- who will play the role of an ideologue, generator of ideas and "leader looking ahead" in this process;
- who is the manager, with required powers and resources;
- who knows how to form public opinion and initiate social mobilization;
- who knows how to finance these interrelated measures;
- who knows how to facilitate the introduction process; and
- who supervises the effectiveness of activities

In its fundamental publications [31, 36, 40, and 56], the Global Water Partnership (GWP), one of major promoter of IWRM introduction, considers that international donors and agencies that act on the basis of WSSD resolutions (2002) or national governments can be "driving forces" of the IWRM planning process. At the same time, the GWP suggests a clear-cut distribution of roles and responsibilities (Table 6.1). When the role of "owner of the process" belongs to the national government that can, *sui juris*, establish the special Steering Committee or working group for governing this process. The GWP network assigns a leading role in this process to its partners and regional coordinators, who should provide the public platform for dialogue and information exchange, and support the processes of developing IWRM plans and strategies based on consultation processes, capacity building, knowledge dissemination and training.

Another an absolutely different approach was recommended in some EU projects. According to them the concept of multi-stakeholders dialogue, which for example, is developed within the frame of EMPOWERS Partnership [56]. Although their approach, so-called SDCA, contains many correct and useful provisions,

the key idea (the primary nature of the dialogue, prior to target actions) is wrong in essence. "Innovation can be seen as the outcome of a mutual learning and social change process taking place among a large number of autonomies, actors of mutual interdependence, challenging them to create conditions through, which innovation can take place." Further, the process boils down to formation of spontaneous understanding among all stakeholders concerning the need of autonomic selection and establishment of common platforms for transition towards IWRM. Although, authors understand very well the complexity of establishing such a platforms in the water sector, they hope that differences and representation of different interests and actual situations can provide the constructive base for innovations and introduction of IWRM. One can agree with some provisions of this concept such as establishment of "horizontal" cross-sectoral coordination and "vertical" coordination of all hierarchical levels, and organizing dialogues between them, employing such instrument of analysis as the Rapid Appraisal of Agricultural Knowledge Systems (RAAKS) developed in the Wageningen University (The Netherlands). However, as a whole, spontaneous mechanisms for IWRM introduction based only on induced awareness, may be a possibility only in well developed countries.

Table 6.1 Breakdown of Roles and Responsibilities for Introducing IWRM [57]

National government	• **Lead role, "owner" of the process** • **Mobilize funding** • **Sets macro-economic policy environment**
Steering committee (group with wide representation)	• **Guide the process** • **Mobilize support across sectors and interest groups** • **Guarantee quality output** • **monitor implementation progress**
Management team (group of qualified professionals)	• **Manage day-to-day processes for strategy development, implementation and capacity building**
Facilitating institutions, where appropriate (for example, national NGOs, GWP Country or Regional Partnerships or local UN country teams)	• **Provide neutral platform for dialogue** • **Support strategy development process by providing advice and sharing knowledge** • **Foster capacity building and training**

The GWP approach is closer to the ground realities in our countries than the EU approach. However, the assigning of a role of "leading owner of the process" to the national government is sooner a particular case than general, because national government agencies are too busy in their day-to-day business and they are unable to execute this leading role, unless a special unit responsible for the IWRM introduction process will be established within their frameworks.

The leading positions in initiating and developing IWRM should belong to ideologues and mediators of this ideology, who can use all necessary tools: analysis, social mobilization, information exchange and training that are combined with the multilateral dialogues. IWRM itself predetermines the need in establishing conceptual, coordination and executive center. The "introduction" is the process of overcoming certain tendencies and inertia of existing status-quo, which as "*swamp*" resists and hampers current reforms and will impede further innovations.

Governing the introduction process is one of preconditions for achieving the success; and it is very important to select a right leader who can combine functions of an ideologue and initiator of this process. A candidate for this role should meet the following requirements:

- excellent knowledge of the IWRM principles, mechanisms and areas of activities;
- possess information on the situation in target areas;
- possess creative and scientific abilities in order to formulate ideas and to plan the ways for their realization;
- possess the practical skills of planning and distribution of assignments per components among executors, who can combined them to a single team; and
- sufficiently sociable and democratic in order to consolidate the team; and, at the same time, be able to create the enabling environment for implementing each of planned tasks

In short, this person should possess combined abilities of a scientist who can suggest ideas, analyze and generalize information and a good manager who can define the goals beneficial for society and put them in practice. Such a principle was practically applied many times, for example, while implementing the very complicated and multidisciplinary programs such as 'space program' (S.P. Korolev) or establishing and developing the Microsoft Corporation (Bill Gates & Paul Allen). A triumvirate consisting of three like-minded persons: an ideologue-scientist, a decision-maker, having powers and governmental support and a manager, directly responsible for governing the introduction process is another option that should be grounded on the scientific idea and its development. In both cases, based on the suggested idea, the process must be implemented according to a plan that has to include four types of support: a political support through a decision-maker, who represents the authorities; information support through a specially established group or NGO; social support through the mobilization and involvement of stakeholders; and finally financial support that is very important for funding the introduction process (Figure 6.2: a and b).

It is very important to organize result-oriented research and pilot projects for improving and adapting IWRM principles to specific conditions with follow-up, and putting them into practice according to the following sequence: "research project – planning of introduction – pilot projects – final large-scale introduction." Implementing this process in the frame of an exclusively scientific program, initially means the orientation on its low efficiency. The content and formulations of the scientific concept is often built according to laws that are incomprehensible for a practitioner, because any novelty, like an end in itself, captivates a researcher, like a treasure hunter or a gold prospector, by the process of searching in itself. An opportunity to receive results, which nobody reached before and the process of gaining new knowledge allure a scientist, forcing him to forget how and where his discovery can be practically used. Such scientific passion is good for academic investigations, but it is absolutely unacceptable for studies aimed at wide introduction and practical use of their results.

The IWRM introduction process requires strict and purpose-oriented planning and its implementation taking into consideration the national and regional priorities, current trends and legislation, and provides for the phased progress and appropriate measures to cover gaps between phases.

How the projects that listed in "the EU Water Initiative" look in this respect? [46]. How do they reflect this complicated process (if to judge from their abstracts)? We made attempt to systematize their outcomes. Out of 87 projects listed and having abstracts: i) manuals, policy briefs, legal recommendations are envisaged in 12 projects; ii) policy guidelines in 44 projects; iii) information websites in 35 projects; iv) seminars and disseminating recommendations in 18 projects; v) stakeholders involvement in 18 projects; vi) pilot activities in 28 projects; and vii) practical recommendations and putting them into practice only in 19 projects.

In most cases, projects' outcomes are not aimed at real practical use, but only at preparing manuals, websites, policy briefs, information networks, databases, conducting seminars and rarely at implementing pilot projects for testing recommended technologies and approaches, and transferring them for follow-up introduction (less than 30%). This means that primarily the projects under the umbrella of the EU Water Initiative didn't envisage the introduction of their outcomes.

The introduction processes in any area of activities provides a set of new ideas, technologies and tools. After testing and adaptation of them before transfering these ideas into a critical mass of rational reforms, they should replace the routine technologies. Therefore, *putting scientific ideas into practice requires an*

integrated approach and introducing IWRM to a wider audience too, because it encompasses social, economic, and environmental reforms based on technical and technological innovations.

For this purpose, it is necessary to provide an *integrated planning of innovations, as well as* it's integrated implementation through pre-envisaged transfer from one target-oriented project to another with continued financial support.

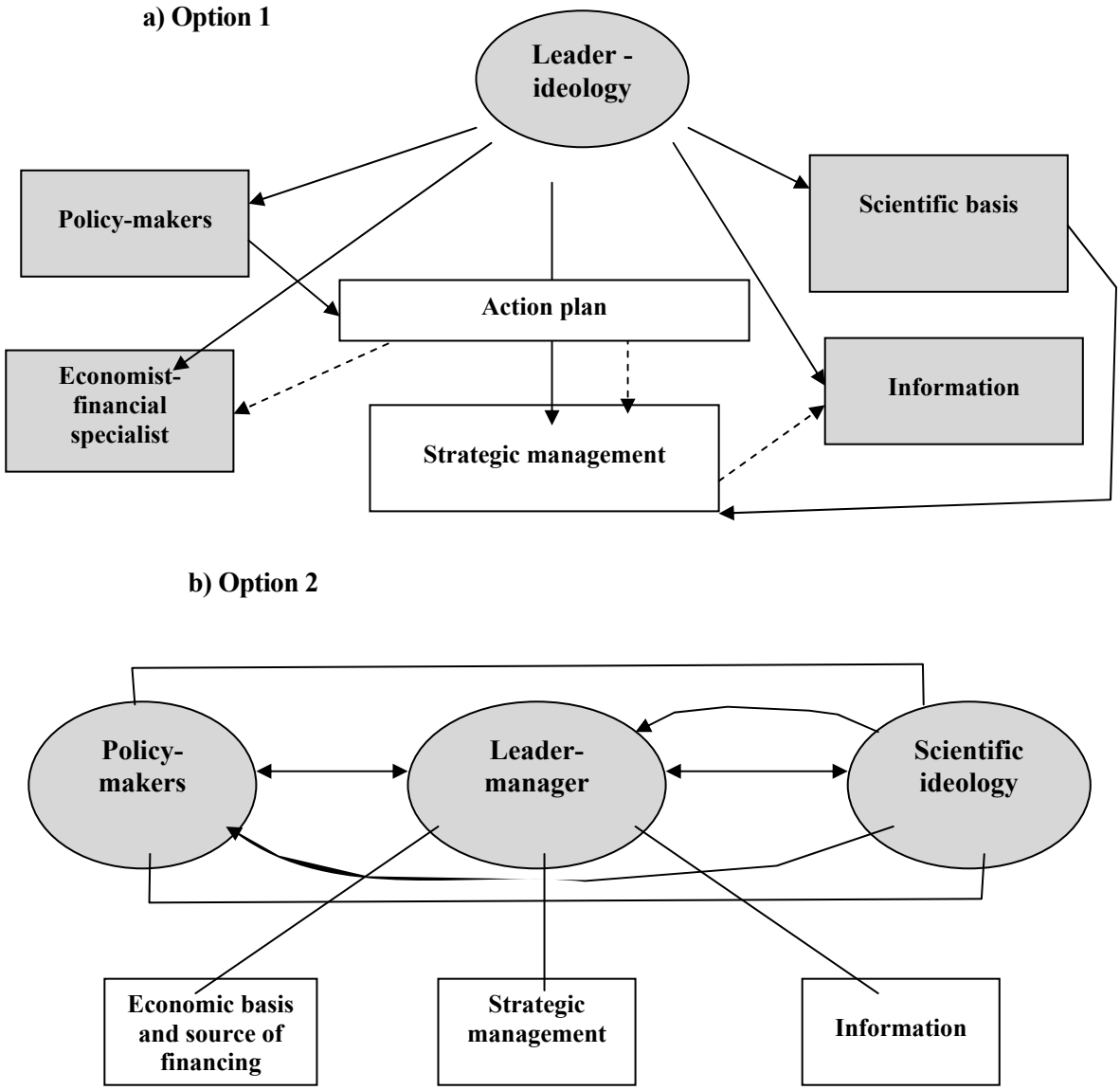


Figure 6.2 Options for Governing IWRM Introduction Process

Focus on target, efficient and practical use of scientific results is the first precondition for successful implementation of follow-up activities, related to introduction and disseminating the results achieved and gained experiences. A "generator" of scientific ideas, who formulates the program and plans the expected output, should clearly envisage what he would like to obtain already at this phase. He should clearly present what obstacles should be overcome in the process of research and follow-up pilot operation cycles (this should be substantiated by the executors), and he has to focus on the scientists and/or their partners, on their outputs that they need to produce.

To reach the final purpose, it is important to specify the phases of introduction process and necessary instruments. The following five phases are proposed as constituents of the process:

- start-up stage for the initiation of the process;
- strategic planning;
- development of work plans;
- pilot projects; and
- experience dissemination and extension of IWRM coverage

The following set of instruments will be used for activities at the last four phases:

- analysis and development of key approaches;
- social mobilization;
- mechanisms and practical tools; and
- training.

Taking into consideration that each country coordinates its water management tasks and requirements with political targets and plans of social and economic development, it is important to specify necessary set of instruments for each phase, the sequence of their application and their links as shown in Figure 6.3. Continued inflow of new analytical and practical solutions and information and interchange of them between instruments (mechanisms) of the introduction process takes place. At the same time, all fundamental approaches and mechanisms, over both vertical and horizontal links, must be clearly specified at the beginning of initiation of any IWRM introduction process, in order to establish the specific systems of activities, links and public participation, which shall be approved by the government with resolutions at the beginning and at follow-up phases.

At the same time, all approaches and mechanisms should pass through "the filter of public opinion" involving policy-makers and other stakeholders. The awareness of these approaches and mutual understanding of various stakeholders' groups have to be reached through the process of training and dialogue.

the composition of stakeholders (SH) needs to be differentiated, according to the specific phase. At the "*initiation*" phase, according to Figure 6.2 "a" and "b", the framework of governance and main leaders, needs to be specified forming the "core" who holds the same views and partners-promoters. At the "*strategic planning*" phase, it is important to have the personal interest and support of decision-makers in the government and provincial (or basin) organizations, on which supposedly initiation of this process depends. At the same time, the most advanced and active representatives of stakeholders from the grassroots organizations, who can be a mouthpiece of water users and water consumers, as well as representatives from other target groups and the appropriate water authorities, should be involved.

At the "work plans development" phase, when the plans of IWRM introduction process is being drawn up, it is necessary to involve specialists and water users who stand close to practical tasks and their implementation and to turn them into owners and enthusiasts of this process rather than executors of somebody else's ideas (in the follow-up activities they should act in the same manner regarding the participants of pilot projects and further IWRM introduction).

Let us review separately the each phase shown in Figure 6.3.

Initiation of the process is the most important phase, where the foundation is established for all successes in the future. Based on scientific analysis, it is necessary to raise the awareness of "pregnancy" (preparedness) of the water sector and all other water users for the transition towards IWRM. This analysis has to be based on evidences of the "revolutionary" situation when, -rephrasing Karl Marx, water users "do not want to live

as before" and top water managers "cannot govern in a new way." For our region, occurrence of this situation was revealed from a number of studies: the WARMAP-TACIS (1997 to 2000) [13]; INCO-Copernicus (2000) [4]; etc. These projects have shown that with reforms or restructuring of the agricultural and other economic sectors, the large state water users and water sector as a whole cannot meet the needs of private and cooperative water users. There exist a huge potential for improving water resources management.

Through other projects ("Principal Provisions of the Water Management Strategy in the Aral Sea Basin" GEF, 1997 [9]; "Strategic Planning and Sustainable Water Resources Management in Central Asia", UNESCAP, 1999 to 2000, [8]) and during study tours abroad, the Ministers of water resources from Central Asian countries, firsthand acquainted with the world experience of putting IWRM into practice. This activities allowed a deeper understanding of the need for transition towards IWRM in the region. Collaboration with the Swiss Agency for Development and Cooperation (SDC) and International Water Management Institute (IWMI) allowed finding the financial resources for the development of the first solutions and implementing pilot projects in three countries. This has resulted in the selection of "key executors", and the coordination of these solutions with three Ministries of Water Resources and was crowned with the decision of the ICWC to establish a regional working group and the Steering Committee. Deputy Ministers of national ministries of water resources were assigned as key executors. The group of initiators has developed the road map and, together with Canadian and Israeli specialists, organized the training seminar for key executors to raise their awareness on IWRM based on the international experience.

Using the international experience and own analysis of pilot projects are important for raising awareness concerning the need, appropriateness, and profitability of putting IWRM into practice. Bombarding with information, it is necessary to convince the higher echelons of stakeholders on the appropriateness to refuse former practices, since, otherwise it can be dangerous not only for the society, but also for the subjects under "pressure for innovation." One of the ministers said: "A government official can refuse from the routine style of management and attempt to convince the government to start reforms only if, he understands, of course through the pressure of information, that unless he does make it happen, he might lose his position and all perspectives."

National IWRM plans for Kyrgyzstan, Tajikistan, and Uzbekistan were developed through the project initiated by the GWP CACENA and UCC-Water (2005 and 2006) and was conducted according to well-tested steps of the "road map" [15]:

- preparing the fundamental ideas based on findings of earlier developed projects (EU INCO-COPERNICUS Program project, Grant INCO-ICA-2-2000-1039 [4], the ICWC and ESCAP: Strategic Planning and Sustainable Water Resources Management in Central Asia [8]) and generalization of the world experience;
- presenting basic IWRM indicators to decision-makers at the governmental level and to leaders of stakeholders to raise their awareness of IWRM through the training seminars and round tables;
- discussion of the future projects with end users and decision-makers and incorporating their inputs into the project activities in the form of conceptual, technical, and financial assistance; discussion of expected results and project resources;
- selection and appointment of project executors and members of the Steering Committee; and agreement on communication and feedback with them;
- selection of pilot projects;

***Strategic planning* should include the following key activities:**

- analysis of the current situation and destabilizing factors;
- assessment of the preparedness to introduce IWRM in the planned zone, basin or region based on the following indicators:

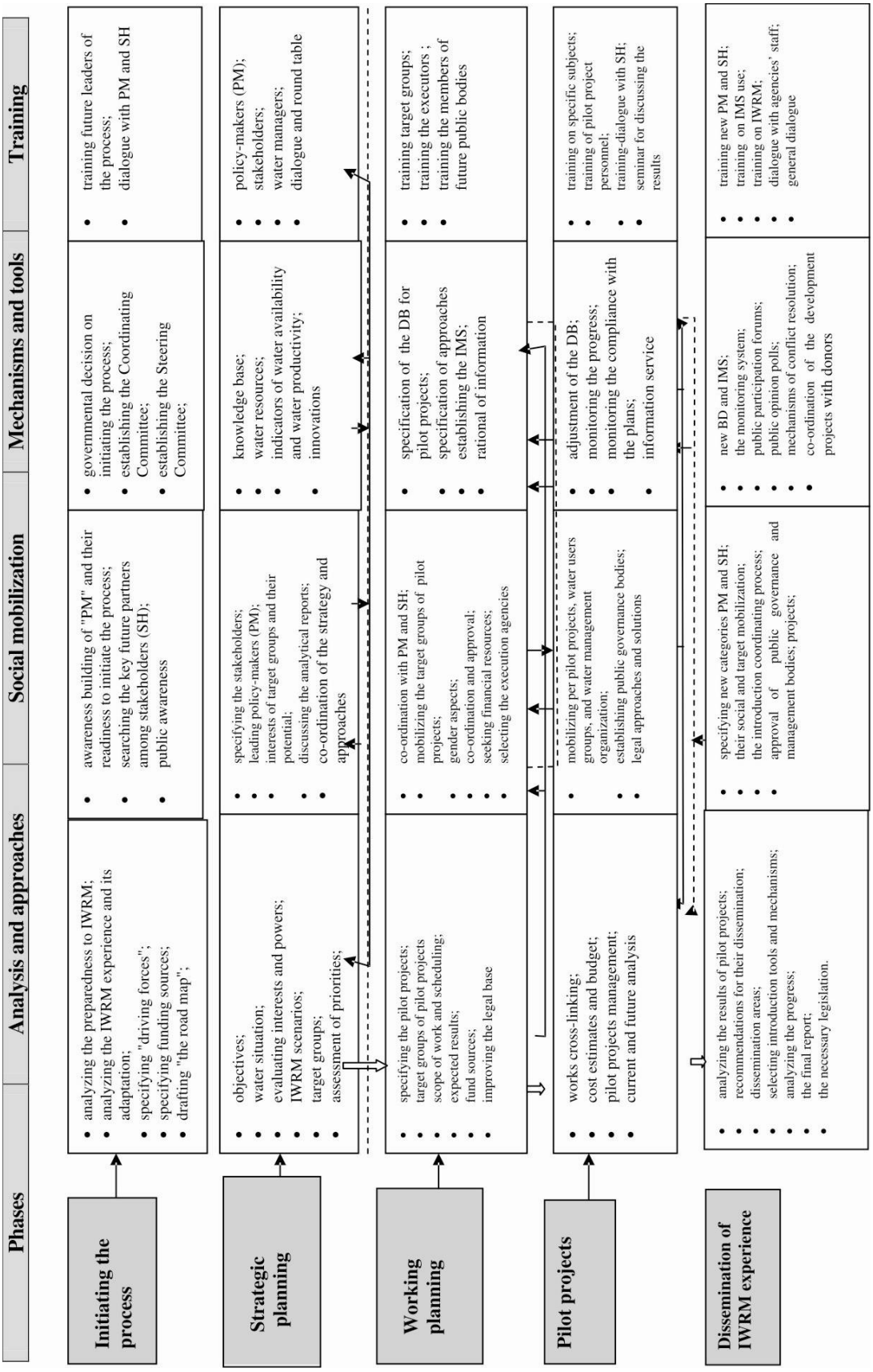
  - social need for introducing IWRM;
  - awareness of these needs among decision-makers and advanced part of the society;
  - scientists and practitioners can suggest solutions relevant to these needs; scientific criteria meet with public interests;
  - suggested solutions will be feasible for the government and society;
  - "decision-makers" are ready to listen to scientists and practitioners and to cooperate with them;
- phases of IWRM introduction, scope of works and appropriate instruments: the information system, training, social mobilization, developing the "road map" in detail;
- specifying the target groups and the level of stakeholders' knowledge, their interests and abilities; and
- definition of IWRM strategic objectives for achieving the MDGs.

The strategic planning, as the first phase of IWRM introduction, creates the basis for involving all stakeholders; but they don't have to participate absolutely and simultaneously at all stages.

Development of Work plans is started with selecting pilot projects and definition of their objectives. Only irrigation systems where the maximum potential of IWRM may be shown, both in enhancing the efficiency of water resources use and its socio-economic and environmental effects should be selected for the pilot projects. The selected systems should be coordinated with local authorities, stakeholders and, more important, with decision-makers and the fact that their consent has to be reflected in relevant documents. At the same time, specific considerations should be given to key aspects, socio-economic and water management situation, and especially selecting the local partners that has to be organized on the competitive basis.

In the framework of the IWRM-Fergana Project [3, 41], the work plans were prepared jointly with SIC ICWC, IWMI, SDC, three Ministries of Water Resources (Kyrgyzstan, Tajikistan and Uzbekistan), water authorities of seven provinces in the Fergana Valley and were completed within six months. The information on this activities and further practical implementation of the IWRM approaches are described in other chapters of this book.

Figure 6.3 Coordination of Works under Introducing IWRM Tools at Different Stages



A specific feature related to introduction IWRM consists of continuous adjustment and development of the "road map" to achieve the planned objectives:

- evaluation of achieved results together with the end users and decision-makers;
- recommendations to "governance" regarding further improvements of the legal, financial, institutional and other kinds of activities;
- feasible scope of works and projects for further development;
- action plan with the cost-benefit analysis;
- definition of the target groups of stakeholders and approaches for involving them in the introduction process; a plan of social mobilization of stakeholders, taking into consideration their specific character and organizing them into appropriate groups;
- training plan for the target groups of stakeholders and dissemination of gained experience;
- capacity building of the information system; and
- assessment of the progress and feedback.

It is important to ensure the sources of financing for this process, active role of its participants and involvement of stakeholders, as well as mobilization of donors' investments of associated sectors; the last task is the most difficult.

Let us consider a role of various instruments at different phases of IWRM introduction.

Analysis and key approaches

Considering the multiplicity of aspects of IWRM, the analytical part of initiation phase should cover, first of all, the baseline situation (prior to the IWRM introduction) in water use, management and protection, and the management and use of other natural resources (land, energy potential, flora and fauna), as well as social and economic factors. Then plan the targets and levels for each of these factors. Further, under strategic planning, it is necessary to select feasible scenarios and define phases of their implementation. Those should be developed in detail for each stage at the phase of work plans development. At the phase of pilot project implementation, the analysis has to show, to what extent those targets, which were planned at previous phases are feasible; and taking into account the outcomes of pilot projects, adjustments of the plans has to be made. From the very beginning, the analysis must cover not only water management aspects but also the set of key results of introducing IWRM, especially those that are aimed at achieving the MDGs, keeping in mind, first, efficient use in all economic sectors of allocated water from the sources and satisfaction of the water needs of the society and nature.

Social mobilization shouldn't be considered as the campaign of involving stakeholders for one occasion. At "*initiation*" and "*strategic planning*" phases, the social mobilization campaign is aimed at "looking-ahead" representatives of society and future leaders of the IWRM introduction process. With transition towards the phase of developing work plans and then pilot projects, this activities should be step-by-step extended to increase the number of target groups and directions of their activities and for further deepening and developing their links both over "vertical" and "horizontal." At that, key tasks of social mobilization also change from such activities as familiarization of stakeholders with IWRM principles to their involving into strategic planning activities and step-by-step transferring to them a role of "owner' of this process. Thus, they should become not only bearers of ideas but also creative participants of IWRM who, has an excellent knowledge of water use and distribution problems, breathe new life into the IWRM introduction process. Social mobilization gradually changes its direction towards involving of stakeholders into governance, elaboration of new forms of management and, finally, development of management directives (a business plan, schedule of water use) and follow-up monitoring of their implementation and achieving planned indicators, etc.

Stakeholders are a source of feedback during the IWRM introduction process that is used for its in-process adjustments, and is the basis for systematic transferring the process into hands of those who are most interested in introducing IWRM.

Instruments and mechanisms of introducing IWRM are not confined only to institutional instruments. Here, it is necessary to focus on the communication systems and equipping the same; databases that gradually accumulate information with development of the process and covering more and more areas of activities; the system of monitoring water use and adjustment plans of water use, according to real demands of water users; models for operational management and planning; conflict resolution system, etc.

In parallel to these instruments and social mobilization, the training system should be active with changing thematic coverage and trainees from decision-makers and leaders of stakeholders towards executors at grassroots level. For follow-up, enhance the training courses arranged according to the "top-down" principle by practical "bottom-up" results. Lectures should be accompanied with "dialogues" and "round tables" with following on-the-job training for personnel of the Canal Administrations and Canal Water Users Councils, WUAs' members and staff, as well as for farmers in the frame of consulting activities. The more experience learnt from the process of IWRM introduction the wider and more diverse coverage of training activities; however, just such an approach guarantees the progress, since the training is not only dissemination of existing knowledge but also gathering and accumulation of new collective knowledge about the IWRM introduction process.

There is one very important conclusion we would make based on the foreign and our own experience. Introducing IWRM presents a long-term and phased process that step-by-step, involving more and more intellectual potential, participants, and objects. In Chile, for example, "community pregnancy" related to the need in reforming the water sector arose in the 1980s, but the IWRM system was finally established in the national scale only in 2005 [7]. We have initiated the process of introducing IWRM in Central Asia almost ten years ago, but managed to cover only small part of the region.

IWRM has to be broadened and deepen, because, with time, the potential of technical progress, on the one hand, and social and economic conditions on the other hand, are changing. These changes and new opportunities dictate the need in new adjustments to the strategy and instruments, to raise the IWRM efficiency and to win more and more supporters "top-down" and "bottom-up."

6.3 The Public Awareness Campaign

(V.I. Sokolov)

The understanding on the importance of developing an appropriate social norm and attitude to water resources management is rising. A personal attitude to this problem should be interlinked with social norms. Decisions on water resources management must be based on the social values of water resources. It is necessary to establish a balance between commercial activities, emotions and social values.

There are a few reasons why the public awareness needs to be raised, and community representatives should be involved in water resources management:

- urgent need in water conservation;
- rising of sanitary requirements;
- protection of ecosystems;
- incentives for the public participation in governance;
- developing the self-regulating organizations;
- reforming the water policy; and
- heightened awareness of the new generation on water problems

The strategy of awareness creation should be grounded on the fact that water governance becomes a part of political instruments. Raised awareness is the direct response medium where all stakeholders specify their roles, responsibilities and ways of meeting their interests. At the same time, an awareness creation facilitates the formation of social norms and behavior concerning all members of the society, aimed at efficient, environmentally sound and cautious use of water, i.e. social encouragement of the principles of sustainable development.

While Initiating public participation campaigns, it is necessary to keep in mind the following:

- how many people need to be covered by this campaign;
- target groups;
- agenda of the campaign, its all-inclusiveness and detailed elaboration; and
- extent of public involvement

Key components of the campaign:

- market aspects;
- educational aspects;
- social / local aspects

Phases of the campaign:

- assessment of the current practice and search for possible improvements (motives);
- elaboration of the ideology;
- defining methods of public relations and involvement; and
- indicators for evaluation

Assessment of the current practice and search for possible improvements:

- analysis of the current practices of water use;
- assessment of current "good practices";
- coordinating the water-saving activities;
- defining the objectives and indicators of public participation (taking into account all interests, but involving only those who can really change something or influence on something);
- seeking acceptable solutions; and
- testing on the pilot objects – demonstration of advanced methods.

Elaborating the ideology:

- search for valid arguments;
- taking into account religious postulates;
- taking into account cultural values and traditions; and
- seeking the simple methods for describing any problem (the clarity – «fool-proofness»).

Definition of methods of public relations and involvement:

- personal presentations of professionals and involving mass media;
- intensifying the campaign in a short periods of time;
- brochures and booklets;
- traditional events (festivals, festive occasions, fairs, etc.);
- water fee charges; and
- involvement of advertising agencies

Indicators for evaluation:

- quantitative assessments (amount of people, women, target groups, etc.);
- evaluating the extent of participation;
- discussing the concepts in focus-groups; and
- Sociological surveys and interviews (questionnaire).

Training of trainers for the mobilization campaign:

- training teachers;
- training trainers; and
- a package of manuals and learning aids for trainers.

Other instruments:

- the water measuring and accounting system (at water sources and on the field);
- water pricing;
- water conservation;
- financial incentives; and
- access to water-related information (periodical publication of data: who, how much and for which purpose consumes water).

Supporting public participation:

- political support (lobbying through politicians);
- governmental support, interviews of professionals;
- support of scientists; and
- support of religious leaders.

Support by cooperative and non-commercial sectors:

- water users associations;
- "round tables";
- large water consumers;

- municipal authorities;
- public events organized by sponsors;
- water-saving contests (bonus funds); and
- trade unions.

Education:

- activities in schools;
- seminars for teachers;
- target children's creativity (target exhibitions);
- summer camps;
- study tours to water infrastructure;
- posters (instructional wall sheet); and
- inclusion of specialized topics in the curricula ("Water and History", "Water and Legislation", "Water Resources –Geography", "Water and Chemistry", "Water and Mathematics", etc.).

Involving mass media:

- newspapers, magazines, radio, TV;
- posters, booklets (educational to support initiatives);
- institutional aspects of involving mass media;
- Internet (websites, virtual conferences, nets);
- press-conferences; and
- exhibitions and concerts.

The key motto for the public awareness campaign is: "from awareness to practical actions!" Some details of practical implementation of the public awareness campaigns in the form of social mobilization in the Fergana Valley were described in Chapter 4 above.

6.4. Water and Education

(V.V. Khegay, A.A, Kadirov)

There is one important factor that affects the current or recommended for the future measures, for the implementation of IWRM principles – the human factor. Water may be and should be saved not only by the introduction of water saving methods of management and economic incentives for water users, and selecting the correct and rational ways for solving problems, but also by an intensification of the human factor. Reorganizing public consciousness and attitude to water, through liquidation of gaps between the notions: "my" and "our" or "public", is needed. It can be achieved through adopting, especially among younger generation, the concepts such as «water is the greatest good and therefore the greatest value granted to us»; « like water, human beings are a part of nature, therefore he cannot be the master of neither nature, nor water». Also through the revival of solicitous attitude of our ancestors to water, expressed by statements such as "Water contamination is the greatest sin" and "Water is life!". However, a few things can be achieved by slogans and appeals. Public consciousness can be shifted in the necessary direction only on the basis of purposeful, integrated and persevering training of people, employing stored knowledge, experience of water use gathered by our ancestors and contemporaries, not forgetting of mistakes made by

the last generations in water management and nature management, as a whole. On a question «who is to be a trainee? » there is a natural answer - no doubt, the schoolchildren. In a few years, they will become adults and active part of the population. Generations, competent in water issues should come to take our place.

Now, strong dependence on the educational programs that were developed and applied still in the Soviet period is being traced in educational systems of most of Central Asian countries. However, specific improvements of the general educational programs in some states are, by this time, in progress. For example, the School Textbooks Publication System Improvement Plan was prepared in Uzbekistan. In accordance with this plan, textbooks and manuals with the general name: «People and Environment» have been prepared. Four textbooks "A Human Being and Water", "A Human Being and Air", "A Human Being and Land", and "A Human Being and Biodiversity" will be published as well as the manual for teachers generalizing all four above-named themes. At present, the Environment Education Training and Research Laboratory of the Training and Methodical Center "Bioecosan" under the Ministry of Education of the Republic of Uzbekistan has prepared 19 scientific and methodical recommendations for secondary schools to promote the ecological education.

In support of the mentioned efforts in reforming general educational programs, the Global Water Partnership for Countries of Central Asia and Caucasus together with the SIC ICWC and Regional Ecological Center (CAREC) has proposed to include the water and ecological topics into the educational programs.

The goal of this initiative is to provide scientific and methodical assistance to experts of national education, to the training and methodical institutions to improve the general educational programs for a number of school subjects (history, geography, chemistry, economic and legal knowledge). This is in tune with the purpose of equipping pupils with good knowledge of the water problems, at the time of graduation, providing their conscious and solicitous attitude to water.

For the realization of this initiative in the Republic of Uzbekistan, it is necessary to keep in mind that the proposed measures and recommendations should not contradict with the laws adopted by the republic (Law on Education and Law on the National Professional Training Program) and the governmental decrees in the field of school education. It means that all amendments and modifications to the general educational programs should be in the context of the public education standard, and meet the principles incorporated in it.

One of principles of the state education standard says that education should meet requirements of the nation and society, and needs of personality. Today, the water matters are a subject of special attention of the State and affect more and more the interests of the society and personalities. Though curriculums of the listed school subjects contain elements covering those or other issues related to water resources management, water properties and data on water formation sources, etc., but all these actions under present conditions are absolutely not enough and do not meet requirements of the State, society and ordinary people.

Creation of a separate school subject: "Water Resources" or "Water Problems" now seems to be impossible, though it would enable to unify knowledge on water and its resources and to focus attention of schoolchildren to concrete practical questions. It is necessary to find ways of integrating the topic "Water resources" into curriculums of school subjects. Implementing this task by including these topics into different subjects seems to be acceptable to the most, but it is too difficult and uncertain. The following sequence seems to be logical: identification of what knowledge pupils have to learn in the complete set from 5 to 11 grade (as though there is a separate topic "Water Resources"), then to formulate what pupils should know in the final, and further. To define what they should be able to do. Such an order should be uniform under formation of topics of curriculums for all school subjects. It enables to find out what questions of the proposed list already are available in existing curriculums, what questions can be easily entered in them, what questions can be included by replacement of those or other parts in curriculums, and what questions remains excluded, and their inclusion or exclusion is to be decided by the relevant approving departments.

Pupils (5 to 11 grades) should get knowledge on the following matters under the topic "Water Resources":

- What is water? Physical states of water and its chemical composition; Water in living matter;
- Natural water and its origin; Water in the atmosphere, on the Earth surface, and in the interior of the Earth; The natural water cycle;
- Total waters reserves (oceans, seas, rivers, lakes, glaciers, icebergs, underground water, soil water);
- Water resources of Central Asia, the Aral Sea Basin and some rivers in the region;
- Fresh water deficiency; the causes of fresh water deficiency;
- Ecosystems in river basins and reasons for their destruction;
- Hydrology of the rivers in Central Asia; Hydrological regimes of rivers and their transformation under anthropogenic impacts;
- River water quality; Transformation of river water quality on the way from river head towards its mouth and in time; the causes of river pollution;
- Drinking water, drinking water requirements, information on the drinking water standard;
- Water reservoirs in river basins, their influence on hydrology and other characteristics of rivers;
- Internal and interstate (transboundary) rivers; Examples of difference in flow management of such rivers;
- Canals, waterworks (intakes, control structures, and off-takes); water measurements at canals; canal efficiency;
- Water infrastructure and dam safety; Examples of dam destructions and their consequences;
- Development of river basins with a view of irrigated agriculture;
- Some information on the irrigation development history in the region stage by stage: before colonization of Turkestan by Russia, during the colonial period, and under the Soviet Power;
- Irrigation and water allocation; development of institutional and physical water infrastructure in the country
- The careful and solicitous attitude of our ancestors to water and its use; conceptions reflected in proverbs and sayings;
- Features of irrigation development during the Soviet period; Achievements, shortcomings, and mistakes resulted in drying up of the Aral Sea;
- Information on water resources management methods; the concept of integrated water resources management (IWRM);
- Water User Associations (WUAs) is a link between the public water suppliers and water users (dekhkan and private farms);
- Water is not only the most valuable and necessary natural resource, but also under the certain conditions - the good having a price;
- Economic mechanisms in the water sector;
- Interrelation between a national economy and its water safety, as well as water resources conservation;
- Legal issues related to water resources, their use and protection;

- Islamic statutes concerning water relations and water use;
- The national law on water and water use; the governmental resolutions in the field of water resources and their use

By the moment of graduation from school, pupils should know that:

- Natural waters of all kinds and physical states are, somehow or other, interrelated and are in permanent cycles - big and small cycles;
- Mankind, for its purposes, uses waters first of all the rivers (big and small rivers), freshwater lakes, dynamic underground water reserves;
- Fresh water to be used by people in the various purposes (drinking and domestic water supply, irrigation, many other needs for which fresh water is necessary) is quantitatively limited, is deteriorated owing to anthropogenic activities, disposal of waste water without treatment to water sources;
- Sustainable economic development of any country, hence, well-being of each of its citizen, directly depends on adequate provision of the country with fresh water resources. Therefore, water conservation and its rational use attract the public attention more and more and gain in the practical importance for society and people;
- Water is valuable natural gift, an irreplaceable resource, and under specific conditions, a good with a price tag. For this reason, use of economic mechanisms (purchase and sale) in water relations is quite naturally and promotes seeking solutions on water conservation and protection;
- Water conservation is a duty of each person here, there and everywhere, where qualitative fresh water is used. To save water means to preserve personal and public savings;
- Deficiency of fresh water (under its quantitative consistancy) is irreversible process due to the population growth and development of water-consuming branches of the economy in the country.
- The duty of everyone is an understanding of decisions and measures of the government directed to mitigation of tension consequences related to water, and strict fulfillment of own duties regarding their implementation in practice.

What a graduate of the secondary school should be able to do?

- To eliminate or promote elimination of fresh water losses (leakage from taps and other plumbing fixture in apartments, basements of apartment houses, and other places), or its use not for direct purpose;
- To explain to relatives and close people the necessity of solicitous attitude to water and its economical use; to be able to measure volume of leaks in apartments with the help of improvised means (a bottle or a glass, and watch) and to express this loss in money;
- To explain people those around him main regulations and meaning of national laws concerning water and water use, last resolutions of the government on water resources and their use.

Quantitative indicators of the national education system specify a scope of necessary works for introducing water themes in the school curricula. For example, in the Republic of Uzbekistan there are 160 administrative districts in 12 provinces and the Autonomous Republic of Karakalpakstan; and the departments of education are active in each district. Taking into account large cities and their subdivision into districts (Tashkent, Samarqand, etc.), as well as towns in provinces (without subdivision into districts) with their city departments of education, the number of district departments of education amounts to 200. In 2005, about 9,737 schools including primary, secondary and special schools, lyceums and gymnasiums

were functioning in Uzbekistan. Since our initiative does not cover the primary schools and from 1st to 4th-class pupils of secondary schools, hence 9,555 schools with 3,752,980 pupils (from 5th to 11th-class pupils) will be covered by this initiative. The total number of teachers amounts to 461,797 persons including 60,000 teachers who give lessons covering subjects (geography, chemistry, history, legal basics, economic basics, etc.), into which the water themes should be integrated (about 300 teachers per each district, on average).

This activities includes the following key directions:

- Preparatory works for establishing the system of centralized courses for training trainers with the follow-up daylong seminars under their leadership in all districts of the republic;
- Supporting activities of these centralized courses and the training necessary number of trainers;
- Organizing the one-day seminars (per each school subject specified for integration of water themes) in all districts of the republic with a coverage of all teachers who give lessons in subjects, which will be integrated with the water themes; and
- Preparation of various tutorials and learning aids to be used during training at centralized courses and one-day seminars, as well as in the future in the secondary schools.

6.5. Climate changes - is good or evil for the water sector?

(G.V. Stulina)

Since the origin of life, different climatic changes took place on the planet Earth, with considerable fluctuations from global warming towards cold spells and vice versa. Ice Ages, in certain periods of Earth's history, sea ice or glaciers have covered a significant portion of the planet's surface, were changing into the periods of global warming that were lasting millions of years. Because of climate changes, flora and fauna were subjected to considerable transformations. Some species of animals and plants disappeared and others have appeared; some civilizations vanished completely.

Mankind, living on Earth for many thousands of years has never was able to influence on weather events. While these events exert considerable impacts on the human beings and communities as far as, first of all, they affect food supply, living conditions in cities and rural areas and access to safe water and energy.

More than 400 million people living in arid, semi-arid and subtropical regions, often overpopulated and economically underdeveloped, are subjected to a serious risk of climatic changes and follow-up effects of political, economic and social instability. Climate changes can become the trials and tribulations for some countries. The whole regions where there is resource deficits and capacities necessary for rapid adaptation to more severe conditions, will be subject to grave consequences of climate changes: hurricanes, floods, and droughts.

It is necessary to note that the future weather conditions or specific elements of sudden climate changes cannot be predicted with a high accuracy. However, studying the retrospective of climate changes provides some useful guidelines. At present, the task of limiting dangerous anthropogenic interference with the climate system is quite topical for policy-makers.

Scientists from all over the world recognize that global warming is already a reality. The UN Intergovernmental Panel on Climate Change (IPCC) concluded that human economic activities (an anthropogenic factor) changes our climate system and will continue to impact on it in the future.

The Earth's surface temperature has risen over the past millennium and it would naturally affect physical and biological systems. Scientists from all over the world recognize that global warming causes gradual changes such as raising global mean sea level, shift in the climatic zones due to rising temperature, and the precipitation patterns. The climate change can also result in increasing the frequency and scale of extreme weather events such as hurricanes, floods, and droughts.

Tracking the history of century-long climatic conditions allows to note that the periods of global warming changes into the periods of global cooling. Since 14th century, the North-Atlantic region had gone through a cold spell that lasted

until the mid of 19th century. This cold spell could be caused by a substantial slowdown of the ocean conveyance system, although the opinion that reduced amount of solar radiation reached the earth's surface and/or global tectonic events could cause changes in the ocean system is more widespread. This period that is often called as the Little Ice Age, lasted since 1300 until 1850, resulting in severe winters and sudden climatic shifts and strongly affected the agricultural, economic and political situations in Europe. After that, the global warming has started, which has lasted over 20th century and continues at the beginning of 21st century. As a result, strong positive climate feedback[58] (Figure 6.4) speeds up the rates of annual warming from 0.2 Fahrenheit degree (0.11 °C) up to 0.4 Fahrenheit degree (0.22 °C), and finally up to 0.5 Fahrenheit degree (0.28 °C) in some areas.

With heating up the earth's surface, the hydrological cycle (evaporation, precipitation, and surface runoff) speeds up the rise of temperature. By far the most abundant greenhouse gas is water vapor, which reaches the atmosphere through evaporation from oceans, lakes, and rivers, and intercepts additional heat flows and increases the mean temperature near the Earth's surface. With increasing evaporation, a rise of the Earth's near surface temperature also takes place resulting in drying up of forests and grasslands. Due to perishing and cutting trees, forests absorb carbon dioxide to lesser extent leading to higher rates of rise surface temperature as well as due to strong and uncontrollable forest fires. Furthermore, higher temperatures cause melting of snow cover in mountains, on open fields, high-latitude tundra areas and permafrost soils in north zones. When soil adsorbs solar radiation and its reflection power is decreasing the surface temperatures are rising much faster.

Since the processes of climate change is going on all over, one can say with certainty that these changes are of the global scale and according to the forecasts of scientists will last up to 2010.

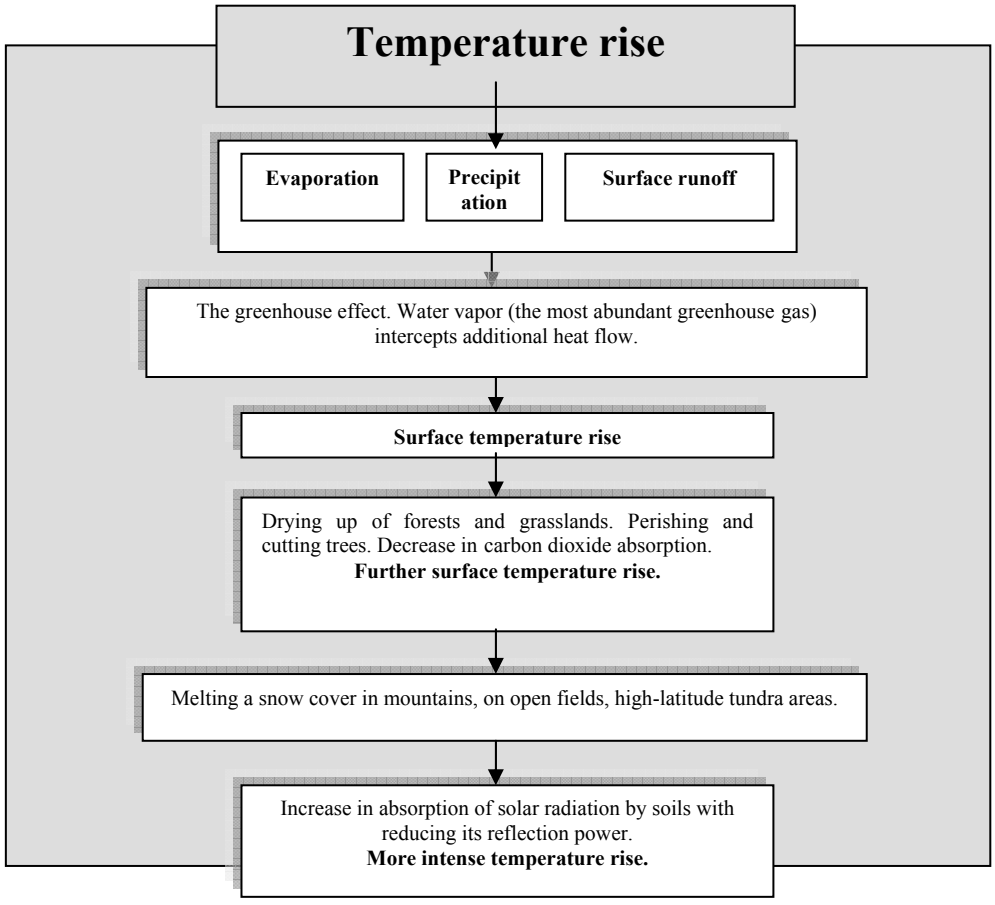


Figure 6.4 A Framework of Climatic Feedback: UN Intergovernmental Expert Panel on Climate Changes

The rates and duration of global warming that are observed during the 20th century are unprecedented over the last millennium. An increase in maximum temperatures, number of hot days and heat indicators is observed almost over

[58] An interaction mechanism between processes in the *climate system* is called a climate feedback, when the result of an initial process triggers changes in a second process that in turn influences the initial one. A positive feedback intensifies the original process, and a negative feedback reduces it

all continents in second half of the 20th century. It is expected that trends of mean surface temperature rise will be kept, and the forecasted rise will vary from 1.4 to 5.8 °C.

More and more evidences that regional climate changes resulted in various transformations of physical and biological systems in most of regions in the world. They include reducing of glacial areas, thawing of permafrost soils, changes in frequency and intensity of precipitation, shifts in the dates of the beginning and end of the growing season, earlier plant flowering and emergence of insects, as well as shifts in plant and animals ranges in response to climate changes.

Central Asian countries, as members of the world community, have also experienced difficulties caused by climate changes [57]. Effects of joint influence of anthropogenic factor and climate changes that resulted in the Aral Sea disaster are especially visible in the Central Asian region.

The first meteorological observations over the territory of Uzbekistan were started more than 100 years ago. At present, there are 87 meteorological stations, 94 gauging posts, and 120 river flow measurement stations. 18 of them were included into the Global Hydrological Observation System, and 3 into the Global Climate Observation System. Purposeful research on climate changes in Central Asia were initiated in the 1980s.

Studying of climate trends using the series of instrumental measurements has shown that, at present, changes of different components of the climate system are being observed. Positive trends prevail in the temperature series, and the tendency of warming is found both during the cold six-month period and the warm six-month period.

For obtaining an objective assessment of climate changes over the territory, the SANIGMI specialists have selected 50 weather stations having series of observations since 1931 that are located in various conditions from the point of view of anthropogenic impacts on the climate and in different physical and geographical conditions. Thus, there was the opportunity to analyze variability of the mean values that were computed for two basic 30-year series of observations (1931 to 1960 and 1961 to 1990).

Air temperature. Analysis of mean values denotes a significant changes in the directions of warming up. The most significant warming over the territory was observed in April, June, November, and December. In these months, a significant rise of mean monthly air temperature was observed at most weather stations (from 50.2% to 92.3%). At the same time, a significant decrease in mean values was observed less frequently (from 7.7% to 19.8%), mainly in autumn months. Thus, even based on the analysis of the historical series of mean monthly temperatures, it is possible to conclude that statistically significant warming is being observed over the considered territory. The standard deviations of mean monthly temperatures vary to a little degree due to a high natural variability of air temperatures.

Assessment of changes in maximum air temperatures has revealed tendencies of their increase over most of months. It is of interest to note that in summer and autumn, the tendency of minimum air temperatures rise is more visible than maximum ones; at the same time, lowering of maximum air temperatures was observed at rather considerable number of weather stations in summer. Influence of the Aral Sea on the pattern of changes in minimum air temperatures (in November) is observed. This becomes apparent in lower rates of minimum air temperature rise over the area in the vicinity of the Aral Sea due to the effect of aridization (reducing of humidity in the zone of exposed sea bed) that causes widening the range of daily air temperature fluctuations. This case shows that impacts of lowering the sea level and drying up of an exposed seabed on the microclimate of this region during certain months are already visible through changes of the climatic norms.

The areas with decreasing maximum air temperatures that are localized by the irrigation districts (Golodnaya Steppe, Karshi Steppe, Fergana Valley, Surkhandarya Valley). The maximum air temperature in these areas has decreased by more than 1°C compared to the natural variability of maximum air temperatures and these regions distinctly stand out. Observed data over the period of 1991 to 2000 shows that the annual air temperature over this region continues to rise. During the last decade, already winter months have contributed, to a greater extent, to the general picture of warming. For example, the mean 10-year air temperature over the winter period was higher than the base value over the whole area, and in some districts, excess amounted to 1.2-1.5 °C. Observations in the mountain river basins confirms the sustained trends of decreasing transient snow reserves. Degrading glaciers and reduction of their area also takes place; and rise of air temperature by 1-2 °C will intensify this degradation process. Over the period of 1957 to 1980, glaciers in the Aral Sea basin have lost about 115.5 km3 of ice (about 104 km3 of water) or almost

20% of ice reserves as of 1957 (a base level). By the beginning of 2000, the ice losses made up additional 14% of ice reserves as of 1957. According to forecasts, by 2020-2025, the glaciers will lose additionally not less than 10% of the initial volume (of the year 1957) [58].

None of climatic scenarios developed according to the methodology suggested by the UN Intergovernmental Panel Climate Change show an increase in water reserves in the region in the future. In contrast, the decrease in water reserves by 3% to 40% was predicted based on simulations using different models. Water deficit continues to grow while reducing available water resources, and increasing water consumption for crops cultivation. Table 6.2 shows the water resources changes found in Chirchik-Akhangaran basin using assessments (two climatic models **"ECHAM4" and "HadCM2"** were used).

Table 6. 2 Comparison of Two Scenarios for Developing Water Resources in the Chirchik-Akhangaran Basin

Year	Total available resources		Water demand	
	BAU/ECHAM4	OPT/ HadCM2	BAU/ECHAM	OPT/ HadCM2
2006	7,908	8,019	4,778	4,968
2011	8,841	9,404	4,714	5,404
2016	7,263	7,540	4,714	5,188
2021	6,662	6,944	5,299	5,958
2024	5,154	5,871	5,362	6,270

Total available water resources in the basin will decrease during next 10 years by 8% and 6% respectively according to the two scenarios of economic development ("BAU – business as usual" and "OPT – optimistic"). By 2024, the decrease in available water resources will reach 35% and 28% respectively according to "BAU" and "OPT", at the same time, water demands will increase by 12% and 26%. Different approaches and scenarios can be used to assess impacts of expected global warming on water resources.

The mountainous river flow model developed by the SANIGMI allows take into account the basic natural laws of runoff formation and evaluating impacts of climate changes on river flows, snow cover, and glaciers in the scale of separate river basins. In the region, rivers react to the warming process in different ways, due to different drainage patterns of their watersheds. Discharge of rivers fed by snowmelt is faster decreasing with a temperature rise. Rivers fed mainly by glaciers are more "inertial" relative to a temperature rise, since the increase in air temperature that intensifies melting of high-altitude snow covers and glaciers is partly compensated at the expense of specific characteristics of watersheds. Nevertheless, due to glaciers' degradation, which is in progress and will be enhanced owing to an air temperature rise, in the second case, decrease in river flows will intensify. This is likely to happen even more actively in the future.

Adaptation of the water sector to climate change

The modern civilization may either adapt to current and future weather conditions and climate changes or mitigate their negative impacts in any feasible way. At present, the task of limiting dangerous anthropogenic interference with the climate system is quite topical for policy-makers.

Studies of climate trends in the Aral Sea basin testifies the changes in different components of the climate system, positive trends in the temperature series over the cold and the warm six-month periods, increase in the atmospheric concentration of CO_2 and the greenhouse effect. All these factors affect the sustainable development of the region, and, first of all, the agricultural sector where, at present, 70 to 90% of population are engaged. Impacts of above factors on crop productivity are given in Table 6.3.

Studies of the present situation, correct assessment of "bottlenecks" in social and economic development and inter-state policy in the region, as well as developing appropriate measures for desertification control and mitigating of consequences of drought events, allows to withstand adverse effects of the climate change.

Table 6. 3. Impacts of Climate Factors on Agricultural Production in Central Asia

Indicator	Affects	
Air temperature	Increased duration of the growing season; Earlier date of sowing Conditions suitable for germination, advancing phenological phases and growth Extremely high temperatures impede physiological processes in plants	+ + ± -
Air humidity	Evaporation intensity Creating conditions for moisture and heat exchange necessary for each specific crop	- +
Precipitation	Soil moisture and air humidity create natural wet conditions necessary for crop germination Storms can be a hinder for germination and agricultural works	+ -
Temperature, humidity and precipitation	Forming crop evapotranspiration as a whole Affect salinization	+ -
Atmospheric concentration of CO_2	Affecting the photosynthesis intensity and gas exchange Forming biomass and crop productivity	- +

Most of irrigated lands in the Aral Sea basin belong to subtropical, semi-desert, desert and piedmont zones. The agro-climatic potential allows cultivating many subtropical plants including cotton and plants belonging to the temperate zone. However, the Aral Sea basin being the most northern zone where cotton is cultivated, it does not have sufficiently sustainable conditions for harvesting guaranteed cotton yields everywhere within the basin. Deteriorating soil conditions and socio-economic factors are a key cause of the loss of land productivity, especially over the recent

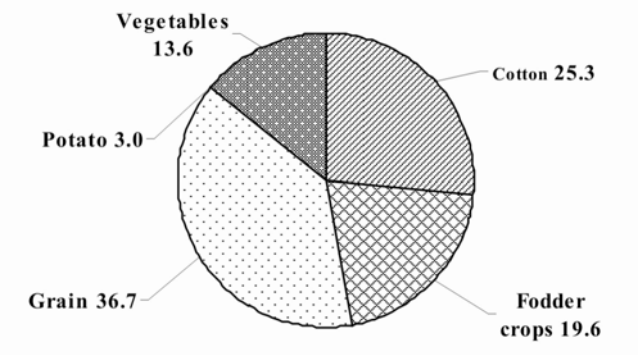


Figure 6. 5 The Sown Area Pattern in the Aral Sea 2005)

period of time. Only 52% of irrigated lands can be referred to lands with satisfactory soil and hydro-geological conditions. Irrigated areas with medium and heavy saline soils are increasing. In the region, agricultural land consists of irrigated land, rain-fed land and natural grazing areas. A total area under irrigation amounts to 7.95 million ha. The crop pattern is given in Figure 6.5.

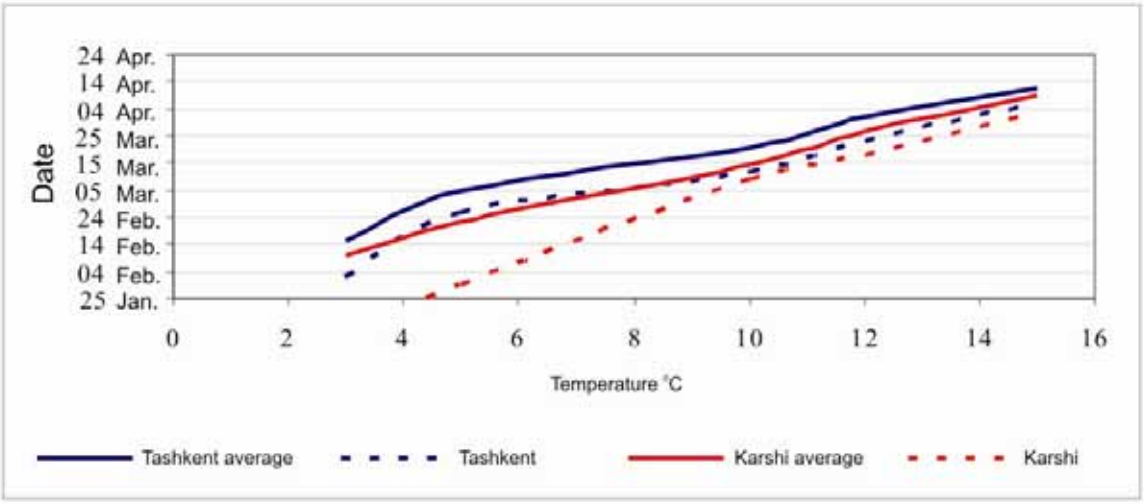


Figure 6. 6 Crossing over the Limits Established for Air Temperatures

(Cp – present conditions, 1 – under climate changes: using data of weather stations in Tashkent and Kashkadarya provinces)

Because of warming and increase in an amount of precipitation, a shift is observed in the altitudinal and latitudinal climatic zones. A border between subtropical and temperate climatic zones has shifted by 150 to 200 km northward and by 50 to 100 km between the actual rain-fed zone and the quasi-rain-fed zone. This means that the northern areas are being transformed into the territories with climatic characteristics more typical for southern areas. Figure 6.6 shows that with air temperature rise due to global warming, the limits established for air temperatures (3, 5, 10, 12, and 15 ^{o}C) in Tashkent Province are lowering up to the mean annual values in Kashkadarya Province. It means that dates of sowing various crops become earlier and, in turn, the growing season starts earlier. Thus, one can say with certainty that under changing climatic conditions, the more northern Tashkent Province gains the climatic characteristics of more southern Kashkadarya Province.

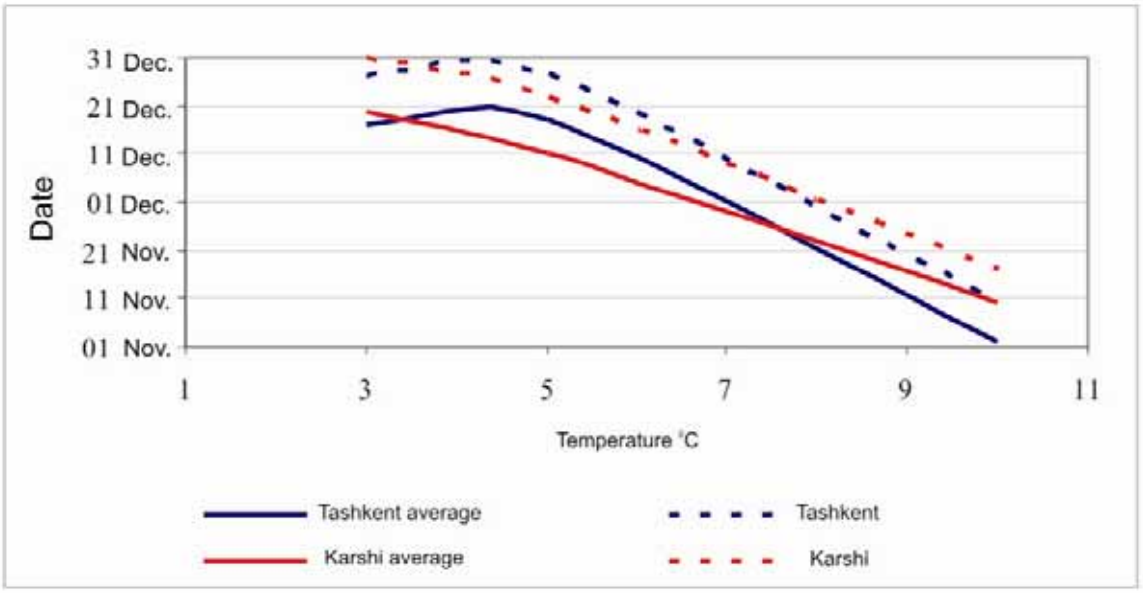
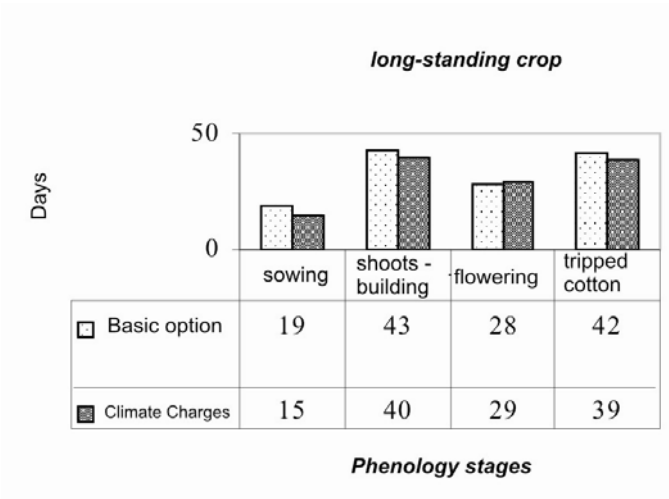


Figure 6. 7 Crossing over the Limits Established for Air Temperatures

(Cp – present conditions, 1 – under climate changes: using data of weather stations in Tashkent and Kashkadarya provinces)

Figure 6.7 shows that the autumn temperatures under crossing over the limits established for Tashkent Province due to the climate change are higher than mean annual temperatures in Kashkadarya Province. They are shifted on 7 to 17 days. This means that the growing season comes to an end later on. A difference in the dates of crossing over the temperature points of 10, 15, and 20 ^{o}C in spring and autumn amounts to 15-30 days, on average, over the whole irrigated area.

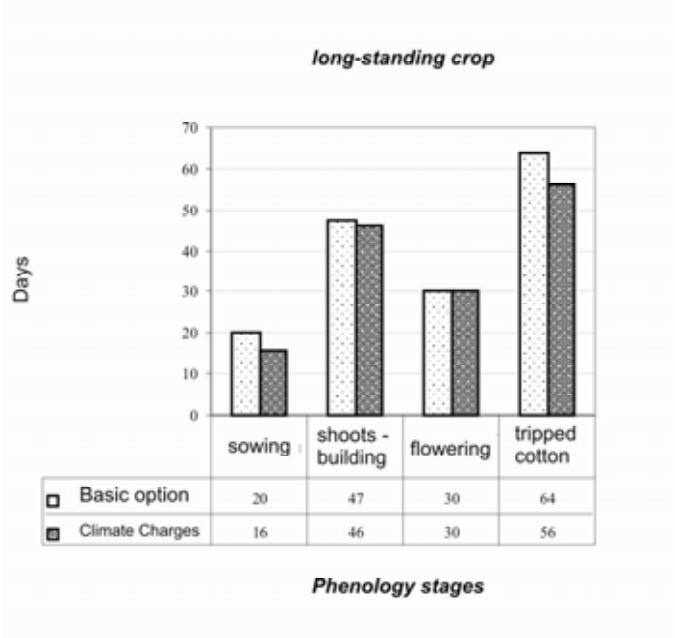


Changes in climate forced agricultural managers to revise the principles of crop cultivation practice. All the sequence of farming operations should be modified under these conditions of rising temperature, changes in air humidity and river flow pattern.

Key factor that affects the crop development rates is the thermal conditions over the growing season, which can be characterized by an average daily air temperature. Shift in the phenological phases occurs when a necessary sum of effective temperatures is provided.

Figure 6. 8 Changes in the Growing Season

As was mentioned above, a temperature rise provides more prolonged growing season, and at the same time, shifts in dates of phenological phases take place due to changed weather conditions (a duration of specific phenological phases). The length of phenological phases under usual and changed climate conditions is given in Figures 6.8 and 6.9.



Dates of sowing are also shifted. Due to air temperature rise in spring and the increase in soil moisture, sowing operations are started earlier. Therefore, the dates of sowing that were established based on mean annual data are not acceptable under new conditions of climate change. Ignoring the current changes results in reducing of crop yields by 10 to 20% on average, since the most important period for forming yields will be affected by increased temperatures in comparison to optimal mean annual ones.

An extension of the potential growing season will allow growing 2 to 3 yields a year, with the assumption that irrigation water will be available. The rise in air temperature will cause a rise in crop water consumption by 5 to 8% according to our estimate. However, water consumption per unit agricultural output can be reduced at the expense of crop yield growth; at the same time, the effect of higher water productivity can be enhanced in the case of planting secondary crops.

Figure 6. 9 Changes in the Growing Season

Temperature rise and heightened atmospheric concentration of CO_2 can advantageously affect plant growth [13]. Under climate change conditions, the potential productivity of most crops shall increase, if *due supply*

of key inputs such as fertilizers, irrigation water, pesticides, etc are done. Only rice that is especially susceptible to temperature rise is an exception to this rule. Under air temperatures higher than 32 ^{o}C and heightened atmospheric concentration of CO_2, productivity of rice is decreasing (Table 6.4).

The adverse affect of climate change is the increase in the number of days with high temperatures that can cause the water stress of plants, especially under low water availability for irrigation. The experience of food crops cultivation (water melons, maize) in the Fergana Valley and Syrdarya Province with application a polyethylene film as a mulch allowed simulating temperature rise expected, in line with some scenarios of climate change (Figure 6.10). A few variants of mulching were used (a transparent film laid over the soil surface; gallery-type film cover, and black polyethylene film cover); and their results were compared with food crop cultivations on open ground.

Table 6. 4 Trends of Crop Yields, centner/ha

Province	Cotton		Rice		Maize	
	Average over the 5-year period	Climate change	Average over the 5-year period	Climate change	Average over the 5-year period	Climate change
Karakalpakstan	14.1	15.5	19.9	17.9	10.7	12.0
Andijan	30.0	33.0	37.1	33.4	54.4	60.9
Bukhara	28.4	31.2	27.1	24.4	35.2	39.4
Kashkadarya	21.5	23.7			17.6	19.7
Namangan	25.0	27.5	20.9	18.8	41.2	46.1
Samarkand	22.7	24.9	21.6	19.5	29.1	32.6
Surkhandarya	27.0	29.7	25.3	22.8	36.9	41.3
Khorezm	26.5	29.1	40.5	36.4	37.6	42.1
Fergana	26.3	28.9	31.4	28.2	35.6	39.8
Tashkent	23.7	26.0	33.4	30.1	29.9	33.4
Syrdarya	14.4	15.9	22.9	20.6	30.8	34.4
Jizakh	15.7	17.3	15.1	13.6	19.9	22.3
Navoi	25.6	28.1	15.4	13.8	19.3	21.6

Soil temperature values at sowing and during the germination period are the most critical. Sowing of water melon was conducted at the minimum permissible temperature of 13 ^{o}C at a depth of seed lying that should be uniform over a whole field. Three days after sowing, a temperature of soil underneath a gallery-type film cover and a transparent film laid over the soil surface was 15 ^{o}C or sufficient for seed germination. A temperature of soil underneath a black polyethylene film cover was ranged from 12 ^{o}C to 10.5 ^{o}C. In the variant of using a transparent film laid over the soil surface, temperature rise resulted in earlier ripening (by 20 days) and the increased productivity (by 30%) in comparing with the “business as usual” variant.

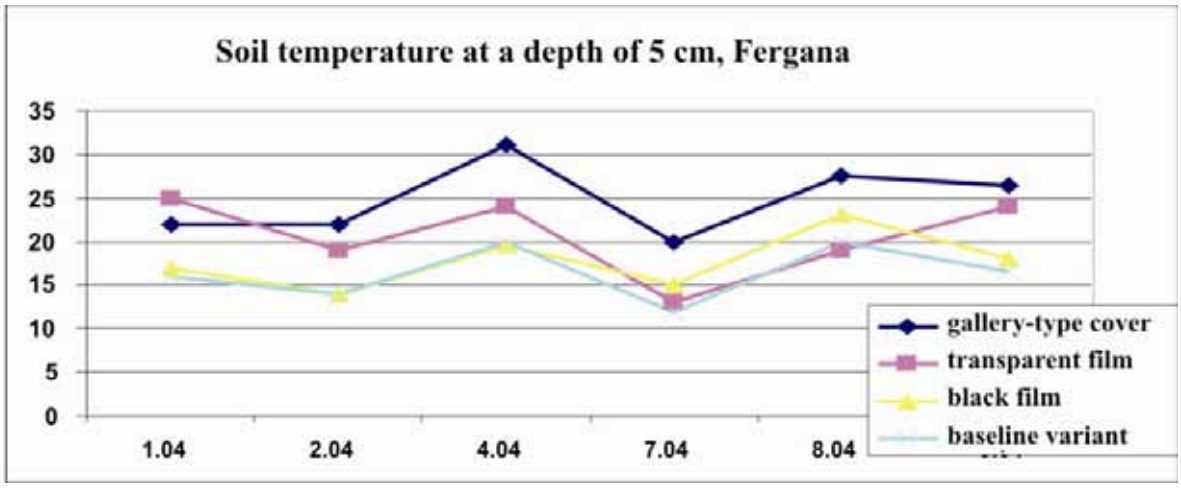


Figure 6. 10 Soil Temperature Pattern on Demonstration Fields

Adverse affects of temperature rise and extreme weather events were simulated using a gallery-type film cover when in daytime, the temperature raised up to 40 ^{o} C, causing considerable slowdown of plant development and, finally, decreasing the productivity (by 8% with compared to "business as usual" variant). It can be noted that mulching and alternate furrow irrigation allows improving the irrigation water productivity almost by 70% (Table 6.5).

Table 6.5 Increase in Irrigation Water Productivity under Maize Cultivation with Mulching by a Film

Field Irrigation system	Water supply in the growing season	% of average value	Crop yield	% of average value	Water productivity	% of average value
	m^3/ha	%	kg/ha	%	kg/m^3	%
Alternate furrow irrigation, mulching with a transparent film	725	-20	5400	35	7.4	69
Traditional furrow irrigation, mulching with a transparent film	915	1	5520	38	6.0	37
Alternate furrow irrigation, "business as usual" variant	730	-20	3400	-15	4.7	6
Traditional furrow irrigation, "business as usual" variant	907	0	4000	0	4.4	0

What conclusions can be made based on the analysis of climate change effects?

1. Climate change is an indisputable fact and it is a factor that considerably affects natural resources in the region;
2. It must be kept in mind that climate change has both advantageous and adverse affects, therefore the adaptation measures need to be developed for mitigating possible adverse affects;
3. Shifting the climatic zones southward is being observed;
4. According to all scenarios of climate changes the increase in crop water consumption in the future is predicted; and
5. Conditions for crop development and growth are changing resulting in the potentially possible extension of growing season and creating an opportunity for harvesting a few yields.

6.6. Water and Globalization: Impacts on Central Asia

(V.A. Dukhovny)

The modern world is entangled in global networks more than ever in the world history. Information space has been formed according to rules of Internet and electronic messaging and ensures instantaneous communication and momentary dissemination of any news, thus bringing about apparent unity of the world. At the same time, many other networks (financial, trade, economic, legal, and institutional) with their own rules of existence and play, while being in continuous development and interacting among themselves, are nothing more than the phenomenon of globalization. This phenomenon, if does not rule the world, at least, is representing one of the fundamentals of its present status, past transformations, and future prospects.

It is quite natural that the water sector, as one of the economic branches and simultaneously a chief actor of environmental management, couldn't avoid being involved into the globalization process that affected this sector since the 1950s. Globalization analysts, both supporters and opponents, single out its several aspects.

- political, economic, technological and environmental; and
- cultural, ideological, and even religious aspects that are not particularly highlighted but both earlier and especially now, in the age of information and communication revolution, have gained specifically powerful influence

Each globalization aspect had a profound influence on the water sector in some countries, regions and all over the world. Undoubtedly, these aspects play different roles at each development stage, and the influence of globalization at the regional and national level are also different depending on the extent of adverse affects of "governance" or its withstanding such phenomena. The water sector was involved in various spheres of globalization even in those periods when the water sector was developing independently within national boundaries. Trends of these processes are quite well observed in Central Asian countries that could not withstand the world tendencies despite being behind the Curtain for a long time. Globalization effects have many-sides and multifactor. Therefore, a clear-cut distinguish between positive and negative aspects of these processes is needed. An attempt to analyze the influence of "globalism" on the water sector in Central Asia is presented below.

Globalization has initially demonstrated advantages

Globalization, as a process of spreading certain influence all over the world, became apparent in the water sector in the 1950s, when global water organizations were established and activities of UN agencies' in the area of water problems were initiated. Later, the International Commission on Irrigation and Drainage (ICID) and the International Association of Hydraulic Engineering and Research (IAHR) were established. They were the pioneers as early as in the 1950s, applied great efforts to establish national committees of these organizations in many developed and developing countries and creating a common platforms for experience sharing, knowledge and information exchange. These organisations have significantly promoted the cross-fertilization of water management approaches practiced by developed countries into developing countries, as well as experience of former 'socialist states' into 'capitalist states' and vice versa. Exactly these activities have promoted not only scientific and professional capacity building and 'know-how' exchange, but also formation of professional relations. This has subsequently facilitated considerably in the establishment of the global community of water professionals at the end of the 20th century. In the past decades, we have been witnessing a rapid upsurge in diverse activities launched by the international water community. Activities of the interstate organizations under the UN umbrella has played an important role in disseminating 'know-how' and water knowledge. First of all, this can be referred to the UNESCO with its water assessment program that involved a great number of participants from various countries on both sides of the Curtain, as well as from developing countries. The same can be referred to the UN regional commissions such as the UN Economic and Social Commission for Asia and the Pacific (ESCAP), the UN Economic Commission for Latin America and the Caribbean (ECCLAC) and the UN Economic Commission for Africa (ECA), and associated international research centres involved in solving water-related problems such as the International Institute of Applied Science and System Analyses (JASSA) in Vienna and the Consultative Group on International Agricultural Research (CGIAR).

At that time, representatives of water science and practice of the former Soviet Union actively participated at the world water forums, for example, the Minister of Water Resources of the USSR, E.E. Alekseevsky, was the President of the ICID and the outstanding soviet scientists such as A.N. Askochensky, V.V. Poslavsky, K.K. Shhubladze and B.G. Shtepa were vice-presidents of this organization. The Ninth World Congress of the ICID was successfully held in Moscow in 1975; and the First Afro-Asian Regional Conference of the ICID was held in Tashkent in 1976. These events attracted attention to significant advantages in the field of land reclamation and water management in the USSR, raising the world-wide prestige of soviet water professionals and concurrently involving them into the process of improving the principles and approaches to water management on an international scale. This was two-way knowledge exchange. The USSR has gained experiences of advanced irrigation methods (drip irrigation, some types of sprinkler irrigation, automation of waterworks), while the soviet scientists made a great contribution to the world development through their achievements in hydrological school, in such areas as assessing water resources, plotting hydrographs of river flows with statistical uncertainty, drainage theory and practice, construction of large dams (Nurek, Toktogul, Bratsk and other dams) where the country played the leading roles in the world.

Great efforts were made to elaborate the so-called "integrated methods" of development and irrigation of virgin lands in the course of implementing the large-scale development projects in desert areas of Central Asia and Kazakhstan and reclamation of formerly abandoned lands in Azerbaijan, the Volga Region, and Kalmykia. All these activities promoted good foreign relations including signing the contracts for implementing works in various countries as well as procurement of equipment and technologies from abroad. Commercial activities in the field of water management has widely spread not only over countries of the so-called 'socialist block' (Vietnam, North Korea, etc.), but also over countries such as Egypt, Syria, Yemen, Mozambique, Iraq, etc. Constructing the Aswan Dam on the Nile River was undoubtedly a great success of soviet hydro-engineering theory and practice. This project had the great technical and political significance, demonstrating the world over the technological and organizational potential of the Soviet hydropower engineering. In the 1960s and 1980s, the irrigation and drainage activities boomed all over the world resulted in elaboration of a new water management and land reclamation concept, which had transformed irrigation, drainage and water management into recognized tools for reducing and even eradication poverty and famine, as well as solving many other social problems of the modern world. In this connection, the comment in the book for visitors made by the prime-minister of Turkey, Mr. Suleiman

Demirel, during his visit to a site of newly reclaimed lands in the Hunger Steppe in 1967, is quite noteworthy. He wrote, "Rulers, who are willing to provide their people with bread, jobs and opportunities of happy development, should come here and make use of this wonderful experience of social reconstruction through applying it in their own countries."

The 1970s and 1980s are marked with the new heights of global influence on water development processes. During those years, humanity began to see clearly that continuation of unrestrained use of natural resources by mankind, without care for their renewal capacity and considering ecological requirements may lead not only to regional disasters but even to a global crisis. However, this movement has initially failed to gain a worldwide support, but has initiated the development of two important principles of the global water policy. The first principle went back to Brutland's slogan: '*Man! You have not inherited nature from your ancestors, but borrowed it from your descendants*'. This slogan has gained worldwide recognition and promoted the prestige of those countries, which follow the principle of nature conservation for future generations. While *the prestige effect* that was of the great significance for political leaders and public movements, especially in developed countries was not a key factor, which could restrain the world from destructive over-consumption of natural resources, it had the immense moral and ever-growing political influence in any case.

Under the influence of activities of the Rome Club [46] in the 1970s and of the JASSA, an opinion regarding the need for environmental dimensions in all large-scale public action plans and programs was being formed in the Soviet Union. The State Committee for Nature Conservation and some government panels were established. For example, to solve problems of the Aral Sea and Caspian Sea. The "green movement" was supported by the Government, which resulted in a number of governmental resolutions and decrees. In particular, the Resolution on Socio-Economic and Environmental Improvement in the Aral Sea Basin that laid the foundation for future joint water resources management in the river basins of the Amu Darya and Syr Darya by establishing the Basin Water Organizations (BWO "Amu Darya" and BWO "Syr Darya"). The Water Code of the USSR has largely reflected new ideas and corresponded, in many respects, to new world tendencies. However, the Soviet management methods, being only formally democratic, did not provide real involvment of stakeholders and the general public in developing the mechanisms of public participation and control over the implementation of these quite correct decisions that remained mainly on paper.

The second aspect of this process was the emergence of documents that formed the legal basis for use of water and other natural resources at both the international and national levels, like the Helsinki Rules and later, after a long-lasting campaign, the Ramsar Convention; the Convention on Combating Desertification (1992); the UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (1992) and, finally, the UN Convention on the Law of the Non-Navigational Uses of International Watercourses (1997). It is not surprising that the Central-Asian countries, just after gaining their independence, were forced to set up their national legislation and relations with neighbors on the basis of old traditions but keeping in mind the UN conventions. Though issues of legal force and jurisdiction are quite vague in these documents, they nevertheless afford an opportunity for conceiving the purposive political movement of the international community towards equitable and reasonable use of water resources, as well as adherence to the "polluter pays" principle.

Summarizing results of the first phase of globalization in the water sector in Central Asia, as well as all over the post-Soviet area, one can note its positive impacts on legal, scientific, and technological progress, on establishing cultural exchange between the countries that previously were isolated from each other, and on forming additional values based on joint actions. In addition, the foundation was laid for water technologies exchange on the commercial basis.

The Period after Independence: a New Impulse for Globalization

The declaration of independence by the Central Asian countries in September-October 1991 posed a problem to the new Governments - where to go and which way to choose for economic and political development? Naturally, the water sector had found itself at the crossroads due to its close relation with the public priorities and directions, particularly in the light of agricultural reforms. Taking into account that the world practice did not know the examples of transition from under-developed socialism towards capitalism and the free market, the governments of the five republics tried to find a acceptable model among the modern capitalistic economies.

The world became opened for Central Asia, and Central Asia has opened up for the world. This openness was dualistic: non-politicized groups that encompass most of water professionals and, in general, of highly-qualified unbiased western professionals were surprised by the existing scientific and technological potential and, at the same time, they have critically analyzed the shortcomings and mistakes of current water management practice.

The understanding of the similarity and differences in the technical approaches, drawbacks and ways of overcoming them was reached just due to such a co-operation. The co-operation with leading specialists was gradually established facilitating the joint elaboration of programs and action plans such as: the Aral Sea Basin Phase-1 Program (1994), the Principal Provisions of the Water Management Strategy in the Aral Sea Basin (1997) [9], the Water Resources Management and Agricultural Production Program" (EU TACIS WARMAP-1, 1995-1997) and others. One cannot but admit a great contribution to this co-operation of such outstanding specialists as Guy le Moigne, Janusz Kindler, Bob Rangeley, Arrigo di Carlo, Michael Armitage, Jutzchak Alster, Joop de Schutter and many others.

Activities of these specialists together with the regional water institutions contributed to the development of new approaches based on up-to-date technologies, information techniques, computerization, etc. In addition, the western work style based on participatory approach has become quite widespread. Both factors promoted the public awareness regarding the need to meet environmental demands with respect to preserving nature. As a result, in 1993, in parallel to the ICWC, the International Fund for Saving the Aral Sea (IFAS) has established the Commission for Sustainable Development; however, it was only a flash in the pan. Nevertheless, according to the saying: "nature abhors a vacuum", and thanks to the initiative of Kazakh specialists, the Regional Environmental Centre was established and managed to stir up relevant activities on the regional level. A cohort of environmental partners has joined the water institutions. Finally, these activities have resulted in implementing the pioneer environmental projects (the Aral Sea Wetland Restoration Project, the Amu Darya and Syr Darya Deltas Biodiversity Rehabilitation Project, etc.).

Another side of the openness is the transformation of the region into a scene for political games. A situation was curious enough, since the international financial institutions skilfully combined the granting of their financial resources with specific political requirements, became the key actors rather than the newly established embassies and missions with their diplomatic activities. The political approach of "the Greeks bearing gifts" had several targets: to prove the disastrous nature and incapacity of the socialistic system and once and for all, to undermine the confidence to its potential, and under the guise of democracy and progress to impose their own vision on the future regional development. However, one aspect was hidden here: transforming the region from the source of raw materials of the Soviet monopoly into the market for western competing economies and, first of all, into the source of fuel and energy resources. Central Asia has possessed rather powerful industrial, agricultural, and human potential. For achieving abovementioned targets this potential need to be destroyed. For realization of such targets quite favourable local conditions have arisen - break-off of economic relations with Russia, loss of federal subsidies, and, at the start, inability of the Central Asian national governments to employ their potential for generating own financial resources for governmental regulation and support of national economies. These factors have caused certain economic recession, setback in agricultural production, disruption of the scientific potential, huge brain drain, and lowering the educational level.

What direction could be selected by national governments in the region? A key demand of all international financial institutions is denationalization and privatisation. A requirement to provide self-sufficiency as the prerequisite of the economic stability and as a new form of the slogan "people in trouble are left to

themselves" has resulted in stagnation of the industrial sector at the first stage, and then in liquidation and step-by-step pilfering of the huge assets. For instance, in Uzbekistan, the production potential in the water sector amounted to more than 10 million m3 of reinforced concrete, 12 thousand km of drainage ceramic pipes, 15 thousand tons of polyethylene goods, hundreds of excavators, levellers, drainage machines, pumps and pumping units, water-measuring devices, facilities, etc. Over the period since 1991 until 1996, this huge production potential was destroyed; and the privatised assets made up less than 10% of the former ones. Moreover, many items, such as drainage pipes and machinery were completely liquidated and pilfered. The national governments were not able to assess and prevent this destructive process, which, eventually, led to loss of the economic potential in the water sector as a whole and, as a consequence, in irrigated agriculture. While in the past the scope of preventive flushing the subsurface drains amounted to about 2,000 km annually, at present, it makes up only 200 km. It remains only to be surprised that under such conditions 60 to 70% of subsurface drains remain to be operational, though their service life is more than 30 years, of which the recent 15 years only negligible maintenance works were being implemented (10 times less than required).

Orientation towards complete privatization of irrigated agriculture and denial of forms of cooperation were more fatal. Regional irrigated agriculture adapted to larger mechanized forms of production has practically degraded, being accompanied with considerable decrease in water and land productivity.

It is interesting that while the world suppliers of grain, such as the USA, Canada, and China, as well as of cotton, such as the USA and China focused their attention to large-scale farming and a high level of mechanization, recommendations for our region were aimed at small-scale privatization. As a result, the average plot of an arable land was reduced to 1 ha in Kyrgyzstan, 4 to 6 ha in Kazakhstan and 10 to 15 ha in Uzbekistan. High-efficient production of such crops as cotton, wheat and corn is impossible under given conditions. Therefore, some years later, an opposite phenomenon could be observed: consolidation of plots. For example, by 2005 in South-Kazakhstan Province, an average area of plots has increased up to 18 to 20 ha through sub-tenancy, transfer of title to tenancy, etc.

At the same time, the Japanese approach that is the most appropriate for small-scale farming and is based on combining cooperative and regional forms of ownership and responsibility was disregarded and not disseminated in the region.

Decrease in irrigated agricultural productivity under transition from the customary method of works (collective forms) concurred with the drop in prices for agricultural outputs (Figure 6.11). Figure 6.11 shows that over the recent 15 years, grain prices decreased twice, cotton - 1.5 times and rice more than twice. This has led to an abrupt drop in profitability of irrigated lands in the region. Data given in Table 6.6 taken from the Water Resources Management and Agricultural Production program (EU TACIS Program, 1994-1998) and the GEF Project: "Water Resources and Environmental Management in the Aral Sea Basin", Component A-2 ("Water Conservation", 1998) financed by the World Bank shows that the mean profitability of irrigated land decreased from 300 - 980 US$/ha in 1993 - 1995 to 150 - 580 US$/ha in 2002.

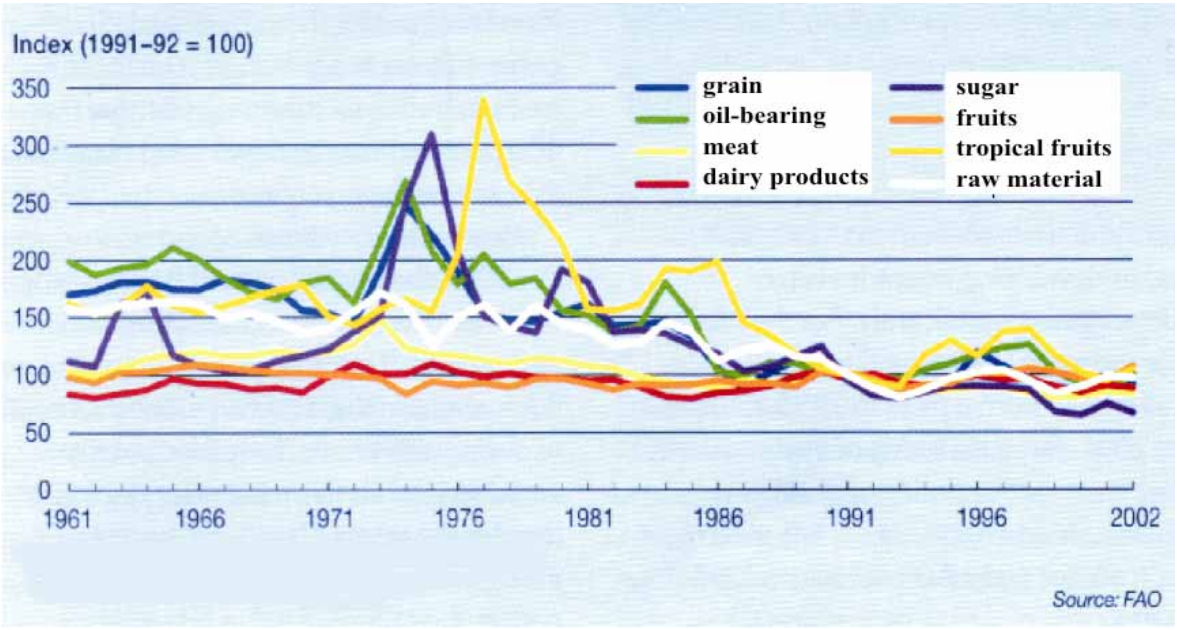


Figure 6. 11 Trends of Prices on Agricultural Output (1961 to 2002)

Table 6.6 Comparative Data on the Gross Revenue in Irrigated Farming

Country	Revenue, $/ha	
	1996	2002
Kazakhstan	982.0	356.0
Kyrgyzstan	759.9	578.9
Tajikistan	719.2	334.6
Turkmenistan	483.0	296.0
Uzbekistan	250.7	151.4

At the same time, calls for full payment for irrigation water-supply services and transferring responsibility for O&M of irrigation and drainage systems to farmers have resulted in the fact that farmers and water management organizations were unable to maintain the required operability of the irrigation and drainage systems, in particular, sprinklers and drainage tube-wells. Consequently, some irrigated lands were abandoned (about 1.0 million ha in Kazakhstan and 260,000 ha in Kyrgyzstan).

The case of Makhta-Aral District in South-Kazakhstan Province is typical. Here, based on efficient operation of drainage tube-wells, cotton yields averaged 3.5 tons/ha over the period of 1980 to 1999. However, over the period of 1991 to 1997, drainage tube-wells have failed over an area of 90,000 ha because of lack of control and maintenance by operational services, followed by soil salinization. The Kazakh Government has taken loans from the Asian Development Bank (ADB) and the World Bank for the rehabilitation of drainage systems, over an approximately 35,000 ha. However, after the rehabilitation, they are again not operable since 2003, due to lack of maintenance as farmer's net income of 250 to 300

US$/ha cannot cover the required maintenance costs of 60 to 80 US$/ha. As a result, during the recent decade, cotton yields amounts to 1.7 to 1.8 tons/ha, less than half of former yields.

The water sector faces a similar degradation. Budget deficit and the tendency to cover this deficit at the expense of fees collected from water users have led to the situation, where over the last 15 years, financing of main water infrastructure was substantially reduced (up to 14 to 15 US$/ha against former 80 to 120 US$/ha). At the same time, a greater share of finance is covering consumption of electric energy, with dramatic rise in price.

Thus, in economic terms, increase in the regional openness for the world tendencies had a negative effect and even, to a certain extent, became destructive for the sustainability in the water sector and irrigated agriculture as a whole. At the same time, it would be incorrect to forget about the great positive effect of increased attention to water in the world during the last 10 to 15 years. Undoubtedly, this should have an effect on Central Asia.

Water is a definite subject of world attention

Awareness on growing water deficit in the world has stimulated active establishment of international organizations and initiatives that involve many governmental and non-governmental organizations, decision-makers, intellectuals, water professionals and promotes water-related intellectual, ethical, informational and technological development. The World Water Council, four World Water Forums, the Global Water Partnership (GWP), Kyoto Protocol, the World Water Vision Report (Cosgrove and Rijsberman, 2000) at the Second World Water Forum in the Hague and the Resolutions of the Bonn Conference (Ministerial Meeting, 2001) have played an immense role in focusing the world attention. The attention of policy-makers (and not only in water management organizations but also in nature conservation agencies) to the need for a radical reorientation of water sector, from meeting water demands towards managing water demands and achieving the potential productivity of water in all economic sectors. Dissemination of advanced approaches and methods, addressing water issues, and their popularization have facilitated practical steps towards IWRM in many countries. It is very important to understand that there is a possibility to meet the needs of society at the rates of water consumption amounting to 250 to 450 m3/year/per capita even in arid areas of Jordan and Israel, based on the modern technical decisions. Also, the comprehensive policies of these states, which stimulate water conservation and supports financially and legally, the systems of upto-date water use and management, demonstrating a participatory approach in the governance of the water sector. Activities of the Global Water Partnership, ADB, Swiss Agency of International Development and Cooperation (SDC), EU with its Water Framework Directive (the European Commission, 2000) has promoted, first of all, the professional understanding of Integrated Water Resources Management (IWRM) and then its political support. Study tours, training seminars and advanced courses have rendered great assistance. Instructive examples have been demonstrated during visits to the French basin water management organizations; the water confederations in Spain having more than 70-years experience of integrated water resources management, and water communes in Italy. All of them use the combination of hydro-geographic principles of water resources management with active participation of water users and their representatives in these activities (see Introduction).

The Japanese experience is worthy of praise, in particular the way that country manages to harmonize interests of nature and society under an immense population density. The same careful and respectful attitude to water is in the Netherlands, Canada and Switzerland and rudiments of hydro-environmental basin management is in the USA, are demonstrating the expediency to follow these practices and applying the instruments of rational natural resources use in developing countries and countries with transition economies.

A role of international financial institutions

At the first stage of transition from the former soviet system to market relations, the World Bank and other international financial institutions made positive contributions. Highly qualified professionals from these organizations selflessly and driven by high human aspirations rendered assistance to local specialists in

coping with rules and regulations of these institutions. It took ten years to introduce appropriate advanced technologies, equipment, computerization, informatics and sophisticated methodologies. After 15 years of donor involvement, water management organizations and conservancies in Central Asia have managed to understand differences in approaches of various donors and their ways of collaboration with partners.

In quite a number of cases, donors' have supported local beneficiaries. These supports were in the manner that created opportunities for self-expressions, sustainability and use of democratic approaches to tackle problems, at the first stage with donors' support and then with their monitoring and participating. They mobilized the preparation of strategic approaches on a long-term basis, training of local specialists in advanced methods and practices, manpower development and raising awareness in western "approaches" as well as developing our own approaches adapted to new conditions. This is demonstrated in projects such as IWRM-Fergana Project being implemented by the SIC-ICWC together with the IWMI with the support from SDC (Switzerland), Canal Automation Project and SIC-ICWC Information Exchange Project, the SIC-ICWC Training Centre Project under supporting by the CIDA and McGill University. Such projects have laid the stable foundation for survival and effective functioning. In this case, donors acted in the interests of local needs and tried to satisfy priorities and tasks of beneficiaries without any political, economic and other preconditions under full mutual confidence in the project implementation. At that, local specialists are considered as equal partners and executives. Such donors are represented by Switzerland, Canada, the Netherlands, the NATO's Program "Science for Peace", the ADB, the EU with its programs FP-5, FP-6 and the International Association for the Promotion of Co-operation with Scientists from the Newly Independent States (INTAS). Another group of donors imposes their own priorities on beneficiaries, doesn't trust local specialists, delays fund allocations for longer times and puts conditions under which practically 70 to 80% of the funds return to the donors themselves in the form of paying for their consultants, equipment, etc. In addition, their projects usually are not aimed at final results, and in this case, the funds allocation is more important than its effectiveness.

It is necessary to consider separately the cooperation with the World Bank in the Aral Sea issues. The World Bank represents the complicated bureaucratic system where decisions on selection, preparation, approval and acceptance of projects by Bank officials take several years, even for projects, which are supported in principle and rather low-cost. For example, the strategic project: "Water Resources and Environmental Management in the Aral Sea Basin" (its total cost of US$ 12.2 million; with the participation of five Central-Asian countries) that was financed by the Global Environment Facility (GEF) took four years for preparation and also four years for implementation. The project was completed in 2003. Selected Consultants did not fulfill the Terms of Reference, but the money was spent and all were satisfied - the consulting company obtained money, the World Bank closed the project, however the region did not receive the expected strategy.

Meanwhile, during the first stage of the ICWC and World Bank's cooperation, the work was well organized. Then the project "Principal Provisions of the Water Management Strategy in the Aral Sea Basin", as the inception of the above-mentioned project was implemented by local specialists with one moderator from the World Bank (Professor Janusz Kindler). However, further, the World Bank predestined to local specialists (no the institutions) a role of helpers doing the legwork and obtaining salaries ten times lower than salaries of foreign specialists. Because of the limitations imposed by borrowers and donors, local organizations could not independently take part in the biddings, resulted in drastically reducing the capacity of national research and design institutes in the region.

One of examples of high efficient assistance is the SDC donor support. The SDC has allocated funds for establishing the automation and monitoring system at waterworks of the BWO "Syr Darya" in the Fergana Valley. The Kyrgyz Company "SIGMA" was contracted to equip water infrastructure with SCADA under the supervision of the SIC-ICWC. Earlier this company had worked for the space industry. The "SIGMA" has executed the works related to automation of all structures in a short period of time at an average cost of US$ 6,000 per one automated point (see Chapter 5). The accuracy of water distribution has risen from ± 10% to ± 2% under extremely variable flow regimes of the Naryn River downstream of the Toktogul Reservoir with changes in daily flows up to 200 m3/s. For comparison, the same work done by French companies on the Southern Golodnostepsky Canal (Uzbekistan) has cost almost three times higher. The well-known French automation expert, Mr. Hervé Plusquellec gave the following assessment of works made by "SIGMA": "According to actual data on automation system performance at the Uchkurgan Hydroscheme, one can note that the system operated stably and performed key functions of automation and data collection on waterworks technological parameters over the period of 2002 to 2006. This system,

providing automated regulation of water and flow rates in the Additional Feed Canal (AFC), the Big Fergana Canal and Northern Fergana Canal, ensured stable water supply under considerable fluctuations of flow rates and water levels in the forebay of the waterworks due to the daily power-generation regime of the Uchkurgan Hydropower Station. At the same time, it is necessary to note that costs of installation and O&M of this system were much lower than those in western countries" [38]. Thus, the effectiveness of donors' assistance could be increased largely in the case of raising the trust to the local capacity of beneficiary countries. Analysis of donors' contribution to the Aral Sea Basin Program, Phase 1 (ASBP-1) and a number of other projects implemented together with ICWC institutions (Table 6.7) shows that, on average, only 30% of the funds that were declared in IFI reports as the assistance to developing countries actually reaches the beneficiaries.

The extremes are represented by SDC, INTAS, and ADB projects where 70% of the funds are directly allocated to the beneficiaries (Table 6.7) and the assistance of the USAID and the EU TACIS program, where these funds amount to only 10 to 25%. There is no doubt that donors must retain functions of supervision over the final results and overall monitoring of project progress, but shouldn't be engaged day-to-day supervision over every step. To ensure successful implementation of the integrated regional programs there is a need of establishing a Board of Donors that will address the coordination and interaction issues. Such an arrangement will allow the international donor community to utilize funds in the efficient manner and to avoid the dissipation of resources, duplication of advertising campaigns and rivalry among donors. At the same time, this might enhance the prestige of donors' community, concentration on joint efforts for providing assistance to developing countries and improving local living conditions.

Table 6. 7 Use of Donor's Funds by Beneficiaries Themselves

Project	Donor	Project amount, 000'USD	Including: used by beneficiaries
Principal Provisions of the Water Management Strategy in the Aral Sea Basin	Global Environmental Fund (GEF)	540.0	420.0
Evaluation of Previous Pilot Projects on Irrigation and Drainage in Central Asia	WB	100.0	100.0
Water Resources and Environmental Management in the Aral Sea Basin	GEF	22,500.0	5,200.0
Developing Recommendations on Distributing Costs and Incomes under Joint Inter-State and Cross-Sectoral Use of Irrigation and Hydropower Schemes on Transboundary Rivers	USAID	22,160.0	204.0
Automated System of Management and Control of the Dustlik Interstate Canal Headwork	CIDA	1,520.0	600.0
Water Resources Management and Agricultural Production in Central Asia	EC TACIS	10,781.0	2,796.0
The Aral Sea Basin Development Program, Component "Creation of Model Instruments on the Basis of Interaction of Water Resources, Socio-Economic Development and Nature in	UNDP	220.0	104.0

Project	Donor	Project amount, 000'USD	Including: used by beneficiaries
Central Asian States for Training and Use by Decision-Makers"			
The System of Automation and Dispatching of the Uchkurgan Hydroscheme on the Naryn River	SDC	5,954.2	4,116.0
Integrated Water Resources Management for Wetlands Restoration in the Aral Sea Basin	NATO Program "Science for Peace"	240.0	195.0

Monetization of the Water Sector

The significant deficit of investments in water resources development has resulted in arising two negative tendencies in the global water sector. The first tendency is the concept "water is an economic good" pushed by many monetarists who called for full payback for water storage, extraction, delivery and use, and the second one is privatisation of water infrastructure.

The slogan stated by the former World Bank Vice President Mr. Serageldin "water is the oil of the 21st century" gained the great support from financial circles. They saw in this approach the way to water monetization and making it a source of profit like other global goods - oil and gas. The legislations of some USA states widely support the water right to be going public. In regions of intensive development like Denver (Colorado), where all water resources have been distributed during the 19th century, this has led to monthly auctions where the cost of one share for the perpetuity of 1 m3 of water increased up to US$ 20. Stakeholders firstly sold shares for saved water and then water from all irrigated areas. If this trend would expand all over the world, mankind might lose up to 40% of the food being produced by irrigated agriculture due to competition of industrial and other economic sectors. It is not a real threat to America - this rich country will provide food for its population but what can developing countries do? Who will buy water to support the poor and the environment?

However, water (in contrast to oil) is a vital element of the noosphere[59] - it is "blood of life", natural essence and social security, non-observance of which will result in death of most of the global population. Only air can be equated with water in its value for human beings, because nothing can replace water and air. People can live without oil and gas over a period of all their life but without water only during one week! Oil can be replaced by coal, firewood, hay or electricity. Brazilians already successfully use bio-ethanol instead of oil, but nothing can replace water. The principle of water has an economic value that was stated in the Dublin Declaration should only support its rational use but not its trade, in any way. Water can become an economic good only after satisfaction of social and environmental needs under certain conditions: lack of water scarcity, possibility of its delivery at any time without damage to basic needs and in case of the capability of competing uses to pay for delivery of excessive amount of water.

Attempts to legalize the trade of water as a commodity were undertaken in the North American Free Trade Agreement (NAFTA) and in the World Trade Organisation (WTO). The new General Agreement on Trading Services (GATS) indicates the water supply services under the category "environmental services". Kavanah and Mander (2002) are absolutely right, proving that water monetization and privatisation according to free market laws deprives water of social properties since, in this case, access to water is ensured only to those who have money to pay.

Unfortunately, these trends affected the Central Asian region as well, when upstream riparian countries provoked by some donors began to compare water with gas and oil and to require from downstream

[59] The noosphere is 'the sphere of human thought' in addition to atmosphere and biosphere

riparian countries not their share of costs in maintaining common water infrastructure but charges for water as an economic good.

Fragmentary awareness of international experience by poorly-educated representatives of "a new democracy", with support of some international consultants, have initiated the campaign for sale of natural waters of transboundary rivers to downstream riparian countries, for example, Naryn River water to Kazakhstan, Tajikistan and Uzbekistan at the rate of US$ 0.12 per m3! Water sales by the Imperial Valley System to Los Angeles and San Diego or water auctions in Colorado are taken as the precedent, but it was forgotten that not the water but the licenses (the right for water within the state) were sold.

At the same time, sale of free water within WUAs and between them, as well as creating economic incentives for water conservation should be supported and expanded.

Another side of the conception "water is an economic good" consists in the fact that the mega-companies with their aspiration for privatisation were attracted to the market. Though this was camouflaged by noble objectives - covering deficit of funds for water resources development by means of private investments, however, it at once resulted in an increase in water charges, decrease in cost recovery and, in turn, in investment outflow from the water sector.

Fortunately, the experience of privatisation was limited to activities of the only one Company "Tractebel" in Kazakhstan - this company was forced to go away because the social potential for water and power consumption was found completely unprofitable for such methods.

Discussions on issues of private participation in water management are still "seething." However, one thing is clear - water management in itself, being the element of state security, cannot be handed over into private ownership; the private sector may be involved only for providing certain services in water management under strict state supervision. Participation of companies and their capitals in water management improvement, water infrastructure development, water conservation and wastewater recycling should be supported by the state because the experience of water managers can help in raising the efficiency of water conservation.

Globalization of Water Resources

Can we speak about this process in principle? For instance, availability of water resources at the rate of 17,000 m3/ person/year in Brazil cannot cover water shortage even in northern district of Mexico, where amount of available water resources makes up 1,400 m3/person/year, let alone shortages in the Sahel region or the Takla Makan Desert [46]. Water demand of mankind is so huge and water conveying is so expensive that transfer of water from water-rich Turkey to money-rich Israel mainly remains as a subject of feasibility studies rather than of real actions.

Nevertheless, thanks to Toni Allan and Michael Rosegrant, many publications that treat water as a resource of global character have appeared [50]. According to the very interesting generalization made by Ashok K. Chapagain [46] water globalization reveals itself in:

- establishing many global and regional institutions that are aimed at tackling challenges of transboundary water use and developing the policy coordination of governments. In confirmation his words, he gives the examples of the Mekong River Commission, the Regional Commission for the Okavanga River, and the Nile Basin Initiative;
- diversion of runoff from one river basin to another one;
- bottled water trade;
- privatisation of water based on recognizing it as an economic good; and
- virtual waters as a tool of global influence on the water use efficiency and covering an water deficit.

The first two facts are of the regional nature, rather than of the global one. According to P. Gleick [50], a sales volume of bottled water of 144 million m3 is insignificant to speak about the ability to cover the water deficit on a global scale. In addition, nobody can make an example of export-import of bottled water between countries. At the same time, the technology of water bottling, as well as equipment for this production can be easily procured and installed; therefore, this is a local process for meeting the demand of either country or any region suffering from shortage of safe water.

Privatisation of water based on recognizing it as an economic good, as mentioned above, is rather a tool of financial and economic pressure; and the number of its supporters, especially, in light of water conservation for the environment (who has to pay for water for nature?) is decidedly reducing. There are more realistic mechanisms to affect global processes in terms of water resources use:

- output prices of irrigated agriculture as the main water consumer in the world;
- electric energy prices and their trends due to the price growth of energy resources and the attempts to transform hydropower generation into a geopolitical tool similar to gas and oil production; and
- the growth of "virtual water" pressure as the incentive for international competition in contrast to the need of developing and supporting the irrigated farming sector in developing countries and countries with transitional economy.

Recent prices on agricultural output at the world market are far from reflecting the actual crop production costs of irrigated farming. The disintegration of the USSR concurred with an abrupt landslide of agricultural output prices, which was mainly caused by subsidy policies of the world leaders such as the USA and the European Community. One cannot better describe this process than A. Shady [44] did: "Subsidizing the national agricultural sector by developed economic systems causes considerable distortions and lack of support to billions of the poor. These systems can assist the rich to become richer based on subsidies to agriculture currently reaching US$ 300 billion a year. Major actors are the EU through its Common Agricultural Policy, which amounts to half of the EU budget, from which US$ 100 billion were allocated to European farmers in the form of subsidies in 2002, and the USA with its subsidies reaching US$ 40 billion in 2002 and ever growing. At the most, 10% of subsidy recipients, accounting for 313,000 farms, received more than US$ 104 billion of subsidies in the USA in the period of 1995 to 2004. This is 72% of the total subsidies during this period. When considering all OECD countries, this form of support is evaluated as 31% of the total farmer's receipts, including: 18% in the USA; 36% in the EU; 70% in Japan and 75% in Switzerland."

An example of the cotton prices is typical. The USA, while producing 3.6 million tons of raw-cotton, grants almost US$ 4 billion a year to cotton-growing farmers, i.e. US$ 1,000 per ton. This means that production of each ton of raw-cotton for American farmers is half the price of that for Central Asian producers. The USA, being one of the leading world cotton suppliers after China, has set dumping the world cotton prices during the last 10 years of the 20th century (the landslide of prices from US$1,750 to 1,880/ton up to US$ 880 to 1,200/ton).

Western subsidies practically made it impossible for the Central Asian fruits and vegetables to compete with the European ones in the Russian market, and Russia is buying cheaper fruits and vegetables with much worse taste. Thus, developed countries protect their national markets and agricultural production and, concurrently, promote the commodity invasion into developing countries. As mentioned above, this resulted in landslide of world prices on agricultural output nearly two times in comparison with 1980 and in *stagnation of developing agricultural production in many developing countries that became unprofitable without vigorous state support*. Roughly speaking, developed countries stimulate the dependence of developing countries from import. Today the consequences of this dependence can be not as painful as in the future when domestic commodity producers will be winded up and world prices again will go up resulting in still worse living conditions for the poor in these countries.

When any country imports more than 30% of food products, it is at the risk of the food security. However, agricultural production is closely linked with overall economic development of each country, since the agricultural sector obtains its resources from 8 sectors of economy, and at the same time, provides inputs necessary for functioning of sixty other economic sectors. According to data of the Russian Academy of

Agricultural Sciences, each employee in agricultural production provides job for five employees beyond the agricultural sector.

Adherents of globalization convince that powerful large-scale agricultural and industrial production and unlimited trade would become the determinants in fighting against famine and environmental degradation. They forgot that capital's egoism and its derivatives, as well as aspirations of the rich to be richer while they get away from real tackling the global famine and poverty challenges by means of granting "crumbs" of welfare, block these good intentions. Such a charity has also created the global network of quasi-philanthropic lobbyists, which capture a substantial share of funds into own pockets under the pretext of helping the poor and starving people.

Hydropower generation prices are another factor of global impacts on the water sector, in particular on irrigated farming. The fact that key power-generation facilities are usually located in upper courses of rivers creates competition regarding flow regimes with irrigated farming most areas of which is mainly located along the middle and lower reaches of rivers. There is a risk that two tendencies - the growth of energy costs (Figure 6.12) due to the increase in oil prices and the drop in agricultural production prices - can create unequal, in economic terms, conditions for compensating the so-called "loss of profit" to the upstream countries by the downstream countries.

Up to now, this problem has arisen only at the Naryn-Syr Darya cascade. Kyrgyzstan and Tajikistan utilize their water resources, first, in the interests of meeting their own energy demands and in expecting some benefits from the downstream countries. An intention of upstream countries to utilize their hydropower potential that is partly developed to obtain the maximum profit is quite understandable.

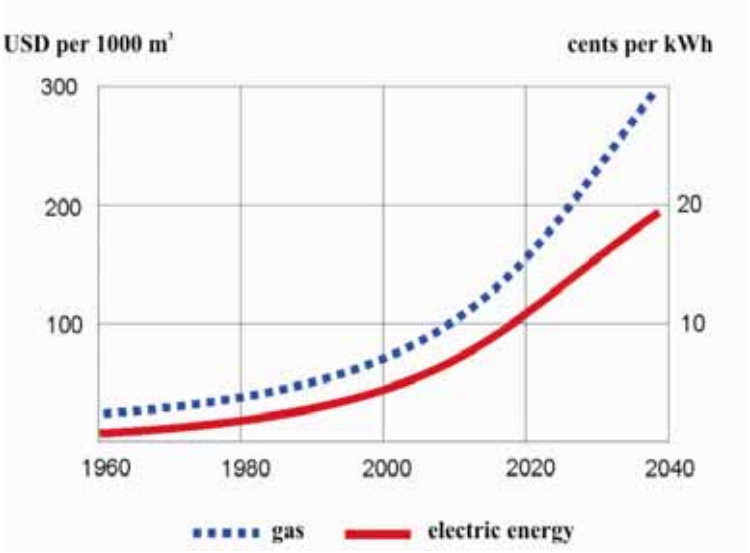


Figure 6. 12

The Global Growth of Gas and Electric Energy Prices

Besides, in the Soviet period, the principle of the common international law: "do not harm, otherwise pay" was applied in Master Plans developed for the Amu Darya and Syr Darya basins. The integration that is in fashion now was provided for by means of using the hydropower potential in such a way that would allow avoiding conflicts with interests of irrigated farming in the middle and lower parts of river basins and with deltas' demand. At present, all countries in the region exploit their hydropower potential only on the basis of the large water infrastructure constructed during the Soviet period but under departure from the principles established at that time - transition from water releases from upstream reservoirs in line with the irrigation-oriented schedule towards mainly the power-generation-oriented schedule.

This problem was partially solved by signing the Agreement of 1998. According to this agreement the excess electric energy generated above the demand through summer releases should be compensated by countries located along middle and lower reaches of rivers at agreed prices. Currently, electricity prices (US$ 00.2 to 00.3/kWh) are still comparable with market prices (thermal energy costs US$ 00.45/kWh) but what is expected in the future? Therefore, Uzbekistan is already striving for almost full satisfaction of its demand for additional water through use of releases from the Andijan Reservoir and, partially, through construction of in-channel basins. Such an approach is possible in wet and average years relative to water availability but fails in dry years.

In addition, prospects of developing hydropower sector in the region, including an opportunity to construct the cascade of the Kambarata Hydropower Stations (HPS) on the Syr Darya River, Ragun HPS on the Vakhsh River, Dasht HPS and Juna HPS on the Panj River attracted attention of the World Bank and even

of the large financing actors in USA, Iran, China and Russia. A possibility to export hydropower to Pakistan, Afghanistan, China and other energy-deficit countries will create commercialism for the hydropower sector and ability to establish, as a lost profit, higher prices of winter electric energy 2 to 2.5 times. A solution should be found using different instruments acting at the regional level, such as:

- Signing the new Agreements on the Syr Darya and Amu Darya rivers, as soon as possible, which have to state the provisions for new construction and operation regimes of reservoirs taking into consideration the interests of hydropower, irrigation and environmental flows. In particular, this Agreement should clearly set obligations of the parties regarding the rivers' demand as the natural object and of other riparian countries' demands. The principle "do not harm, otherwise pay" implies that any country that causes damage or is planning to undertake actions that may cause damage should enter into negotiations with the neighbouring countries and will have to implement a set of measures to prevent the expected changes, or compensate losses or pay for damage;
- Thus, agreed actions are needed to prevent probable damage. At the same time, one should bear in mind that the successful parity management of transboundary waters is feasible only if all the countries are not aimed at maximum effect for one country, and observing the so-called Pareto's principle, according to which every party can get a maximum effect without damaging another party;
- The present system of relations concerning the Naryn-Syr Darya cascade result in regular neglect of the environmental flows through the Syr Darya River in summer and in floods in the lower reaches in winter. If to evaluate the social and economic losses and to counter-claim to the hydropower sector, then it would be hardly advantageous for the latter to strive for maximum profit. Thus, if the consensus regarding equal profits will be achieved then the solution could be found: the effect of hydropower development while meeting the clear-cut reasoned social and environmental demands with specified compensations;
- Riparian countries by uniting with the countries interested in electricity supplies should establish the water-power consortium for constructing and operation of hydropower station cascades that would balance the demand of electricity supplies proceeding from the demand of country-recipients and satisfy irrigation, nature and other downstream users' demands as specified by the ICWC;
- Establishing the River Basin Council in each river basin as the public body for governing activities of the BWO, which along with ICWC members, i.e. representatives of the national Governments responsible for water supply will include representatives of all provinces located in the basin and large water users such as the hydropower sector, delta management organizations, and conservancies. Their involvement and public control over management will promote equal and equitable water use and allocation on transboundary rivers.

It is advisable to consider and apply the experience of Canada and the USA, where hydropower station management is separated from river water management, and those in charge of hydropower buy water from the US Bureau of Reclamation or from Canadian provincial water organizations.

The Concept of "Virtual Water"

Thanks to Tony Allan's publications, the concept of virtual water has been recently developed. According to this concept a volume of water required to produce commodities or services which are exported from one country into another one creates an opportunity to reduce water demand in country-importer, especially in countries with scarce water resources. In the case study of the Middle East countries, such as Israel and Jordan, the concept was demonstrated as the means for country survival when water availability was less than 500 m3/year/capita. A. Hoekstra [47] and especially recently A. Chapagain [45] made a great contribution to the dissemination of this concept.

The approach is quite interesting for researchers and analyzing redistribution of water used for producing various commodities and services among countries. However, it doesn't discover any new fragment in the general picture: taking into account virtual water, water consumption per capita in countries of the G8 amounts to 1,676 m3/year whereas in other countries only 1,160 m3/ year.

However, the USA with a consumption of 2,483 m3/capita/year is on the top of water users' pyramid, and at the same time, in China a minimum amount of water is consumed (702 m3/capita/year). A very interesting situation is observed: the USA consumes more than 330 billion m3/year of foodstuffs produced using alien water and, hence, is responsible for pollution and depletion of almost 8% of the global "blue" water resources. In the similar way, A. Chapagain has estimated that EU countries consumed 20% of water taken out of the Aral Sea. This estimation did not consider losses in the irrigation systems, with accounting of which "the EU's share in depleting the Aral Sea would exceed 30 to 35%"!!! From this point of view, undoubtedly, the approach of "virtual water" is interesting for estimating the profitability of cultivating various crops under different conditions, for selecting the most profitable crops and comparing their potential sale at international or domestic markets. However, all authors make estimations only in terms of water, forgetting at all about economic indicators that are derivatives of income, especially in such areas as processing, marketing, consumption, as well as about economic benefit of agricultural production in itself, the role of associated effects and the social value of irrigated farming.

In addition, a water-dependency index taking into account virtual water is introduced in contrast to the food independence notion. A water-dependency index, as proposed, and assessment of water deficit based on virtual water create distorted picture of national food self-sufficiency. J. Worner [51] correctly noted that under the conditions of price fluctuations at the international market, an opportunity of developing countries to provide their population with food at reasonable prices may be lost due to a jump in import food prices or a great drop in export food prices. Therefore, the index (a water-dependency index as the ratio of the net virtual water import and the total national water resources use as proposed by A. Hoekstra and I. Hung [47]) that seems to be satisfactory may react to any landslide of prices of export showing the need to reduce food import for enhancing "own water security" while the food self-sufficiency can considerably decrease.

Therefore, the national food security is more important than fictitious water security. An index showing a share of consumed food that is produced in a country will guarantee that jumps in prices at the free market will not create the critical social situation in the country.

All publications make casual mention of the very important aspect of irrigated farming in developing countries, i.e. its social value as one of key factors of rural employment and a source of incomes for those who are directly engaged in irrigated farming and for employees in associated sectors, services, etc. In this context, the analysis conducted in the frame of the RiverTwin Project (www.cawater-info.net/rivertwin) is representative regarding a role of irrigation in generating the GDP in rural areas in the Tashkent oasis. A size of income generated on large-scale irrigation areas is comparable with that obtained from crop production and consumption at own small holdings. The latter sometimes exceeds the first mentioned component of rural incomes. Appeals of some globalists to head for the experience of countries ensuring employment in the industrial sector are hardly feasible for developing countries with low incomes, taking into account that the costs of job creation in industry (US$ 10,000 to 16,000 per one jobsite) is several times higher than in agriculture (US$ 1,000 to 2,000 per one jobsite).

Thus, virtual water as an indicator of food production profitability or its non-profitability in any country is just a potential theme for researches and macroeconomic exercises. As applied to countries with the transition economy, deficit of available assets and poor purchasing power, virtual water is a counterweight of national or regional self-sufficiency of food or agricultural raw materials. The policy of subsidizing in developed countries along with propaganda on the virtual water concept can also undermine the financial potential of local producers in the future when food and agricultural production prices will increase (this is quite realistic due to the WTO policy), and then famine challenges will be exacerbated owing to destruction of the national infrastructural potential.

How to withstand the global challenges? National policies vis-à-vis globalization

In our opinion, in such areas as information, scientific-technical and know-how exchange, the openness and opportunities to apply institutional, managerial, communication and other innovative advances, the global tendencies need to be widespread in the water sector and water-related sectors, first of all, in irrigated farming. At the same time, the specific "spirit of water" needs to be created. This implies the spirit of sanctity, free access to safe water, and overall responsibility of communities regarding water resources and water users regarding supporting its exclusiveness and rational use, as well as the overall understanding of impossibility of monetizing water and transforming in an economic good, its pollution and depletion. It seems that there are good lessons learnt from such countries as Japan, Canada, The Netherlands and Switzerland. These water-abundant countries have created the perception of uniqueness of water as both nature component and a public good. This does not mean that water should not be evaluated in economic terms; moreover, only a stable and reliable financial basis aimed at conserving and enhancing the water potential may serve as the cornerstone for the future sustainability of society under the conditions of imminent water shortage.

Water ethics, which was developed in all religions and ideologies, have to be put into practice in the form of specific culture of water perception, awareness of all generations that water is unique for both a human being and nature and of elaborating the global water code as the statute-book with indisputable rules of water relations in the context of water right!

From this point of view, the international water law and UN documents (human rights, international conventions) don't state clear-cut recommendations, guarantees and mechanisms for enhancing the rights to access to safe water, water for food production and water for nature. This implies that these documents cannot be used as the basis for future sustainable water supply for population and society as a whole. On the one hand, the vagueness of many provisions in the international water law that may be interpreted by any country to its own benefit is certain impediment and, on the other hand, the lack of understanding of the enforcement mechanism as a chain of obligations and rights of actors and an opportunity to avoid the bureaucratic influence of national, provincial (governor) and local hydro-egoism at all levels of the water hierarchy from a basin to a water consumer. Understanding the need for elaborating strong and obligatory rules and regulations in the frame of inter-state agreements and the principles of water management at the national level should withstand new regional challenges. In Central Asia, water-related, transport, energy, economic and other interests are closely interlinked, especially taking into account certain geographic isolation of these nations, and only cooperation - and water as its pivot - may ensure the sustainability and long-term prosperity and peace in this region.

The most reliable "compass" for this cooperation is the efficient regional legal and institutional frameworks coupled with a present-day national systems of water governance, which include the National Water Codes and future development strategies stipulating efficient and rational water use, wide introduction of integrated water resources management (IWRM) at all levels of the water management chain, along with public participation and water users' initiatives based on local traditions of careful attitude of all our nations to water.

At the same time, one should also bear in mind that the forces of monetary globalization and egoism will seek various forms and loopholes to exert their pressure on the spheres of economy, policy, culture and education in order to perpetuate the power of money and the permanency of social stratification. As A. Shady underlines in the above-mentioned summary: "One cannot ignore those actors who are driven by their mercenary interests are present at the "water scene". These are large corporations that actively operate in the global food production chain: industrial contribution into agriculture (incomes from sales of ten best goods amount to US$ 370 billion), among which Syngenta, Bayer, BASF, Monsanto and DuPont; food companies of the processing industry and traders (incomes from sales of ten best goods amount to US$ 363 billion), among which Nestle, Cargill, Unilever, Midlend Arkera Daniels (ADM), Craft's foodstuff; food retail dealers (incomes from sales of ten best goods amount to US$ 777 billion), including Wal-Mart, Carrefour, Royal Ahold, Metro AG, Tesco." In addition, there are great interests of hydropower corporations, manufacturers of hydraulic machines and their accessories, financial corporations of "selfish nature."

How to withstand these phenomena? There is only one way. It is necessary to strengthen the national and regional policy that should be opposed to global tendencies and simultaneously make use regional capabilities and globalization advantages. John Ralston Saul in his book: "The Collapse of Globalization" [52] shows that the theory enunciating the freedom of market and competition as key driving forces of the economy and progress has led to a chain of crises like the collapse of the Asian economy in the late 1990s, recession of Canadian development over the same period, and the growth of unemployment even in OECD countries in absolute terms. In contrast to that, China and India, by adapting to globalization trends, are dictating to the world their own rules of play and demonstrates their high and stable development rates. The basis of their success is the national strategy and purposeful policy that take into account market's driving forces and global challenges.

Some peculiarities of the modern market are driving forces of globalization: in particular, at the market of food, fuel and energy resources; deficit of some natural resources; respective natural and social phenomena. One may literally say that these forces, besides apparent management mechanisms and tools, are controlled by "invisible submerged parts of icebergs" such as international financial institutions and international financial and business monopolies reproduced by the globalization. Protectionism, subsidies, public relations and even the fight against international terrorism appear now at this scene as "pros-globalization", while trade barriers, customs fees and liberties, international unions and agreements, and wise national policies are the sides of "cons globalization" that defend national rights, food self-sufficiency, etc.

China showed an excellent example of benefiting from its anti-global strategy in cotton production and processing. Taking into account low cotton price, China processes all of its own cotton, 4.5 million tons a year, in textile manufactured under support by the Government and buys about one million ton of cotton a year at low prices for following processing. At present, China is the world supplier of textile at the expense of advanced technologies and cheap labour. In contrast to subsidies in developed countries, China has developed its own system of supporting agriculture and the water sector. As a result, these two sectors achieved the highest level of development according to both growth rates and crop yields, thus allowing to feed China's population and to provide export of goods.

A role of subsidies in irrigated farming and the water sector depends on those forces which manage these subsidies invisibly for us. Whereas subsidizing of food and technical crop production in developed countries is aimed at market penetration into developing countries, the latter have to protect their own commodity producers. Domestic subsidies or protection of national producers through setting custom and tax barriers for foreign importers can become the only response to backing of foreign producers. However, it is necessary to avoid the influence of personal interests of local bureaucrats, intermediaries, lobbyists who are eager to make money at any cost and often promote import to the detriment of fellow-countrymen instead of supporting national producers. Consequences of such harmful actions are affecting not only agricultural producers; they exert negative impacts on the whole social sphere in rural areas, development and maintenance of transport communications, secondary processing industries and supplementary enterprises, etc.

All these actions tangle a knot of incompetent solutions, which sometimes look like helpful ones, but often end up in failure on the national level. Let us consider the subsidies of the water sector. After independence, the World Bank and other international financial institutions, all the time, were urging on Central Asian countries to refuse from supporting the water sector. To their credit be it said that Uzbek, Kyrgyz and Turkmen leaders have not allowed to do this. Kazakhstan has decided to liquidate almost completely all sources that were formerly used for supporting the water sector and especially land reclamation activities. Initially, everything went well in this country, the Ministry of Finance was pleased, but drainage tube-wells, in particular in southern areas of Kazakhstan, went out of operation. Farmers could not afford to cover operation and maintenance costs of drainage tube-wells at the expense of their incomes. Gradual salinization (that had been forgotten in the nearest past) has now proliferated like a cancer all over Southern Kazakhstan, and crop yields on lands, which formerly used to produce 3 to 3.5 ton/ha/year of cotton, have reduced up to 1.7 to 1.8 ton/ha/year! At present, the Government of Kazakhstan has launched an impressive program of subsidizing the agricultural and water sector that provides considerable support to these sectors in Kazakhstan.

Along with improving the national policy, the co-operation of regional communities, which will enable to develop joint measures for ensuring the regional security including water, power, food and environmental aspects, should become the response to globalization. Regional co-operation allows smoothing the regional differences in demography, availability of land and water resources and ensuring peace and prosperity in

the region. The results obtained at our demonstration sites in all countries of Central Asia show that the cheapest grain is grown in Kazakhstan, most cost-effective sugar and potatoes are produced in Kyrgyzstan, fruits and vegetables in Tajikistan and Uzbekistan and maize in Uzbekistan. When an agreement (like in the EU) on domestic and regional foreign-trade prices on agricultural output will be reached, the region itself will be able to supply all necessary foodstuffs in full. By the way, the forecast up to 2025 allows making the conclusion: if this will not be done then Kyrgyzstan and Tajikistan will fail to meet their demands for food products even in the case of planned development of irrigated farming.

Co-operation of Central Asian states based on the understanding of mutual interests should become a barrier for harmful hydroegoism; since 60% of the rural population in Central Asian countries and 100% of total population, directly or indirectly, depend on water and irrigated farming, and the latter, as in other countries, is related to the sustainability and security of water supply.

Without negating positive implications of global challenges for our countries, it is necessary to note that there are threats related to apparent or latent tendencies of globalism that must be taken into account by Central Asian governments under strategic planning and decision-making. In Central Asia, nations united by centuries-old common cultural, human, social, legal and religious traditions need to use positive factors of globalization and to withstand its negative consequences based on the regional co-operation.

CONCLUSION

The future of this region more and more depends on abilities of countries and their communities to cope with challenges of water deficit. While earlier, the impressions of forthcoming triumph of overcoming famine and poverty all over the world have grown, a few recent years have shaken these complacent convictions. Documents published by the FAO, IWMI (the IWMI Strategy for 2009 to 2011) and other international organizations also give evidence of this concern. As far back as 2005, we established linkage between rising prices on energy resources, and correspondingly on electric energy, and growing competition between such economic sectors as hydropower generation, nature management and irrigated farming. Today, a new aspect of the fuel and energy crisis – developing the production of biofuel and the increase in areas under appropriate non-food crops that earlier were sown with food crops – has emerged at the international scene. A new challenge has resulted in sudden, quite likely, speculative boom of world prices on provisions. Rice and wheat, major food of the underprivileged, have risen in price two and more times. While the population growth, due to its gradual rates, creates slowly increasing "headache" for the governments regarding food supplies to their citizens, such sudden global challenges forces decision-makers to come back to developing the strategy of food self-sufficiency i.e. the food security. Countries of our region face the same perspectives. Under aridness conditions of the Central Asia, the solution can be found only through the growth of irrigated farming output, reducing unproductive water losses i.e. due to further rise in water productivity.

One of the ways for comprehensive improvements in the water and agricultural sector is IWRM. The first wide experience of putting IWRM into practice was gained in the Fergana Valley on territories of Kyrgyzstan, Tajikistan and Uzbekistan, where pilot projects were launched in 2002. Analysis and findings of pilot activities presented in this book were prepared by the think tank of the IWRM-Fergana Project, key specialists of the SIC ICWC and IWMI, as the first generalization of seven-year adaptation of IWRM principles to the conditions of the arid zone in Central Asia. Along with the description of practical activities and case studies of improving the water sector, some theoretical provisions based on former and current studies of national specialists and scientists are given here. The key components of the IWRM concept that we have employed include water resources management based on hydro-geographical principles, broad involvement of stakeholders and water users into the decision-making process by different ways and at different levels, using various sources of water resources, as well as the combination of institutional and technical instruments of IWRM introduction. Integration of these activities has considerably reduced the total water withdrawal into all pilot irrigation systems, and raised their efficiency and productivity of water use. However, the main achievement of this project consists in the fact that IWRM, as the integrated approach, was welcomed by the broad circle of stakeholders. Essentially, public participation, to a considerable degree, is the recovery of former, being existed prior to the colonization, management methods with employing water users' initiative, funds and self-discipline, as well as the traditional institutions such as "water resources management by mirabs (public irrigators)", "organization of khoshars (voluntary public works),"etc. Such an approach facilitates the creation of awareness of local population regarding suggested methods. Seminars, training courses, and conferences held at the regional and national level have shown the considerable interest in our experience of top and middle-ranged specialists in the water and agricultural sector. We have seen the interest of direct water users, whose number exceeds tens of thousands in the frame of this project. Just their attention and aspiration for innovations inspire the optimism regarding the IWRM introduction into the water sector practices in Central Asia.

Many planned tasks were not solved at the desired level including applying the IWRM methods at the basin level, the level of public participation, integration of irrigation and land reclamation activities, and involving non-agricultural water users. During the next phase, we should elaborate and proof in practice the

clear-cut recommendations on putting IWRM into practice in the pumped irrigation systems. Many things have to be done for the improvement and adaptation at the governmental level the methods of financial and legal governance of IWRM in all three countries. At present, especially during the new project phase, one of key project activities is aimed at dissemination of IWRM methods, approaches and instruments over other regions of water use both in the Fergana Valley and beyond its boundaries. Initiating these activities, we have great expectations for close cooperation with other donors of the projects that are in progress in our region.

At the same time, it is necessary to keep in mind the introduction of IWRM in each water district or each new irrigation system, the experience learnt from pilot projects in the Fergana Valley cannot be blindly replicated. Just as each human being has his own traits, each new irrigation scheme can be quite specific in the morphology of irrigation network and water infrastructure or subjected to different economic, legal and financial circumstances in the country or its separate areas. Therefore, the approaches employed and tested by us should be adapted to the specificity of new natural, economic, and social conditions and the system of water resources management.

In the process of introducing new management principles at pilot sites it was revealed that simply "mechanical" transferring the hydro-geographical approach employed in Europe into our conditions with using only participation of local authorities' representatives in the community-based management bodies cannot provides good results in full. Many responsibilities lies with local, district and provincial organizations to implement production plans. At these levels, they manage the appropriate systems of resources supply, technical and ameliorative services, and financing the agricultural sector requirements. A certain combination of water resources management based on the hydro-geographical principles with the administrative management of land resources and nature management is required taking into account some marketing requirements. This approach will be developed during the new project phase.

This book brings to your attention and judgment not only the result of thoughts, ideas and works of authors mentioned at the front-page. This is the fruit of collective work of the great number of formal and informal participants of many projects related to developing the IWRM methods. First of all, it could not be possible to collect necessary information and data for writing this book without continuous not only financial but also technical assistance of the Swiss Agency on Development and Cooperation (SDC). Undoubtedly, active participants, advisors and managers of the IWRM-Fergana Project were Messrs. Juerg Kraenhiebuehl and Johan Gely, chiefs of the Regional Office and Headquarters in Berne, and Messrs. Markus Muller, Urs Herren, Hanspeter Maag. Regarding their participation one can say: "Thought thrives on conflict." The continuous support of Director General of the SDC Mr. Valter Fust, as well as direct participation of chiefs of water management bodies of three countries Messrs. D. Bekbolotov, B. Koshmatov, A. Nazirov, S. Yakubzod, A. Jalalov, Sh. Khamraev were the backbone for developing this project. The real co-authors of this book are most of our project colleagues and partners in all three countries whose input in developing IWRM in the Fergana Valley is hard to evaluate. These are also chiefs and officials of the BISA "Syr Darya-Sokh" (former "Fergana") Messrs. A. Rakhmatilaev, F. Rasulov, R. Rustamov, and O. Khalikov; specialists of the BISA "Syr Darya- Karadarya" (former "Andijan") Messrs. Sh. Ergashev and M. Dusmatov; specialists of Soghd Oblvodkhoz Messrs. Kh. Khojiev and A. Boboev, and the untimely departed Mr. Bakhit Matraimov, chief of BISA "Osh". Personnel of the Ministry of Water Resources and Ministries of Agriculture and Water Resources of Kyrgyzstan, Tajikistan, and Uzbekistan Messrs. A. Djaylobaev, A. Zairov, U. Azimov, and Kh. Umarov have continuously participated in implementing IWRM activities. Specialists of the CARWIB Project Messrs. I. Beglov and B. Turdibaev presented the project activities at the special website.

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