

Report of the

**REGIONAL SCOPING WORKSHOP ON THE USE OF IRRIGATION
SYSTEMS FOR FISH PRODUCTION IN CENTRAL ASIA**

Tashkent, Uzbekistan, 17–20 July 2007



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Report of the
REGIONAL SCOPING WORKSHOP ON THE USE OF IRRIGATION SYSTEMS
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Tashkent, Uzbekistan, 17–20 July 2007

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ISBN 978-92-5-105958-6

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PREPARATION OF THIS DOCUMENT

The Regional Scoping Workshop on the Use of Irrigation Systems for Fish Production in Central Asia (Tashkent, Uzbekistan, 17–20 July 2007) was organized in close collaboration with the Scientific Information Center of the Interstate Coordination Water Commission (SIC–ICWC) and counted on technical assistance from FAO and the Ministry of Agriculture and Rural Affairs (MARA) of Turkey. The Workshop was held in the context of decreasing inland capture fisheries and aquaculture production in most of the Central Asian countries – Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan – after independence from the former Union of the Soviet Socialist Republics in the early 1990s.

This report is the record of the Workshop proceedings, which includes summaries both the presentations made by the participants from the Central Asian countries and those made by resource persons from the United Kingdom, Turkey and FAO.

The report was prepared by the FAO Subregional Office for Central Asia (SEC), in close collaboration with the Fisheries Management and Conservation Service (FIMF), FAO Rome.

Distribution:

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Van Anrooy, R.; Marmulla, G.; Payne, I. (eds).

Report of the Regional Scoping Workshop on the Use of Irrigation Systems for Fish Production in Central Asia. Tashkent, Uzbekistan, 17–20 July 2007.

FAO Fisheries Report. No. 843. Rome, FAO. 2008. 41p.

ABSTRACT

The Regional Scoping Workshop on the Use of Irrigation Systems for Fish Production in Central Asia (Tashkent, Uzbekistan, 17–20 July 2007), was organized by the Scientific Information Center of the Interstate Coordination Water Commission (SIC–ICWC) in close collaboration with FAO and with assistance from the Ministry of Agriculture and Rural Affairs of Turkey (MARA). The Workshop was attended by 31 participants, including stakeholders from each of the five Central Asian countries, a regional institution and FAO resource persons.

The Workshop was held in the context of decreasing inland capture fisheries and aquaculture production in all five countries in Central Asia (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan) after independence from the former Union of the Soviet Socialist Republics in the early 1990s. Millions of rural households in the Central Asian region are dependent to some extent on inland water resources for their livelihoods; inland capture fisheries and aquaculture are potentially important sources of food, income and employment for many of them.

The Workshop aimed to build awareness among policy-makers, administrators and sector representatives of the irrigation and fishery sectors on the need to share information and increase collaboration and review the current status of inland capture fisheries in irrigation systems at the national level in the five Central Asian countries. Further, it aimed to analyse recent achievements, constraints and opportunities in the future to increase inland capture and aquaculture production in irrigation systems in each of the countries.

The Workshop recognized that inland capture fisheries and aquaculture have the potential for increasing productivity of irrigation and water management systems in Central Asian countries. It noted that the infrastructure that used to support inland capture fisheries and aquaculture production has gradually deteriorated since the 1990s due to a lack of maintenance and limited budgets. Consequently, many hatcheries, research facilities, fish landing places, pond systems and cold storage, and processing and marketing facilities are now not functioning. The workshop came up with comprehensive conclusions and practical recommendations in support of inland capture fisheries and aquaculture rehabilitation and development in irrigation systems in the region.

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SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

Since independence from the former Union of the Soviet Socialist Republics in the early 1990s, inland capture fisheries and aquaculture production have decreased in all five Central Asian countries, i.e. Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. At the same time, the maintenance and development of irrigation systems for agriculture and water management systems have increasingly received attention in these countries. Many of the irrigation facilities (reservoirs, canals, residual basins) are suitable for fisheries purposes, but currently their potential for fish production is hardly used.

Millions of rural households in the Central Asian region are dependent to some extent on inland water resources for their livelihoods; inland capture fisheries and aquaculture are potentially important sources of food, income and employment for many of them.

The Regional Scoping Workshop on the Use of Irrigation Systems for Fish Production in Central Asia (Tashkent, Uzbekistan, 17–20 July 2007), recognized that inland capture fisheries and aquaculture have the potential for increasing productivity of irrigation and water management systems in the Central Asian countries. It noted that the infrastructure that used to support inland capture fisheries and aquaculture production has gradually deteriorated since the 1990s due to lack of maintenance and limited budgets. As a result, many hatcheries, research facilities, fish landing places, pond systems, and cold storage and processing and marketing facilities are currently not functioning.

CONCLUSIONS

With respect to policy, legal and institutional frameworks, the workshop noted the following:

- Linkages between irrigation and fisheries authorities are very limited or non-existent as far as planning and management issues are concerned (e.g. fish passes and screens).
- There are major differences between countries in the region in legislation related to fisheries, water management and irrigation.
- Access arrangements for fishing operations related to transboundary waters appear to differ greatly between countries in the region, due to the changes taking place in the transition and privatization processes.
- Strengthening of institutional capacity of the line authorities involved in fisheries is required, in collaboration with the irrigation authorities (those involved in activities related to fisheries).
- Illegal, unreported and unregulated (IUU) fishing practices are widespread either due to weaknesses in current legislation or institutional deficiencies in the enforcement of existing laws, regulations and decrees.

With respect to water management, the workshop concluded the following:

- The current basin plans in the region do not take into account capture fisheries and aquaculture as users of the basins and their water quality requirements.
- An increase in stability in water delivery to the Aral Sea coast, and particularly, the northern areas, will yield relatively large gains in terms of fish production and livelihoods opportunities. Neither the ecological minimum flow nor the sanitary level of water flows in transboundary rivers is respected in the countries of the region.
- Information on water quality is insufficient because limited water quality monitoring is carried out and available information is not exchanged or accessible for all water users.

With respect to fish production, the following was noted:

- A large part of inland capture fisheries production is based on restocking programmes, following traditional practices, but there are few profitability analyses carried out for such programmes.
- Reservoirs, natural lakes (if part of irrigation systems) and terminal lakes (sinks) are a major resource for fisheries and can rely on natural stocks, artificial stocking or cage culture. Rivers can also be a significant resource for fisheries and aquaculture production.

- The status of natural stocks in the lower parts of the rivers, particularly migratory species, remains unclear. Similarly, the water quality for fish use in these rivers is also uncertain. If water quality is adequate, the priority production systems can include fish ponds, cages and stocking of the canals as well as habitat restoration.

In respect of capacity building, the workshop further recognized the following:

- The previous levels of education and training in capture fisheries and aquaculture are no longer available in the region, which needs to be rectified.
- Research efforts on capture fisheries and aquaculture are currently less than what is needed to support a developing sector, and monitoring capacity needs to be expanded.

With respect to economics and marketing, the workshop stressed the following:

- Fish is relatively expensive in the region, and the markets for specific fish species are uncertain.
- The general investment climate for investing in fisheries and aquaculture is considered very limited and a major constraint to sustainable development.

Finally, in terms of regional cooperation, the Workshop noted that there are as yet neither in place regional strategies related to fisheries and migratory species on transboundary river systems, nor strategies related to transboundary movements of living aquatic animals, although it is clear that such strategies are urgently needed.

RECOMMENDATIONS

In recognition of the above, the participants endorsed the following recommendations of the Regional Scoping Workshop:

Governments in the Central Asian region are encouraged to:

- harmonize the objectives of fisheries legislation on water management and on irrigation between countries with transboundary waters, and update and modernize the laws where required;
- develop, through training needs analyses, a regional capacity-building programme for the fisheries sector, including both short-term in-country training courses and a long-term educational programmes. Training programmes or educational programmes could be carried out in cooperation with, for example, Turkey, the Russian Federation and other states where these systems are well developed. A training centre should be established;
- use a cost-benefit analysis to evaluate the relative efficiencies of all production systems for capture fisheries and aquaculture (e.g. natural production, restocking, ponds, cages and raceways), with a view to encourage investment in feasible activities across the region;
- establish contacts with international financial institutions to increase access to credit and other financial services for the capture fisheries and aquaculture sector, with specific emphasis on small-scale fisheries;
- review the prospects for the better use of species and further introductions of new species and technologies in terms of ecological, economic and social aspects;
- develop national plans of action to deter illegal, unreported and unregulated (IUU) fishing practices in the region, based on the International Plan of Action (IPOA);
- carry out an economic appraisal of revenue generation and the market prospects for different fish and fisheries products;
- take measures to use the sanitary flow in line with international norms, rather than the ecological flow (as defined regionally), which is usually not continuous in Aral Sea affluents;
- support the development of joint ventures in capture fisheries and aquaculture as well as in facilitating and processing sectors;
- conduct a review of irrigation management practices to identify the needs for fish passes, screens and sluice gate management to improve the movement of fish within the systems. This should include the construction and monitoring of pilot and demonstration examples.

International organizations and other donors are encouraged to:

- assist the governments of the region to develop a Regional Strategic Plan for the integration of fish production with irrigation and other water users in the Aral region. The plan should be based on ongoing stakeholder consultations and aimed towards creating a regional enabling agreement and a regional management body;
- increase the scale and accessibility of information on water quality monitoring for all water users via the Internet and other means of communication;
- establish a special department in ICWC with a laboratory for water quality control and monitoring.

The different strategies and programmes should be developed in line with the international treaty obligations of the states – the Ramsar Convention, the Convention on Biodiversity (CBD) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Environmental impacts should also be taken into account.

PART I – WORKSHOP REPORT

BACKGROUND AND OBJECTIVES

1. Since independence from the Former Union of the Soviet Socialist Republics in the early 1990s, inland fisheries production in most of the Central Asian countries, i.e. Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan, has not increased significantly. At the same time, the development of irrigation systems for agriculture has increasingly received attention in these countries. Many of the facilities constructed for storing water and conducting it to the fields are suitable for fisheries purposes, but the fisheries sector is often neglected for various reasons. Consequently, while in theory there is a sizable potential for the rehabilitation and further development of fisheries in irrigation systems in Central Asia, in practice much of this potential is not used.

2. The FAO Expert Consultation on the Use of Irrigation Systems for Sustainable Fish Production in Arid Countries of Asia, held in Almaty, Kazakhstan, 25–29 September 2001 (Petr and Marmulla, 2002),¹ made a number of recommendations towards increasing fish production in irrigation systems in the region. These recommendations included: reviewing the situation with regard to the use of irrigation canals and reservoirs for fisheries; evaluating fish stock enhancements; encouraging artificial breeding technologies; improving available statistics and information on fisheries in inland water bodies; construction of fish passes on a pilot scale; improving laws and regulations on inland fisheries development and management; and enhancing and standardizing monitoring and enforcement activities in relation to inland fisheries. The experts at this consultation requested that the Interstate Commission for Water Coordination (ICWC), located in Tashkent, Uzbekistan, assume a coordinating role in the enhancing of inland fisheries management in irrigation bodies in Central Asia. Moreover, FAO was requested to assist the countries through the organization of a follow-up regional workshop, in which the current situation, achievements and problems as well as the necessary steps for improvement and advancement of fisheries in irrigation systems in Central Asia would be discussed.

3. Considering that food insecurity in rural areas in Central Asia is common among poor farming households in this region, fisheries in underutilized irrigation systems could provide an opportunity to improve rural livelihoods. The rising demand for fish in urban centres in the region adds to the opportunities for fisheries development, which was also emphasized by various authors in *Fisheries in irrigation systems of arid Asia* (Petr, 2003).²

4. At the same time, however, it is recognized that co-management and community-based management schemes for integrated management of inland capture fisheries within irrigation schemes and inland water (storage) bodies such as reservoirs are generally not yet in place, and central management authorities do not have the ways to enforce their policies and management ideas at the local level. As a consequence of low priority given to the fisheries sector, the sector is often not represented in the development and management of irrigation schemes; review studies of fisheries in irrigation systems of various Central Asian countries in the 1990s have shown this. There is no information sharing and inadequate collaboration between stakeholders in the fisheries sector and those in the irrigation sector. A regional scoping workshop was considered necessary to address this gap in communication and collaboration, and strengthen ties between sectors and between public and private entities within the sectors.

5. The Regional Scoping Workshop aimed to bring together representatives of the inland fisheries sector (i.e. fisheries administration/fisheries institutes and fisheries organizations/associations) and representatives of the irrigation sector (i.e. irrigation administration/institutions) from Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan, as well as some international

¹ Petr, T. & Marmulla G. 2002. *Report of the FAO Expert Consultation on the Use of Irrigation Systems for Sustainable Fish Production in Arid Countries of Asia*. Almaty, Kazakhstan, 25–29 September 2001. FAO Fisheries Report No. 679. Rome, FAO. 2002. 22p.

² Petr, T. 2003. *Fisheries in irrigation systems of arid Asia*. FAO Fisheries Technical Paper No. 430. Rome, FAO. 2003. 150p.

experts, donor agencies, and FAO and ICWC resource persons. In this way, it tried to encourage the development of greatly needed strategies to contribute to the generation of increased production, better management, increased food security, rural incomes and more efficient use of available water resources in the Central Asian countries.

6. The Scoping Workshop had five objectives:

- To bring together policy-makers, administrators, sector representatives and other main stakeholders from the fisheries and irrigation sectors in the Central Asian countries to increase awareness in both sectors of the need to share information and increase collaboration.
- To review the current status of inland capture fisheries in irrigation systems at the national level in the five Central Asian countries, and describe how much capture fisheries in irrigation systems currently contribute to the fish production in each of them.
- To analyse recent achievements, constraints and opportunities for future increase in inland capture and aquaculture production in irrigation systems in each of the countries.
- To provide a follow-up on the recommendations and requests made by the FAO Expert Consultation on the Use of Irrigation Systems for Sustainable Fish Production in Arid Countries of Asia, held in Almaty, Kazakhstan, 25–29 September 2001, and particularly, on the needs to identify the necessary steps to increase fish production in irrigation systems.
- To develop practical strategies in support of inland capture fisheries and aquaculture rehabilitation and development in irrigation systems in Central Asia.

7. In view of these objectives, the Workshop was expected to produce the following outcomes:

- increased awareness among policy-makers and sector representatives of the viewpoints of the other sector, mutual challenges and opportunities for furthering collaboration.
- a review and analysis of the current situation (2006/07) with regard to the use of irrigation systems for inland capture fisheries and aquaculture in Central Asia.
- draft strategies in support of inland capture fisheries and aquaculture rehabilitation and development in irrigation systems in Central Asia.
- recommendations for follow-up activities by the inland capture fisherfolk, aquaculturists, governments, and national and international development agencies and donors.

ATTENDANCE

8. The Workshop was attended by 31 participants from all five countries in the Central Asian region, i.e. Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan, as well as from Turkey and the United Kingdom, and from the Scientific Information Center of the Interstate Coordination Water Commission (SIC–ICWC), FAO Fisheries and Aquaculture Department and the FAO Subregional Office for Central Asia (FAOSEC). The list of participants is attached as Appendix A to this report.

PROCEEDINGS

Opening ceremony

9. The Workshop started with an opening address by Mr Viktor A. Dukhovny, Director of SIC–ICWC, who welcomed the participants on behalf of ICWC. Mr Gerd Marmulla, FAO Fishery Resources Officer, conveyed his regards to the participants on behalf the Assistant Director-General of the FAO Fisheries and Aquaculture Department, Mr Ichiro Nomura, and the FAO Subregional Coordinator for Central Asia, Mr Abdellatif Tabet. He thanked ICWC for having made all the arrangements to host this Workshop in Tashkent and the participants for attending. The welcome statements from SIC–ICWC and FAO are provided in Appendix C and D.

10. After a round of introductions during which all participants presented themselves and their institutions, Mr Raymon Van Anrooy, FAO Fishery Officer, proceeded with a historical background on FAO's past activities in support of inland fisheries development in the subregion.

11. Mr Van Anrooy referred to the work undertaken by Mr Tomi Petr (FAO) and some of the participants of the current Workshop on the documentation of the inland fisheries situation in Central Asia in the 1990s. He mentioned the papers published in *Inland fisheries under the impact of irrigated*

agriculture: Central Asia (Petr, 1995)³ and in the FAO Fisheries Technical Paper that was produced after the FAO Expert Consultation on the Use of Irrigation Systems for Sustainable Fish Production in Arid Countries of Asia (Petr, 2003), held in Almaty, Kazakhstan, 25–29 September 2001. He also repeated the main conclusions and recommendations from the expert consultation and concluded that development of the inland fishery sector in Central Asia has been very slow and often negative over the last decade. Following the historical background, he explained the purpose and objectives of the Workshop (see introduction above), and informed the participants of the FAO Fisheries and Aquaculture Web site⁴ and how to obtain information on the Code of Conduct for Responsible Fisheries.

Sessions on the background and country reviews

12. The various workshop sessions were chaired by Messrs V. Dukhovny, N. Beisheke, S. Dilmurod, P. Umarov, R. Celebi and K. Guvanch. The Agenda (Appendix B) was discussed and subsequently adopted. Summaries of most of the papers presented during the working session can be found in Part II of this report.

13. Mr Ian Payne of the Marine Resources Assessment Group Ltd. (UK) started the session with a general background presentation entitled “Introduction to inland fisheries”. He discussed the basis of production, how differing water systems are reflected in fish and fisheries production, lakes and river catches, biomass, and the importance of water quality monitoring. In addition, he provided some specific suggestions for fisheries development in the Central Asian region.

14. The discussion that followed focused mainly on the experiences with cage culture in upstream reservoirs. It was argued that cage culture is often more feasible downstream, although elsewhere in Asia (e.g. Viet Nam and China), good results have been shown, for instance, with cage culture of grass carp and other carp species in reservoirs. When discussing pond culture practices, it became clear that the terminology used was not the same throughout Central Asia; in particular, the levels of intensity of culture practices (e.g. extensive, semi-intensive and intensive culture systems) were mixed up, resulting in some confusion among the participants.

15. Mr Dukhovny of SIC–ICWC presented “Transboundary water collaboration in Central Asia”. He started with an overview of the history of the ICWC, its principles and objectives. He then described the outlook for freshwater availability in the region until 2030, showing that in all scenarios, there is a reduction of water availability per person. He continued by describing the information role of ICWC and Central Asia Regional Water Information Base Project (CAREWIB). The latter is a programme implemented in support of the interstate and national management and development of water and ecological sectors of the Aral Sea Basin. It supports the planning of water, agriculture and related economic aspects at the level of the departments and ministries, ICWC and decision-makers. He also informed the participants of important Internet databases on water resources in Central Asia, such as CA Water Info.⁵ Mr Dukhovny concluded his presentation by discussing the role ICWC plays as a training and capacity-building institution for the region in terms of water resource management.

16. Uzbekistan reviews

“Country review of aquaculture and the potential role of irrigation systems for fisheries in Uzbekistan” was presented by Mr Dilmurod Shohimardonov Deputy Director of Uzbek Research Centre for Fisheries Development. The second presentation on the situation in Uzbekistan, “The use of irrigation systems for sustainable fish production: Uzbekistan”, was made by Mr Bakhtiyar Kamilov.

The presentations emphasized that in Uzbekistan, irrigation is the basis of the economy, although it has had serious impacts on the Aral Sea. Before the 1960s, the Aral Sea contributed 60 percent of fish production in the country and the average catch was 25 000 tonnes. This declined to zero after 1983.

³ Petr, T. 1995. *Inland fisheries under the impact of irrigated agriculture: Central Asia*. FAO Fisheries Circular. No. 894. Rome, FAO. 1995. 62p.

⁴ FAO Fisheries and Aquaculture Web site: www.fao.org/fi/default.asp.

⁵ CA Water Info information can be obtained at: www.cawater-info.net/index_e.htm and www.tc.icwc-aral.uz.

Fish was regarded as the third most important source of protein after milk and eggs, and the government health target is a fish consumption of 12 kg/capita/year for fish. Currently, it is less than 1 kg/capita/year, most of which is produced by aquaculture. It is reported that less than 1 percent of reservoir area is currently used for capture fisheries, whose rates of yield are 2–10 kg/ha. Only a few small fishing brigades remain, which are using parts of the irrigation system usually where the water salinity is less than 6 ppt. Following earlier experience, restocking has shown that putting 20 tonnes of juveniles into reservoirs can produce 1 300 tonnes after three years. Much interest is also emerging in aquaculture. In the USSR era, there was a successful carp-based aquaculture subsector. This is now much less viable, however, partly due to problems with feed and fertilizer, and also to the low commercial price of such fish, of less than US\$2/kg.

The discussion that followed the presentations noted that it is thought that more modern international systems are required, but these obviously need investment. The private sector has shown some interest, but it is suggested that working models are required to encourage investment and, therefore, pilot projects should be inaugurated.

17. Kazakhstan reviews

The first country review for Kazakhstan was made by Mr Dyusembay Magzumovich, Department Head of the Committee on Fish Industry, Ministry of Agriculture. The presentation stressed that in Kazakhstan, the fisheries sector was extremely important during the former Union of the Socialist Soviet Republics period, with fish production exceeding 80 000 tonnes/year. Much of this was from the Caspian Sea, but 8 800 tonnes were also being produced for pond culture with farms in all regions. Since then, overall fish production has dropped to one-third (currently 43 900 tonnes) and pond culture has almost disappeared. In a parallel institutional development, the previous Ministry of Fisheries has been subsumed into departments in other ministries. This has been reflected in a lack of overall start strategy for fisheries development. Similarly, while there is a national target for fish consumption of 14 kg/capita/year, the actual level is closer to 4 kg/capita/year, much of which is fed by increasing imports. Earlier lacustrine commercial fish farms were established together with other improvement measures to assist fish production. Since 2003, a Fish Farming Committee has been established to try to resurrect these measures. Some ten hatcheries have been supported to supply 5 million ha of lakes. This has been further encouraged by new state laws on land and property whereby long-term rental agreements of 10–49 years can be arranged with the state to encourage private investment. Some 1 000 fishers now have rental agreements in Kazakhstan to enable them to fish; those without, pay a fee based on what they catch. There is, therefore, revenue for re-investment.

It was further reported that seven hatcheries can provide 150 million carp fingerlings and 7.8 million sturgeons for stocking. The Workshop was informed that in 2008, some private groups may purchase fry and that the state hatcheries may be privatized. There is a new initiative to develop pond culture by 2015 and to add to existing farms. Further, training of staff is very difficult since there are no regional training facilities.

The second presentation, “Irrigation system use for fisheries production in the Syrdarya River Basin in the territory of the Republic of Kazakhstan”, was given by Mr O. Kystaubayev, Head of Monitoring, National Water Accounting and Water Inventory Division, Aral-Syrdarya Basin Authority. From the irrigation and water resources viewpoint, he suggested that regulation of river flow by cascades of reservoirs in the upper and middle reaches to support hydroschemes and irrigation has led to a severe deterioration of fishery potential of the Syrdarya River and Shardara Reservoir, such that 97 percent of spawning areas have become unusable and fish production, insignificant. However, the creation of the dam in the North Aral Sea, together with dam and water channel remedial works on the river, has helped recreate the wetlands and provide an improved habitat for fish. Even in the Syrdarya River, the mid and lower reaches are unsuitable for drinking and fisheries due to a combination of salinity and agrochemical residue problems. Some fishing units have been renting areas nevertheless. Indeed, most lakes have also been assigned and rented for fishing. While most reservoirs are still used generally for irrigation purposes, more water is now being allocated for wider environmental needs, although there is generally little linkage between irrigation and fisheries interests.

18. Kyrgyzstan reviews

Ms Mayram Sarieva, Fisheries Specialist of the Department of Fisheries of the Ministry of Agriculture and Water Resources Management and Processing Industry presented “The use of irrigation systems for fisheries production in the Kyrgyz Republic”.

The second paper from Kyrgyzstan, “Review on the current and potential role of irrigation systems for fisheries production from the viewpoint of the irrigation sector in the Kyrgyz Republic”, was presented by Ms D. Al’chibekova, Senior Officer of Division for Irrigation and Drainage System Operation of the Water Resources Department of the Ministry of Agriculture and Water Resources Management and Processing Industry.

Summaries of both reviews are available in Part II of this report. The discussion after the presentations was directed towards the possibilities to increase collaboration between fisheries and irrigation sectors, and particularly how the interests of the fisheries sector could be brought to the forefront when rehabilitating irrigation schemes and when designing and constructing new irrigation schemes.

19. Tajikistan reviews

The first presentation, “Position and prospects for development of fisheries and irrigation water bodies in the Republic of Tajikistan” was made by Mr G.N. Karimov, Senior Specialist of the Department for State Control over Use and Conservation of Nature in Sogd Province.

A second presentation from the irrigation sector, “The main problems, solutions and development of fish sector in Tajikistan” was made by Mr S.H. Mahmaddullaev, the Chief of the Gisar Training-Research Centre.

“Fish industry restoration strategy in the Republic of Tajikistan” was then presented by Mr Khaitov Abduvali, Chairman of the State Unitary Enterprise of "Mokhiparvar".

The Tajikistan reviews were followed by some intense discussion on the possibilities for investment in the country, the privatization process, market prices for fish, management regimes in irrigation schemes, and subsidies applied by the state. It was noted that beneficial taxation schemes for the sector are in the pipeline, but that investor interest in the sector is poor. Moreover, it was mentioned that the privatization process is ongoing and that there are fishers associations in the country. As concerns market prices for fish in Tajikistan, it was mentioned that these prices do not differ much from the prices in the neighbouring countries, as the market price of carp species is generally US\$1.5–2/kg. On the subject of management regimes, it was made clear that monitoring for water quality is carried out in some of the main lakes, but that fishery management regimes are not in place. Subsidies are available for water use by agricultural enterprises.

20. Turkmenistan reviews

Only one presentation with the irrigation sector viewpoints was made by the Delegation of Turkmenistan, although a paper from the fishery sector, Inland Fish Resources of Turkmenistan, was also provided. The presentation, “The role of irrigation systems in fisheries production in Turkmenistan”, was made by Mr Khanmedov Guvanch, Head of Department, The Garagumderyasuvkhodjalik Association. Summaries of both papers are available in Part II of this report.

Mr Guvanch’s presentation triggered a discussion on water quality of drainage water from irrigation systems. It was argued that the quality would not be suitable for fish production. It was noted that Turkmen experience with usage of drainage water for fish production was generally good, because there are regulations that restrict release of such water in collector canals. There are, however, uncertainties related to using certain water bodies for fish production; water quality monitoring should take place before any tests are undertaken for investigating the suitability of these water bodies for fish production.

21. Following the country reviews, an overview presentation, “The general principles and implementation of the use of irrigation systems in artificial water bodies for sustainable fisheries and aquaculture” was made by Mr Ramazan Celebi, aquaculture expert of the General Directorate of

Agricultural Production and Development of the Ministry of Agriculture and Rural Affairs of Turkey. The presentation was followed by an exchange of experiences on reproduction technologies and comparisons of prices of equipment and other aquaculture inputs between Turkey and Central Asian countries.

Working sessions

22. In this first working session, the Workshop participants discussed in plenary the priorities for the region in terms of interventions in support of promoting fisheries development and management in irrigation systems.

To facilitate the discussion on priorities for the region, general subject headings were classified as follows:

- Water resources management
- Production (capture and culture) upstream
- Production (capture and culture) downstream
- Policy/legal/institutional frameworks
- Capacity building
- Marketing/processing/trade and consumption

23. Resulting from the above categorization, the priorities for the five countries were as follows:

Priorities related to water resources management

- Increase collaboration between states and sectors involved in natural resource management and protection (Kazakhstan) on control of water quantities and quality.
- Increase recognition of the fisheries sector as important sector for water management and planning among other stakeholders (promotion of the multi-users aspects) (Kyrgyzstan).
- Establish friendly cooperation between different sectors and/or water users (Kyrgyzstan).
- Rationally utilize all types of water bodies for fish production (Tajikistan).
- Ensure that attention is paid to fisheries-related issues during the design and construction of new irrigation and water management systems (e.g. fish passes and/or screens) (Tajikistan).
- Request the government to guarantee that fisheries have access to and can make use of available suitable water bodies (Uzbekistan).
- Rehabilitate the Aral Sea in support of the fisheries sector development (Uzbekistan).

Production (capture and culture) – upstream

- Increase the availability of and access to seeds and fry of different species (Kyrgyzstan and Uzbekistan).
- Develop and introduce modern technologies for complex water use, e.g. fish screens on dams and fish ways or fish passes (Kazakhstan, Turkmenistan and Uzbekistan).
- Renovate production facilities (Kyrgyzstan).
- Support the establishment of modern feed production facilities (Kyrgyzstan).
- Improve species selection and work on genetic improvements (Kyrgyzstan).
- Develop aquaculture in upstream waters, including the introduction of new species (Tajikistan).
- Increase the access to new brood stock/ breeders (with the aim of increasing the health of the stocks and biodiversity) (Tajikistan).
- Develop trout cold-water culture in cages or raceways (Uzbekistan).

Production (capture and culture) – downstream

- Construct fish ways/passes for dams to support migratory species (Kazakhstan, Kyrgyzstan and Tajikistan).
- Establish a monitoring scheme for fish in important water bodies (Kazakhstan).
- Develop a (re-)stocking programme for irrigation systems (Uzbekistan).
- Introduce new technologies for fish production and fish feeding (Turkmenistan).
- Develop warm-water fish culture in cages and tanks (Uzbekistan).
- Increase artemia production in the Aral Sea (Uzbekistan).

Policy/legal/institutional frameworks

- Improve fisheries management through the development of fisheries laws (Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan), including the establishment of a fisheries licensing system (Kyrgyzstan).
- Strengthen the institutional capacity of line ministries and their institutes (Kyrgyzstan, Tajikistan and Uzbekistan).
- Design and implement specific aquaculture laws (Kyrgyzstan).
- Establish a better structure within the line ministries for fisheries support and determine which ministry has the responsibility for fisheries management and development (Kyrgyzstan)
- Increase public awareness on fisheries and aquaculture and the health benefits related to fish consumption (Kyrgyzstan).
- Increase international cooperation on all levels in fisheries (Tajikistan).
- Stop illegal, unregistered and unreported (IUU) fishing activities (especially poaching) (Turkmenistan and Kyrgyzstan).

Capacity building

- Establish education and training programmes at the regional level (transnational) (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan).
- Update the knowledge of specialists working in the sector (Kyrgyzstan, Tajikistan and Uzbekistan)
- Carry out research and development at the regional level (Uzbekistan).
- Establish systematic scientific cooperation (including conference attendance) in the region (Tajikistan).
- Create an international training, demonstration and development centre on the premises of ICWC (Uzbekistan).
- Disseminate the findings, conclusions and recommendations of this and other workshops to the governments in the region (Uzbekistan).

Marketing/processing/trade and consumption

- Study local and international markets for fish and fisheries products (Kazakhstan).
- Provide market information and increase exchange of market information between the Central Asian countries (Kazakhstan and Kyrgyzstan).
- Improve regional trade in fisheries products (and removal of trade barriers) (Tajikistan).
- Modernize processing facilities for fish, including caviar production (Turkmenistan).
- Create a fish marketing support service at the regional level (Uzbekistan).

24. In the second working session, the workshop participants discussed in working groups possible strategies in support of inland capture fisheries and aquaculture rehabilitation and development in irrigation systems in Central Asia. Each working group was requested to base its discussions on one or several priority issues (constraining factors/ opportunities) as identified in the first working session. The proposed duties of the working groups involved the following:

- List the actions/activities (steps) that have to be undertaken to remove the constraint or to take advantage of the opportunity offered. (**What** has to be done and **how** should it be done?)
- Discuss the responsibilities (institutions involved) for each of the activities. (Who should be involved/take a lead?)
- Identify the possible countries to pilot the interventions. (**Where**?)
- Discuss the follow-up on the activities from this Scoping Workshop in terms of responsibilities of various institutions/organizations/businesses, set a time frame to field-test the approach (**who and when?**) and, if time permits, provide a budget estimation for the activities.

The plenary divided into four working groups, each of which was requested to address two priority issues as identified in the first working group session.

The working groups reported the following outcomes of their discussions to the plenary:

Working Group 1

I. Strengthen cooperation between different water users and countries in planning and water resource management.

What should be done?

- A working group should be created under ICWC for the cooperation and coordination between water users and countries.
- Water requirements should be determined for the region, using current monitoring systems as a basis, and a single monitoring system should be established for the Basin of Amudarya and Syrdarya Rivers.

Who should be involved?

- ICWC should take the responsibility for coordinating all activities of the working group. Representatives of all water-using sectors of the region should be involved.

What are the follow-up activities?

- Further cooperation should be strengthened between water users. Furthermore, it is necessary to conduct workshops and training on integrated water resources management in each of the countries of the region.

II. Rehabilitate the Aral Sea and its fish stocks.

What should be done?

- Eco-sanitary measurements should be established for water along the Amudarya and Syrdarya Rivers.

Who should be involved?

- ICWC should confirm the volume of discharge for eco-sanitary measures. Representatives of controlling units (ecologists, water management specialists, fishing inspectors) should control water discharge into the Aral Sea with support of the relevant authorities.

Where should the interventions take place?

- Diversion of rivers from Siberia into Aral Sea could be an option. In this respect, the governments of five Central Asian countries might make proposals to the Russian Government. It is recognized, however, that awareness should first be raised on this subject and the possibilities that it might offer for Aral Sea rehabilitation.

What are the follow-up activities?

- In order to improve the ecological sustainable use of water bodies and to ensure the proper ecological and sanitary measures in downstream areas, it is necessary to create a council in Aralsk City for the Syrdarya delta with the participation of local governmental organizations and stakeholders (fisheries, hunters and others).

The discussion that followed Working Group 1 presentations contained topics such as the situation in the northern and southern parts of the Aral Sea, the importance of ensuring minimal water levels for medical and ecological purposes, and ICWC's involvement in a project on the formation of water user associations in the Fergana Valley.

Working Group 2

I. Develop restocking programmes in inland water bodies.

Priority activities:

1. Identify bio-economical feasibility.
2. Carry out a unified monitoring programme.
3. Organize a scientific interregional group in support of the programme.
4. Develop modern methods to carry out the research.
5. Arrange for a tender among scientific institutions to carry out the research to ensure good quality outputs at reasonable costs.

The national governments will be responsible through authorized persons that work and make decisions on their behalf. The Working Group considered it important that all five Central Asian countries participate in a workshop to carry out an inventory of water bodies with the aim of introducing modern fisheries management and aquaculture practices.

II. Construct fishways /passes for dams to support migratory species.

Priority activities:

1. Carry out monitoring of current irrigation systems, taking into account the fisheries interests.
2. Request governments to modify the construction of dams and irrigation systems to enable fish migration.
3. Develop a programme and plans of action to carry out the work under item 2 above.
4. Obtain approval of the programme from the governments and agree with governmental organizations on how and when the work should be conducted. The construction works will undergo a competitive tender.

It was observed by other participants of the Workshop that the two priority issues presented by Working Group 2 are relevant to all Central Asian countries. It was further suggested that clear goals and targets be set at national levels for restocking and aquaculture production in order to support the development of these activities. Moreover, it was recommended that in addition to clear ecological and productive goals, it is important that stocking be economically feasible as well. Similarly, also for the construction of fish passes, the economic feasibility, costs and benefits should be analysed in detail to make a case for the proposals to government.

Working Group 3

I. Develop a legislative base for fish production and aquaculture.

Priority activities:

1. Create working groups composed of fisheries experts, water management specialist, ecologists and legal specialists.
2. Develop legislation on fisheries to submit for consideration and agreement to the interested ministries.
3. Send agreed on project to the government.
4. Pass a law on fisheries in the government, which will regulate fish production, fish stock protection, fish pond outlets and licensing for hunting aquatic animals in lakes, irrigation systems, reservoirs and ponds.

II. Strengthen regional cooperation in fish production (information exchange and advice).

Priority activities:

1. Increase cooperation and experience exchange between Central Asian countries on fish production through workshops and training sessions.
2. Jointly carry out scientific research on information exchange on fish production and water resources.
3. Provide extension services to disseminate up-to-date technologies on fish production.

The lack of a regional inland fishery and aquaculture body was noted as a factor hampering regional cooperation on sustainable development of the sector. It was urged by the participants that regional collaboration be formalized in such a body to guarantee long-term collaboration in both inland capture fisheries and aquaculture.

Working Group 4

Establish educational and training programmes at the regional level.

Priority activities:

It is important to start by determining training requirements by specialists (fisheries, hydrologists, hydrobiologists, ichthyologists and others) through a comprehensive training needs analysis. Based on the analysis, trainers should be prepared to provide training to address the identified needs. It is

important that young professionals are trained. A next step in the process would be to organize educational and training courses on professional development of these professionals.

Steps to take:

- a. Identify specialists.
- b. Identify where education/training can take place.
- c. Develop programmes to send students abroad to gain experience.
- d. Establish a network of training centres.

Training staff/professionals remains the duty of the line ministry responsible for fisheries and aquaculture. The training of professionals in the region should be facilitated by international organizations such as FAO, ICWC and others, which should take a leadership role. Part of the training programme could take place in the Russian Federation and Turkey, for example.

II. Establish research and monitoring of water quality for sustainable fish production.

Priority activities:

Establish regional laboratories to study and monitor water quality of transboundary rivers under the aegis of ICWC. The line ministries responsible for water resources, institutes concerned with water problems and laboratories working on water quality should be involved in studying and monitoring water quality in transboundary rivers. Water quality monitoring should include pollution levels, mineralization and insecticide factors.

It was noted by the plenary that ICWC is well-positioned to lead such collaboration, which is necessary for all five Central Asian countries and that results will have to be communicated frequently and regularly to all participating members.

25. A plenary session followed the working group presentations. This session was used to brainstorm on the conclusions and recommendations of the Regional Scoping Workshop. Notwithstanding the diversity of experiences expressed from both sectors, irrigation and fisheries, there was consensus among the participants that collaboration between the sectors at national and regional levels should be further increased.

26. The conclusions and recommendations from this Regional Scoping Workshop on the use of irrigation systems for fish production in Central Asia, as prepared and adopted by the workshop participants, are as follows:

CONCLUSIONS

With respect to policy, legal and institutional frameworks, the workshop noted the following:

- Linkages between irrigation and fisheries authorities are very limited or non-existent as far as planning and management issues are concerned (e.g. fish passes and screens).
- There are major differences between countries in the region in legislations related to fisheries and water management/irrigation.
- Access arrangements for fishing operations related to transboundary waters appear to differ greatly between countries in the region due to the changes taking place in the transition and privatization processes.
- Institutional capacity of the line authorities involved in fisheries needs to be strengthened in collaboration with irrigation authorities involved in activities related to fisheries.
- IUU fishing practices are widespread either due to weaknesses in legislation or institutional deficiencies in the enforcement of existing laws, regulations and decrees.

With respect to water management, the workshop concluded the following:

- The current basin plans in the region do not take into account capture fisheries and aquaculture as users of the basins and their water quality requirements.
- An increase in stability in water delivery to the Aral Sea coast, particularly the northern areas, will yield relatively large gains in terms of fish production and livelihoods opportunities. Neither the

ecological minimum flow nor the sanitary level of water flows in transboundary rivers are respected in the countries of the region.

- Information on water quality is insufficient because limited water quality monitoring is carried out and available information is also not exchanged or accessible for all water users.

With respect to fish production, the following was noted:

- A large part of inland capture fisheries production is based on restocking programmes, following the traditional practices, but there are few profitability analyses being carried out for such programmes.
- Reservoirs, natural lakes (if part of irrigation systems) and terminal lakes (sinks) are a major resource for fisheries and can rely on natural stocks, artificial stocking or cage culture. Rivers can also be a significant resource for fisheries and aquaculture production.
- The status of natural stocks in the lower parts of the rivers, particularly migratory species, remains unclear. Similarly, the water quality for fish use in these rivers is also uncertain. If the water quality is adequate, the priority production systems can include fish ponds, cages and stocking of the canals, together with habitat restoration.

With respect to capacity building, the Workshop further recognized the following:

- The previous levels of education and training in capture fisheries and aquaculture are no longer available in the region, which needs to be rectified.
- Research efforts on capture fisheries and aquaculture are currently less than is necessary to support a developing sector, and monitoring capacity also needs to be extended.

With respect to economics and marketing, the Workshop stressed the following:

- Fish is relatively expensive in the region and the markets for specific fish species are uncertain.
- The general investment climate for investing in fisheries and aquaculture is considered very limited and a major constraint to sustainable development.

Finally, **with respect to regional cooperation**, the Workshop noted that there are as yet neither in place regional strategies related to fisheries and migratory species on transboundary river systems, nor strategies related to the transboundary movements of living aquatic animals, although it is clear that such strategies are urgently needed.

RECOMMENDATIONS

In recognition of the above, the participants endorsed the following recommendations of the Regional Scoping Workshop:

Governments in the Central Asian region are encouraged to:

- harmonize the objectives of fisheries legislation on water management and on irrigation between the countries with transboundary waters, and update and modernize the laws where required;
- develop, through training-needs analyses, a regional capacity-building programme for the fisheries sector including both short-term in-country training courses and a long-term educational programmes. Training or educational programmes could be carried out in cooperation with, for example, Turkey, the Russian Federation and other states where these systems are well developed. A training centre should be established;
- use a cost-benefit analysis to evaluate the relative efficiencies of all production systems for capture fisheries and aquaculture (e.g. natural production, restocking, ponds, cages, and raceways) with a view to encourage investment in feasible activities across the region;
- establish contacts with international financial institutions to increase access to credit and other financial services for the capture fisheries and aquaculture sector, with specific emphasis on small-scale fisheries;
- review the possibilities for better use of species and the prospects for further introductions of new species and technologies in terms of ecological, economic and social aspects;
- develop national plans of action to deter IUU fishing practices in the region, based on the IPOA;
- carry out an economic appraisal of revenue generation and the market prospects for different fish and fisheries products;

- take measures to use the sanitary flow in line with international norms, rather than the ecological flow (as defined regionally), which is usually not continuous in Aral Sea affluents;
- support the development of joint ventures in capture fisheries and aquaculture as well as in facilitating and fish processing sectors;
- conduct a review of irrigation management practices to identify the needs for fish passes, screens and sluice gate management to improve the movement of fish within the systems. This should include the construction and monitoring of pilots and demonstrations.

International organizations and other donors are encouraged to:

- assist the governments of the region to develop a regional strategic plan for the integration of fish production with irrigation and other water users in the Aral region, which should be based on ongoing stakeholder consultation. The plan should be aimed towards creating a regional enabling agreement and regional management body;
- increase the scale and accessibility of information on water quality monitoring for all water users via the Internet and other means of communication;
- establish a special department in ICWC with a laboratory for water quality control and monitoring.

The different strategies and programmes should be developed in line with the international treaty obligations of the states, such as the Ramsar Convention, the Convention on Biodiversity (CBD) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The environmental impacts should also be taken into account.

OTHER ISSUES AND CONCERNS

27. In response to questions related to the follow-up from the Workshop, the FAO officers suggested various possible means to facilitate the implementation of recommendations as suggested by the participating experts, including the FAO Technical Cooperation Programme (TCP). It was suggested that after participants had consulted further with their national fishery administrators, formal communications could be initiated to seek access to facilities such as TCP or other possible sources of international assistance.

CLOSING OF THE WORKSHOP

28. The Workshop was officially closed on 20 July by Mr Dukhovny who thanked all participants for their active contributions and wished them a safe return to their countries.

APPENDIX A

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APPENDIX B

Agenda

DAY 1 – Tuesday 17 July 2007

- 08.00 Registration
- 09.00 **Session I: Opening ceremony**
- Welcome remarks:
- Mr Viktor Dukhovny, SIC–ICWC Director
Mr Gerd Marmulla, FAO Fisheries and Aquaculture Department
Introduction of participants
- 10.00 Coffee break and photo session of workshop participants
- 10.30 Background and objectives of the Workshop
(Mr Raymon van Anrooy, FAO)
- Session II: General information on inland fisheries, background and country review presentations**
Chair: Mr Viktor Dukhovny (ICWC)
Rapporteur: Mr Raymon van Anrooy (FAO) – Uzbekistan
- 11.00 *General introduction to inland fisheries, with particular reference to fisheries in irrigation systems (Mr Ian Payne)*
- 12.00 *Overview of ICWC activities in water resources development in Central Asia (Mr Viktor Dukhovny)*
- 12.30 Lunch
- Session III: Background and country review presentations**
Chair: Dr Niyazov Beisheke (Kyrgyzstan)
Rapporteur: Mr Ian Payne
- 13.30 Uzbekistan reviews (Mr Bakhtiyar Kamilov, Mr Umarov Muhammad and Dr Shohimardonov Dilmurod)
- 15.00 Kazakhstan reviews (Mr Dyusembay Magzumovich and Mr Optepbergen Askarovich Kystaubayev)
- 15.45 Break
- 16.00 Kyrgyzstan reviews (Mr Beisheke Niyazov and Mr Kadyrbek Egenovich)
- 16.45 Discussion
- 17.15 End of session/Closure of day

DAY 2 – Wednesday 18 July 2007

- Session IV: Background and country review presentations**
Chair: Mr Shohimardonov Dilmurod (Uzbekistan) Rapporteur:
Mr Gerd Marmulla (FAO) – Kazakhstan
- 09.00 Tajikistan reviews (Mr Sadridin Mahmaddullaev Khafizovich and Mr Karimov Gafurjon)
- 09.45 Turkmenistan reviews (Mr Guvanch Ovezovich Khanmedov and Mr Viktor Bojko)
- 10.45 Break

- 11.00 *General principles and implementation of the use of irrigation systems in artificial water bodies for sustainable fisheries and aquaculture*
(Mr Ramazan Celebi)
- 11.30 Discussion
- Session V: Working session – Definition of priorities for inland fisheries and aquaculture development in irrigation systems**
Chair: Mr Pulatkhon Umarov (ICWC)
Rapporteur: Mr Raymon van Anrooy (FAO) – Tajikistan
- 12.00 Discussion of priorities in Plenary with respect to:
1. Water resources management
 2. Production (capture and culture)
 3. Policy/legal/institutional frameworks
 4. Capacity building
 5. Marketing/trade and consumption
- 13.00 Lunch
- Session VI: Working Group session – Strategies in support of inland capture fisheries and aquaculture rehabilitation and development in irrigation systems in Central Asia**
Chair: Mr Ramazan Celebi (Turkey)
Rapporteur: Mr Victor Khegay (ICWC) – Kyrgyzstan
- 14.00 Introduction of Working Group tasks and reporting mechanism to Plenary
- 14.10 Working Group discussions
- 15.30 Break
- 15.45 Working Group discussions (continued)
- 16.30 Presentation of Working Group Reports of Session VI
- 17.30 Discussions
- 18.00 End of session

DAY 3 – Thursday 19 July 2007

- 09.00 Field visit to Balykchi Fish Farm near Tashkent (70 km)
- 13.00 Lunch
- 14.00 Field visit to state hatchery
- 17.00 Sightseeing in Tashkent (city tour)
- 18.30 Return to hotel

DAY 4 – Friday 20 July 2007

- Session VII – Conclusions and Recommendations**
Chair: Mr Khanmedov Guvanch (Turkmenistan)
Rapporteur: Mr Ian Payne – UK
- 09.00 Review session
- 10.00 Discussion of follow-up activities
- 11.00 Discussion on and finalization of Workshop conclusions and recommendations
- 12.00 Closing remarks

APPENDIX C

Welcome speech by Mr Viktor A. Dukhovny, Director of SIC–ICWC

Dear guests,
Dear colleagues,
Dear participants, ladies and gentlemen,

It is my great pleasure to welcome all of you here in Tashkent in the framework of our joint FAO/SIC–ICWC Regional Scoping Workshop on “The use of irrigation systems for fish production in Central Asia” which has been prepared during the last year after an agreement for cooperation was signed between FAO and SIC–ICWC. We thank in particular Mr Gerd Marmulla from FAO Headquarters for his initiative in organizing this workshop. I also like to thank Mr Raymon van Anrooy, FAO Sub-Regional Office for Central Asia (FAOSEC), for his kind cooperation and support. Equally, many thanks to the consultants Mr Ian Payne and Mr Ramazan Celebi for their contributions that will certainly make the workshop very interesting and fruitful.

First of all, I would like to mention that apart from our workshop organizers, who are directly involved in fisheries, there are also present here today in Tashkent representatives of the Ministry of Environment of Spain, who expressed their wish to participate in the opening ceremony of this Scoping Workshop. The purpose of their visit to Uzbekistan is the exchange of experiences in water management and water quality between the two water basin associations of the Amudarya and Syrdarya Rivers, and the Spanish Confederation for River Basin Management, Valencia. In return, representatives of SIC–ICWC will make a visit to Spain at the end of August 2007.

Uzbekistan is one of the largest regions of irrigated agriculture in Central Asia. The Amu-Darya and Syr-Darya Rivers are the principal sources for irrigation. Irrigated agriculture is still one of the major sectors of economy of all five republics of Central Asia. It provides a significant contribution to gross domestic product (GDP) and gives significant opportunities for employment of the population. Further, it is the basic source of income from foreign investment and contributes to development of the industrial sector, the economy and services.

There are no economic limitations for expansion of farming industry and agricultural production, since there is an increase in population growth, national income and international demand for export cultures, such as cotton. But water resources limit the development of irrigation and the current way of producing already developed irrigated areas becomes more and more unacceptable.

From 1990 to 2004, irrigated areas have slightly increased. Today, only Kazakhstan and Turkmenistan have a good ratio of the irrigated land per capita (0.28 ha and 0.33 ha, respectively), and we hope that Kyrgyzstan (0.17 ha), Tajikistan (0.11 ha) and Uzbekistan (0.16 ha) will also reach similar levels.

In recent years, integrated water resources management was introduced in Kyrgyzstan, Tajikistan and Uzbekistan, and only due to improved water resources assessment was achieved a decrease in water loss of 15–20 percent, excluding increases from water efficiency. Today, water efficiency, especially at farms, is very low. I think this has occurred due to privatization and restructuring of farms by people who have money but who lack knowledge about land. Therefore, we put strong emphasis on development of extension services for farmers, taking into account the effective use of water resources to achieve high yields by using a minimum of water.

The use of our water bodies for fish production has huge potential. We have fine examples, as Mr Kamilov mentioned, in Aydarkul, Uzbekistan. There are opportunities for using an operating mode for our reservoirs such as Kayrakum and Arnasay. In this respect, I would like to point out that under such conditions, where less water is needed for irrigation, there are vast possibilities for fish production, especially in our irrigation systems. It seems to me that private investment in fish production in our water bodies should be encouraged; the irrigation sector should not be afraid to conclude contracts on maintenance or use of irrigation systems with fisheries stakeholders. Look, how much does 1 kg of fish cost? It costs US\$10. Could we ever have imagined that the local fish price would be this high?

This is because the operations of irrigating systems are inequitable, and we irrigators do not initiate the production. I think we should help developing public thinking in this direction.

Once again, I would like to thank Mr Gerd Marmulla for his initiative.

APPENDIX D

Welcome speech by Mr Gerd Marmulla, Fishery Resources Officer, Fisheries Management and Conservation Service, FAO, Rome

Mr Shohimardonov, Deputy Director of the Uzbek Research Centre of Fisheries Development,
Mr Dukhovny, Director of the Scientific Information Centre of the Interstate Coordination Water
Commission of Central Asia,
Distinguished delegates,
Ladies and gentlemen,

On behalf of the Subregional Coordinator for Central Asia of FAO, Mr Abdellatif Tabet, and Mr Ichiro Nomura, Assistant Director-General of the FAO Fisheries and Aquaculture Department, it is my pleasure to welcome all of you to this Workshop, the Regional Scoping Workshop on the Use of Irrigation Systems for Fish Production in Central Asia. As you can see from the Prospectus and the Agenda, this Workshop was jointly organized by Scientific Information Centre of the Interstate Coordination Water Commission, whose Secretariat is based here in Tashkent, and the Food and Agriculture Organization of the United Nations.

First of all, I would like to express our sincere gratitude to the Interstate Coordination Water Commission – ICWC – for having made all the arrangements to host this Workshop here in the interesting city of Tashkent, with its long and rich history. In the middle of this very active city, the Turkestan Hotel has been chosen as an ideal venue for our “retreat”.

The request to hold such a workshop dates back to a recommendation put forward by the participants who attended the FAO Expert Consultation on the Use of Irrigation Systems for Sustainable Fish Production in Arid Countries of Asia, held in Almaty, Kazakhstan, 25–29 September 2001. There, it was requested that ICWC would assume a coordinating role in the process of defining the needs for better integrating irrigation and fisheries for an increased fish production in the five Central Asian countries that it is serving – Kazakhstan, Kyrgyzstan, Uzbekistan, Tajikistan and Turkmenistan. FAO was asked to assist these countries through the organization of a follow-up regional workshop, in which the current situation, achievements and problems, as well as necessary steps for improvement and advancement of fisheries in irrigation systems in Central Asia should be discussed.

Globally, there is a growing awareness of the economic and social importance of inland fisheries and aquaculture to satisfy nutritional needs and recreational demands. Taking into consideration that food insecurity in rural areas in Central Asia is fairly common among poor farming households, fisheries in irrigation systems that are not yet or not adequately used for fish production could provide an opportunity to improve rural livelihoods. The rising demand for fish in urban centres in the region further adds to the need for sustainable fisheries development wherever possible; this should, of course, be based on the provisions of the FAO Code of Conduct for Responsible Fisheries and other international instruments.

We all know that here in the region, there is also a competing demand for the utilization of the water resources, for example, for agriculture production, hydropower generation, drinking water supply, water supply for industrial purposes and fisheries. And we know that a sustainable management strategy is required so that each user may have a fair share of the resource – and here I insist on saying a “fair”, not “equal” share – as we are well aware that the fisheries sector does not play the leading role in the regional economy. However, the sector already plays an important role with regard to food supply, and must do so more in the future.

Globally, it is now also more widely recognized that current and planned water development projects have to be better harmonized with ecosystem conservation needs in terms of protecting the environment and the living aquatic resources. It is well known that agriculture, particularly cotton production, is a sector that has a very strong demand for water here in the region, and that extensive

irrigation systems serve this purpose. It is also recognized that co-management and community-based management schemes for integrated management of inland capture fisheries within irrigation schemes and inland water bodies (for example, reservoirs) are generally not yet in place, and central management authorities do not have the means to enforce their policies and management ideas at local levels. As a result of the low priority given to the fisheries sector, fisheries interests are often not considered in the development and management of irrigation schemes. Review studies of fisheries in irrigation systems of various Central Asian countries in the 1990s have shown this. Therefore, it is hoped that this Regional Scoping Workshop on the Use of Irrigation Systems for Fish Production in Central Asia will play an important role in showing ways for an integrated sustainable use of water resources that will allow all stakeholders including fisheries, to benefit from the water passing through the region.

It seems that fisheries sector stakeholders and other users do not share information and do not collaborate closely enough. This Workshop could provide a unique opportunity to address this gap in communication and collaboration, and strengthen ties between sectors and between public and private entities within the sectors.

I wish this important Workshop good success and hope that the fruitful deliberations of the following days will help to better integrate fisheries in irrigation systems and, above all, make fish production more sustainable here in the region. Rest assured that FAO is willing to explore further possibilities for assisting the Central Asian countries in this challenging endeavour.

Thank you.

PART II – SUMMARY REPORTS OF PAPERS PRESENTED

INTRODUCTION TO INLAND FISHERIES

by Ian Payne

Marine Resources Assessment Group Ltd., United Kingdom

Relation of freshwaters to irrigation

In general, it is worth putting this review into the context of the present Workshop, which concerns using irrigation schemes for improved fish production. The basic irrigation system is a mix of still water lake-like reservoirs for storage and flowing water as it is released or diverted. We therefore have the same elements as natural systems, although in a clearly modified form.

What influences production in each of these two components?

Basis of production

Rivers tend to start at altitude and flow to the sea. They increase in size during this journey and form a horizontal network of tributaries. Essentially it is an *open system*. As such, most of the food comes from outside the system. Organic detritus is washed in from the basin or drops from marginal forests, i.e. it is *allochthonous*. Phytoplankton plays a small role, as basically, it is rapidly washed downstream out of system. Most primary producers are higher plants. These marginal plants do, however, contribute decomposing material as they die. As a result, there tends to be few plankton feeders among river fishes.

By contrast, lakes are more stable, relatively *closed systems*, e.g. the turnover time for Lake Tanganyika is 1 700 years. A stable water column and lower suspended sediment favours production by phytoplankton and also stratification by thermocline or ice formation, which gives a very significant three-dimensional structure to the environment and its communities.

How are these differing systems reflected in the fish and fisheries?

In the widespread, diffuse *river systems*, the extent of the basin seems to be positively correlated with the number of species available (Welcomme, 1985). Also, since they start at altitudes where slopes are steeper, flows are turbulent and temperatures are cooler, zonation of species result in having differing characteristics.

The transition from small turbulent streams to deeper, meandering rivers is associated with a predictable increase in production and potential fish catches. Hence, the biomass of European rivers can be given by:

$$\text{Biomass (kg/ha)} = 6.957 W^{1.845} \quad (r=0.919)$$

where W= channel width (m) and a typical range of **200-660 kg/ha**.

$$\text{or Catch (kg/km)} = 0.0064y^{0.95} \quad (\text{Welcomme, 1979})$$

where y = distance from source and giving a typical range of **1 to 20 tonnes/km** from small to large rivers.

Catches per hectare can average **52 kg/ha** in the tropics +/- 32 (Welcomme, 1985), while in Eastern Europe, the Danube average is some **8.7 kg/ha**.

Lakes are less dynamic but zoned by depth as a function of volume and the species are also broadly zoned. Commoner species are often similar to those in a lowland river, often typified by carps and catfishes.

The most useful production-related correlation is between ionic concentration with mean depth, the *morpho-edaphic index* (MEI):

where MEI = conductivity ($\mu\text{S/cm}$)
mean depth (m)

From this: potential catch (kg/ha) = $8.749 \cdot \text{MEI}^{0.381}$ (Welcomme, 1974).

Thus, catches increase with shallower depth and also with increased ionic concentration probably from increased nutrients, especially HCO_3 . Catch ranges in lakes/reservoirs are between **6-100 kg/ha**. A specific comparison suggests that within the *ICWC region* historically, average catches for small/medium lakes have been given as **10-12 kg/ha** (Rudenko and Pechnikov, 1988).

A change in conditions can yield major changes in fisheries. Lower river species are pre-adapted in some ways to still waters such as reservoirs, as are plankton feeders, which may mean that the planktivorous small herrings, or *kilka*, found abundantly in the Caspian fisheries, might be good fish species for large regional reservoirs, as they tend to be common in man-made lakes elsewhere.

Change from open to controlled system

The conversion of a flowing water system into an irrigation system needs water control management. This normally means some form of barrage to divert the water or storage dam, which gives more control over the flow pattern. If a storage dam is used, then the area behind the dam is converted to a lake. This normally leads to a change in species composition, favouring the less migratory, more sedentary types typical of the lowland rivers. It also changes the downstream flow pattern, confusing the migratory types and sometimes physically preventing them from moving upstream. This can be a particular issue with long-distance migration such as that of sturgeon or salmonids. This does not mean that the reservoir is not productive, just that the nature of the fish community and the fishery can alter. There are numerous examples where reservoirs have produced valuable fisheries. It depends on how the impoundment is used and how the water flow is managed.

Where mature river systems are impounded, species of the communities can often fill all the niches. In other cases, it is possible to:

add or subtract species;

alter relative stock densities.

There is considerable experience in the region of this type of management. Of course, the river will be allowed to flow naturally, although in a pattern to suit the particular crops. Much of the water, however, will be diverted into artificial channels to supply those crops. For example, the barrage across the Ganges at Rishikesh in India diverts off 40 percent of the total river flow for irrigation. The water is ultimately returned to the main Ganges, and the downstream fisheries do not suffer, mainly because the use of agricultural chemicals is low. However, intensive crops such as cotton and sugarcane need pesticides and herbicides, to which fish are particularly susceptible, and which preclude much fish production downstream. If intensive crops are raised, then agrochemicals become a problem. Any integration with fish within the irrigated system becomes difficult. It is possible to use the upstream water channels. The flowing water makes *cage culture* a possibility since the water is flowing to carry away waste, providing a suitable supplementary feed is available. Common carp or silver carp can be used, although it depends upon their market price.

Another possibility is that the water is first channelled through *fish farms*. This resembles an irrigation system in engineering terms. Yields can vary from **1-2 000 kg/ha** for carp monoculture to **10 000 kg/ha** in polyculture.

Small-scale control of water management, such as the timing of sluice gate openings to coincide with upstream spawning migrations, can help colonization and production as can fish screens and fish passes.

Finally, in the specific case of the *ICWC region*, a great contribution is to be gained from at least partial restoration of the Aral Sea by reduced abstraction from the Amu Darya and Syr Darya Rivers,

which previously carried more than 60 km³ per year into this endorheic lake. The latter was reduced to 4 km³ during the height of irrigation, when it was considered necessary to have at least 25 km³ as a minimal flow.

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COUNTRY REVIEW OF AQUACULTURE AND THE POTENTIAL ROLE OF IRRIGATION SYSTEMS FOR FISHERIES IN UZBEKISTAN

by Shohimardonov Dilmurod

Deputy Director, Scientific Research Centre for Fish Development, Uzbekistan

There are more than 800 000 hectares of reservoirs and lakes in Uzbekistan, of which 661 200 hectares are suitable for fish production. It is suggested that these can produce 10 000 tonnes of fish per year, although they currently produce only 3 400 tonnes. Before the 1960s, there was also a significant fishery on the Aral Sea, but this declined as the sea shrank and the salinity increased, due to abstraction for irrigation. The country also contains 10 357 hectares of ponds for fish culture, of which 1 738 hectares are for seed production. It is suggested that these ponds could produce 20 000 tonnes per year of commercial fish, although the total is currently 3 700 tonnes together with 14 million fish seed (2007). Total current fish production is therefore 1 200 tonnes per year, having declined from 26 500 tonnes in 1990. Almost 25 percent of fish production originates from natural waters. The culture ponds are currently established within 21 functioning farms. The sector has been privatized by a decree, dated August 2003, and the water bodies have been assigned to fish enterprises on a competitive basis. Lease periods are for a minimum of ten years. The area of inland water currently leased is around 545 700 hectares of the total 800 00 hectares available; currently, there are 254 fishing enterprises that have leased part of this area.

Commercially important species include: common carp, zander, common bream, catfish (*Silurus* sp.), asp, goldfish, silver carp, grass carp, snakehead (*Channa*) and pike. Fish breeding tended to concentrate initially on common carp and silver carp, but the extensive technology required high inputs of forage and fertilizer that were hard to justify commercially, particularly with a two-year production cycle. Lack of working capital and high interest rates were among the factors causing the decline in production of these species. However, recently, a Uzbek/United States joint venture, which leased Tudakal Reservoir, has successfully established a broodstock and seed farm, which is producing 2–2.5 million fish seeds a year.

To use the reservoirs more rationally, it has been proposed to renovate facilities and make the system more market-directed. More advanced technologies should be introduced to allow extensive seeding of canals and drainage systems with phytophagous carp species to produce an additional crop and help keep these irrigation systems clear.

THE USE OF IRRIGATION SYSTEMS FOR SUSTAINABLE FISH PRODUCTION IN UZBEKISTAN

by Bakhtiyar Kamilov

Aquaculture Production Engineer, Scientific Research Centre for Fish Development, Uzbekistan

Irrigation is one of the most important sectors in Uzbekistan, using around 53–55 km³ of water per year to make it a world leader in the production of cotton, silk, fruit and vegetables. The system includes 53 reservoirs and 171 000 km of canals and 100 000 km of drainage canals. Some reservoirs, particularly those for residual water storage, are used for fish production, such as Tudakul, Shorkul and Mezhdurechye, and together cover an area of 7 000 km². There is also the artificial Aydar-Arnasasi Lake system now covering 4 000 km². In the 1960s, the Amu-Darya delta had 40 lakes covering 100 000 hectares, whereas now there are only 20, but stretching over 115 000 hectares.

Initially, there were 60 indigenous fish species in the country. The number has now risen to 75–80 due to introductions, although up to six native fish species have disappeared in the last century. The introduced species came from China and the Far East or other parts of Eurasia. The introduced species have been reared extensively and used for stocking or aquaculture. The local species are regarded as trash fish compared to many of the exotics.

In recent times, national fish production has fluctuated from 30 000 tonnes in the 1980s to around 7 200 tonnes in 2006. Currently, around half of the fish production originates from aquaculture and the remainder comes from lakes and reservoirs.

Before the 1960s, the Aral Sea contributed 60 percent of fish production in the country and the average catch was 25 000 tonnes, although this declined to zero after 1983. Fish was regarded as the third most important source of protein after milk and eggs and the Ministry of Health fish consumption target for the population was 12 kg/capita/year. Currently, fish consumption is less than 1 kg/capita/year, half of which is produced by aquaculture. It is reported that less than 1 percent of the reservoir area is currently used for capture fisheries and those that are have yields of 2 to 10 kg/ha. Only a few small fishing brigades remain, which are using parts of the irrigation system usually where the water salinity is less than 6 ppt. Following earlier experience, restocking has shown that putting 20 000 juveniles into reservoirs can produce 1 300 tonnes after three years.

Much interest is emerging in aquaculture. In the former Union of the Soviet Socialist Republics era, there was a successful carp-based aquaculture subsector. Now, however, this is much less viable, partly due to problems with feed and fertilizer, and also to the low commercial price of the cultured species of fish of less than US\$2/kg. It is thought that more modern international systems are required, but of course, these need investment. The private sector has shown some interest, but it is suggested that demonstration models with proven economic feasibility are required to encourage investment; such pilot projects should therefore be established.

KAZAKHSTAN COUNTRY REVIEW

by K. Magzumovich

Department Head of the Committee on Fish Industry, Ministry of Agriculture, Kazakhstan

In Kazakhstan, the fisheries sector was extremely important during the USSR period, with fish production exceeding 80 000 tonnes per year. Much of this was from the Caspian Sea, but 8 800 tonnes were also being produced for pond culture with farms in all regions. Since then, overall fish production has dropped to some 43 900 tonnes at present and pond culture has almost disappeared.

In a parallel institutional development, the previous Ministry of Fisheries was subsumed into departments in other ministries. This is also reflected in the lack of an overall strategy for fisheries development for Kazakhstan. Similarly, while there is a national target for fish consumption of 14 kg/capita/year, the actual fish consumption level is closer to 4 kg/capita/year, with much of this fed by increasing imports. In the 1980s, lacustrine commercial fish farms were established to improve production of small- and middle-sized lakes, together with which other improvement measures were taken by the state to assist fish production.

In 2003, a Fish Farming Committee was established to try to resurrect these measures. Some ten hatcheries were to be supported by the Committee to supply 5 million hectares of lakes. These efforts have been further encouraged by new state laws on land and property whereby long-term rental agreements of 10–49 years can be arranged with the state; these agreements should encourage private investment. It was reported that seven hatcheries can provide 150 million carp fingerlings and 7 million sturgeons for stocking.

For 2008, it is expected that some private groups may purchase some of the fry and that some of the state hatcheries may be privatized. There is a new initiative to develop pond culture toward 2015 and to add to the operating farms. It also transpires that training of staff is very difficult since there are no regional facilities.

The waters generally included within the fishery sector are the Caspian and Aral Seas, Balhash and Alkol Lakes, and Buhmtarmin, Kapshagay and Shardin reservoirs, among others. Recent policies for fish breeding have focused on the replication of endangered fish species for re-introduction and, in particular, the conservation of sturgeon gene pools. It is anticipated to increase the capacity for sturgeon (re)stocking to 12 million seeds per year to reduce the pressure on natural stocks. This has been developed into a specific programme using partnerships of local institutions. However, to achieve the goals set in the programme, modernization of out-of-date technology will be needed, as well as international cooperation in research and development and commercial breeding technologies. Identified constraints for the development of the sector include the high costs of feeds, fertilizer, therapeutic agents, electricity, water and land resources, and the high custom duties for imports of fish seeds.

IRRIGATION SYSTEMS USE FOR FISHERIES PRODUCTION IN THE SYRDARYA RIVER BASIN REGION OF THE REPUBLIC OF KAZAKHSTAN

by Kystaubaev Otepbergen

Head, Department of Monitoring of Water Control and Water Resources, Kazakhstan

Regulation of river flow by cascades of reservoirs in the upper and middle parts of rivers to support hydropower schemes and irrigation schemes have led to a severe deterioration of fishery potential of the Syrdary River and Shardara Reservoir. Ninety-seven percent of spawning areas have become unusable and fish production is now insignificant.

In other parts of Kazakhstan, however, habitats for fish have improved. The creation of a dam in the Northern Aral Sea, together with water channel remedial works, have helped to recreate the wetlands and provide an improved habitat for fisheries. In the Syrdarya River, the mid and lower reaches are unsuitable for drinking and fisheries due to salinity and agrochemical residue problems. Nevertheless, some fishing units have been renting areas; indeed, most lakes have also been assigned and rented for fishing. While most reservoirs are still generally used for irrigation purposes, more water is now being allocated for wider environmental needs. Nevertheless, there is generally little linkage between irrigation and fisheries interests.

In terms of development, however, a total area of the dammed-off Small Aral covering 300 000 hectares are now available for fish farming, while in the Syrdarya delta, a further 35 500 hectares distributed over 190 lakes are also available.

In 2006, in southern Kazakhstan, 522.7 tonnes of fish were caught within an authorized limit of 524 tonnes. For the Syrdarya Basin, the authorized limit was 3 186 in 2007, but 144 tonnes had been caught over the first five months only. The Kamistibas Fish Nursery and Shardare Fish Nursery are releasing 15 million carps into the basin this year. There are possibilities to increase the restocking capacity, but they depend on government spending on restocking.

THE USE OF IRRIGATION SYSTEMS FOR FISHERIES PRODUCTION IN KYRGYZSTAN

by **Mukhtar Alpiev**

Head, Laboratory on Ichthyology and Hydrobiology, National Academy of Sciences

Beisheke Niyazov and Mayram Sarieva

Specialists, Department of Fisheries; Ministry of Agriculture, Water Management
and Processing Industry, Kyrgyzstan

In addition to natural lakes and ponds, inland waters for fish production include 5 804 hectares of reservoirs and 3 399 km of rivers in Kyrgyzstan. Development of these fisheries is under the Department of Fisheries as established by a Presidential order. Estimates of natural fish production are approximately 400 tonnes per year, although intensification through artificial inputs could increase this to 1 600 tonnes per year. It is also anticipated that effective nursery farms to further enhance fish production could be established in the cascade of Nargu reservoirs, among others, although immediate financing is not available.

Toktogul Reservoir

Constructed on the Naryn River in 1970 and created by filling the Ketzize-Tyaka Valley depression of the river Tien Shan, Toktogul Reservoir covers 265 km² and is the third greatest source of fish production in the country. Seventeen natural species are recorded, but only one, the marinka or snow trout (*Schizothorax intermedius*), is commercially significant. However, a number of species have been introduced, including, in keeping with the cooler upland waters, two trout species (*S. trutta* and *S. ischaman*), as well as the more ubiquitous Chinese grass and silver carps.

Large numbers of these introduced species have been released along with possum shrimps, which act as a forage. Fish production at the reservoir has varied between 93 and 434 tonnes per year over the 1978–2007 period, mainly from silver, grass and common carps, together with trout and snow trout.

Part of the difficulties encountered with this type of reservoirs has been that fish reproduction is badly affected by the annual reservoir drawdown, which mitigates against the non-migratory native species and necessitates large-scale stocking of the introduced species. It should be noted, however, that stocking also has positive impacts on downstream reservoirs.

Other reservoirs

The total area of reservoirs in Kyrgyzstan is 43 986 hectares. Their general characteristics are listed below:

Kurp Sai Reservoir is for irrigation and power, covers 12 km² with winter downstream flows of 0–1 000 m³/sec. The ichthyomass can reach 7 tonnes.

Tashkumyr Reservoir has a water surface of 7.8 km² and is subject to from acute fluctuations. It can freeze over in cold winters and has a mean depth of 18.5 m. Ichthyomass is estimated at 4.5 tonnes and comprises a mixture of indigenous species and some trout.

Bazar-Korgan Reservoir is mainly for irrigation. It has a water surface of 270 hectares, declining to 63.8 hectares in summer. There are a variety of indigenous species, particularly Tibetans char, which are regarded as trash species. Some returns from stocked species have been yielded, although small.

Orto-Tokay Reservoir, on the Choo River at 1 700 m above mean sea level (AMSL), is mainly used for irrigation. It covers 23.2 km² in winter time, which is reduced to 4 km² during the summer. Again, it has an array of indigenous species, but stocking with trout upstream and 0.5 million whitefish and peled (*Coregonus*) has taken place. The main catch remains snow trout (marinka), but is small.

Kirov Reservoir has a surface area of 2 900 hectares. It contains an array of indigenous species with a mixture of snow trout, native dace and chars. The water has been stocked with over seven non-indigenous species, but their stocks have not become established probably due to the colder water. Between 1 and 1.7 tonnes of young fish have been stocked annually and annual catches have varied from 6 to 16 tonnes.

REVIEW OF CURRENT AND POTENTIAL ROLE OF IRRIGATIONAL SYSTEMS FOR FISHERIES PRODUCTION FROM THE VIEWPOINT OF THE IRRIGATION SECTOR IN KYRGYZSTAN

by Damira Alchibekova

Chief Specialist

Department of Operation of Irrigation Systems, Kyrgyzstan

Water resources and the water sector

The major water sources are from glacier melt and are consequently often rich in sediment, which can cause problems in the distribution and storage systems. From total water available in Kyrgyzstan, the country uses 20–25 percent, while the rest flows down to supply Uzbekistan, Tajikistan and Kazakhstan. The water supply and irrigation network are the responsibility of the Water Resources Department, which can supply 10 billion m³ of water to the 1 043 200 hectares of irrigation systems during the growing season. There are 34 reservoirs and 6 200 km of canals in the systems as well as large hydropower schemes.

Current status of the irrigation facilities

Currently, the irrigation facilities are out of date and have badly deteriorated. The major deficiencies include: functional depreciation and deterioration of water infrastructure; non-development of new irrigation lands; poor productivity of irrigated land; poor efficiency of water use; low efficiency of the monitoring system that monitors status and use of water resources; deterioration of irrigated land; increasing negative impact of water (soil erosion, groundwater rise, mudflows); halted construction of accumulation reservoirs; limited and outdated communication equipment and technologies for providing information on the water sector; inadequate degree of safety of water facilities; imperfect legal and regulatory frameworks for water issues and water-related activities; non-optimal system of management of water resources and related infrastructures; development constraining tariff and investment policies; and an imperfect system of state control over the status and utilization of the water fund. In addition, serious soil salinization and water logging have been noted in recent times. The World Bank has estimated that repairs to the system require increasing investment. The country has introduced water charges, although it is estimated that these should amount to 24 tiyn¹/m³ for full rehabilitation rather than the current 3 tiyn/m³. Consequently, despite investment, only 25 percent of the required funds have been made available and only one-third of structures are being rehabilitated.

Possibilities of using irrigation schemes for fisheries

Rivers, lakes and reservoirs may be used for fish production. The requirements for fish spawning in rivers can be supported by special releases of water and remedial engineering around the spawning grounds. However, those fish passes that were previously put in place are currently no longer functioning. For successful fish reproduction in reservoirs, the water level should be lowered in spring and summer to allow the development of vegetation in shallow areas as a substrate for spawning. However, the negative consequences for the supply of irrigation water of such measures probably exceed the benefits achieved in terms of fish production.

¹ 100 tiyn = 1 som (KGS)

POSITION AND PROSPECTS FOR DEVELOPMENT OF FISHERIES ON IRRIGATION WATER BODIES IN THE REPUBLIC OF TAJIKISTAN

by Karimov Gafurjon

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Tajikistan is a mountainous country with 947 rivers totalling more than 28 500 km and 1 300 lakes with a total areas of 705 km². These waters feed through an extensive irrigation system with 28 000 km of canals and a number of reservoirs, all in the Amudarya and Syrdarya Rivers. A further 36 hydro-electric power plants are planned for construction. Natural fish production of the lakes was around 20 kg/ha. Yields from the regulated water bodies amounted to 20–30 tonnes per year in the 1970s, but were interrupted by the drying out of these bodies due to water regulation.

Major contributions to fish catches were made with the construction of the Farkhad, Kayrakkum and Nurek Reservoirs in the 1950s. The original fish stocks came from natural sources and included snow trout (*marinka*), Amundarya trout, *Samarkand kharamulya*, Tibet char, Tajik char, Turkestan bullhead, Amudarya goby and topminnows, among others.

In 1978, 1 million Siberian peled (*Coregonus* sp.) and 300 000 reared silver carp were put into the Nurek Reservoir. However, poor feed availability is thought to have impeded the survival of these exotic species. Nevertheless, it is still thought that Nurek can be used for sport fishing and the rearing of rainbow trout. In 1974, in the Kayrakkhum Reservoir, fish yields peaked at 522 tonnes, while it is currently producing 150 tonnes per year. Production is largely based on the natural reproduction, and declines were largely due to overexploitation of the common carp stock. An enhancement programme for the species was introduced, which appears to have reversed the process. The proportion of predatory species in the total stock has been recorded at 32 percent, yet at the same time, these species are considered useful as control species, but not as a contribution to production in terms of volume harvested.

A series of stock management actions and remedial water control measures are needed to manage the fishery. However, the large water intake structures of irrigation systems do not have protective measures such as fish screens, which have continuous negative effects on the fish stocks. In recent times, however, the capacity to conduct rearing, stock enhancement and other management measures has been drastically reduced due to obsolete equipment and institutional difficulties. Measures needed to increase fish production include, among others: education of professionals in the sector; commercial fish feed production in the country; improvement water infrastructures and irrigation systems; breeder stock development; reduction of IUU fishing practices; and equipping of irrigation works with fish screens and fish passes. It is should be noted that Decree No. 123 of 2001 allocated 1 million ha of irrigated land to increase feed production to encourage fish pond production.

THE MAIN PROBLEMS, SOLUTIONS AND DEVELOPMENT OF THE FISHERIES SECTOR IN TAJIKISTAN

by Sadriddin Makhmadulloev

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Tajikistan has a relief ranging from 300 to 7 495 m above mean sea level. Its springs and glaciers provide almost the whole run-off for the Amudarya River, at around 50 km³ per year. Since much of this water is used for irrigation, significant volumes of polluted water are consequently discharged, some 40 million m³ in 1997, for example. There are also around 1 300 lakes, mostly in the mountains, with the largest, Karakul, stretching over 380 km².

The official fishery and fish-breeding industry is centred in eight reservoirs, which are used not only for irrigation and energy purposes, but also to manage fish production. These reservoirs are Kayrakkum, Daganasay, Mumbianabay, Selbur, Nurek and Bayzin. Activities around these reservoirs are legally regulated to restrict contamination and misuse, and to promote fish conservation. Much of the effort is directed at fish breeding, particularly of sazan, bream, asp, roach, sabrefish, catfish, zander, snakehead and white-eye, together with the more valuable exotics, silver carp, grass carp and trout.

Up to 1 million fish juveniles are released into Kayarakkum each year, which yields a final 20 percent commercial return. The farms have also become renowned for their high standards of hygiene and sanitation in dealing with both fish and fishery products. The fish breeding industry suffered badly after the crisis that followed the dismantling of the Soviet Union, when much of their broodstock was destroyed, and after which the importation of vital fish feeds became impossible.

The fish sector in Tajikistan is no longer financed from the state budget, as it was in earlier years, but is now self-financed, albeit with difficulty. On average, 1 kg of fresh fish sells at US\$2 in rural markets, although trout can attain US\$15–20 per kg.

The government is taking steps to support the production of national fish feeds, provide training in advanced techniques, and enhance conservation of fisheries. More specifically, the Ministry of Land Reclamation and Water Resources has been entrusted with the task of improving regulation on water use and water quality.

FISH INDUSTRY RESTORATION STRATEGY IN THE REPUBLIC OF TAJIKISTAN

by Khaitov Abduvali

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Mr Khaitov Abduvali described the history of fish production in Tajikistan in a PowerPoint presentation. He mentioned that aquaculture started in 1970 with phytophagous fish species (silver and grass carps) imported from Karamat-Niyaz Fish Farm, Turkmenistan. In 1971, an incubatory plant in Djami was created and polyculture was introduced. In 1983, the team of S. Nazimov, holder of the Order of the Red Banner of Labour, obtained 9.37 tonnes of pond fish per hectare per year. Over the 1970–1990 period, new pond farms were established: Pyandjikent Fish-Works, Djilikul and Kumsangir Fish Farms, Chubek Fish Farm and spawning-nursery pond in Kayrakkum fish farm. In 1988, a fish reproduction complex of regional significance with a capacity of 250 million larvae of carp and phytophagous fish species was created on at the foot of Djami Fish Farm. This complex is unique in the Commonwealth of Independent States (CIS) states

Activities of leading farms at Mohiaparvar State Unitary Enterprise (SUE)

The SUE farms produce ten types of fish products (fresh, live, frozen, dried, smoked fish), two types of canned fish and three types of fish paste. Their products have been awarded a number of prizes, including: “Gold Star” for quality (Madrid, 2002), “Golden Arch of Europe” (2003) and “Industry Leader” nomination (2003).

At present, the constraints for development of the fisheries and aquaculture sector in Tajikistan are the following:

- a lack of commercial high quality feeds, which leads to only 20–45 percent of production capacity of the farms being used;
- a breach of relations with neighbouring countries of the former Union of the Soviet Socialist Republics, reducing the export potential for fish;
- an increase in prices for feed, fuel and lubricants;
- low population living standards leading to customers’ inability to pay;
- aging equipment and machinery.

In 2006, fish production was estimated at 215 tonnes. The Tajik Government is eager to increase fish production and has therefore issued various policies and decrees:

- Under Decree No. 123 issued on 3 March 2001, 1 000 hectares of irrigated lands were allotted to produce feed crops for fish.
- Under Decree No. 106 issued on 3 March 2006, the fish industry was included in the list of priority areas for potential investors.

THE ROLE OF IRRIGATION SYSTEMS FOR FISHERIES PRODUCTION IN TURKMENISTAN

by Khanmedov Guvanch

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It has long been contended that the water bodies of Central Asia, including Turkmenistan, show low rates of fish production, related to low nutrient contents of the water and high altitudes. Natural fish production levels range between 5 to 17 kg/ha (e.g. Lake Balkhash 5–10 kg/ha and Murgat and Tedjen Reservoirs, 5–17 kg/ha). An upper limit was considered 25–30 kg/ha.

The production levels have increased with the introduction of phytophagous silver and grass carps from China. Introduction into the Amudarya River Basin has resulted in one of the few places in the world where these carps have produced a self-sustaining, breeding population outside their natural range. This has positively influenced fish production, particularly in the Khauzkhan Reservoir on the Karakan canal, the largest national water body of the country. The reproductive areas appear to be in the Garagumdarya, rather than in the Amudarya itself.

The water regime in these areas may play an important part since, during the autumn and winter, the water is regulated to provide stable water levels with a limited impediment to fish movement. During the spring/summer, the rise in water levels through floods can cause peaks in current flows through sluice gates that can exceed 6–7 m/sec, which will constitute a barrier to migrating spawners. (The maximum for a strong-swimming fish is around 1.2 m/sec.) The canals may provide less turbulent conditions and the spawning grounds are thought to be in the 13 km section downstream of the head structure. Spawning is preceded by large-scale migrations of these Chinese carps.

These carp species are of great significance to irrigation. The grass carps eat all soft aquatic vegetation, thereby keeping canals clear; this saves huge efforts in keeping the 10 000 km of canals clean. The silver carp consumes the phytoplankton, even blue-greens such as *Microcystis*, and thereby prevent the damaging blooms of eutrophication. The institutions to support the conservation and production of these phytophagous fish have been established by presidential decree to ensure the maintenance and future development of the system.

INLAND FISH RESOURCES OF TURKMENISTAN

by **Ashirmurat Durdyew and Victor Bozhko**
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Commercial fisheries in Turkmenistan are found mainly on reservoirs and lakes on the Amudarya, Garagumdarya and Murgab Basins as well as in Sarykamysh Lake. Also, pond aquaculture is practised in the Ashgabat (Gerens) and Tedzhan Fish Farms. The utilization of fish resources in lakes and reservoirs is based mainly on natural fish production. Only a limited number of wild species contribute to fish production, with 17 of the 48 species in the Amudarya River, and 16 of the 36 in the Garagumdarya River of commercial value; similarly, only 17 of the 34 species in Lake Sarykamysh are being utilized for fish production. In 2000, according to official figures, the total fish production in Turkmenistan was 12 000 tonnes, of which only 500 tonnes were recorded as coming from inland water bodies. It has been estimated, however, that the potential of these inland water bodies may be as high as 6 000 tonnes per year. A short overview for each of the major inland fisheries sources is given below.

Lake Sarykamysh

This lake has been used for fishery production since 1966 and, at the peak of the fishery from the 1970s to the 1980s, it produced 65 to 70 percent of all inland fish production. The predominant species are bream, zander, roach and sabrefish. Previously, the Aral barbel and zherekh, among others, were important, but their stocks have since declined. Since the 1980s, general production has shown downward trends. A number of exotic species have been introduced from hatcheries. Among these exotic species, snakehead has started to contribute significantly to inland capture production, but the exotic phytophagous Chinese carps are currently less common in the catches. The indigenous species, derived from the Amudarya River, are still predominant in the catch statistics.

Khauskhan Reservoir

At the beginning of the 1970s, both the indigenous species, such as sazan and catfish, and the introduced phytophagous species were prevalent in the catch recorded from this reservoir. The phytophagous species contributed 75–80 percent of the fish catch. Since then, a dramatic decline took place, resulting in annual catches that were eight times less than at their peak. The indigenous species have also declined, with sazan production falling from 15–20 kg/ha in 1978 to 0.04 kg/ha in the 1990s. Similarly, the zander stocks and catches have declined, mainly due to non-compliance with regulations. Of the indigenous species, the Aral barbel has not been recorded in the catches since 1978 and zherekh since 1982.

Koperdag Reservoir

As with the Khauskhan Reservoir, indigenous species caught in the Koperdag Reservoir include the Aral zherekh, barbel, sabre fish, bream, zander and sazan. Silver carp is among the exotic species often recorded in the catches. Zherekh should be managed carefully to avoid impacts on other species, and mesh size limits of 60–70 mm should be applied together with minimum allowable lengths of the harvested fish of 45 cm for general conservation.

The basins contain a number of reservoirs with patterns of development similar to those above, with a mixture of indigenous species and introduced Chinese carps. Here, however, the Chinese carps have acclimatized successfully and have contributed up to 57.7 percent of the total catch recorded in some years. As in other inland waters, however, there has been a general decline since the 1970s, particularly among vulnerable species such as the Aral barbel.

A further feature is the reduction of water availability to the Adzhiyob spawning grounds for Caspian Sea species, which has reduced reproduction from this area to almost zero in recent years.

GENERAL PRINCIPLES IN THE USE OF IRRIGATION SYSTEM AND ARTIFICIAL WATER BODIES FOR SUSTAINABLE FISHERIES AND AQUACULTURE

by Ramazan Celebi

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Introduction

It is clear that fisheries and aquaculture are mainly based on restocking and small-scale fisheries in Central Asian countries. Some countries, including Kazakhstan, Kyrgyzstan and Uzbekistan, have numerous of water resources of considerable volumes that are part of irrigation systems and can be used for fisheries and aquaculture.

Fisheries authorities should develop new strategies to use irrigation systems for sustainable fisheries and aquaculture. In general, three strategies could be followed for sustainable fisheries in relation to irrigation: utilization of water reservoirs for semi-intensive or intensive aquaculture; development of traditional fisheries in irrigation systems; and expansion of aquaculture in the irrigation system.

Since the collapse of the Soviet Union, the few studies on fisheries and aquaculture reported sharply decreasing production and consumption. In order to develop sustainable fisheries and aquaculture in irrigation systems and other water bodies, technical and institutional capacity should be strengthened by development programmes.

General principles of fisheries and aquaculture in irrigation systems

Climatic moisture deficits normally occur in many parts of the world during the summer months. Irrigation is often required. Farmers access irrigation water by pumping from surface or groundwater sources or have it delivered by an irrigation supplier or other water purveyor.

The Central Asian countries in the Aral Sea Basin – Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan – have some of the largest irrigation schemes in the world. Some 22 million people depend directly or indirectly on irrigated agriculture in these countries. Twenty to forty percent of the GDP of these countries is derived from agriculture, almost all of which is irrigated. In 1999, the agricultural output supported by irrigation accounted for 11 percent of the GDP in Kazakhstan, 19 percent in Tajikistan, 27 percent in Turkmenistan, 33 percent in Uzbekistan and 38 percent in Kyrgyzstan. In Uzbekistan, Tajikistan and Turkmenistan, agricultural products, particularly cotton, constitute 20–40 percent of exports.

While some areas have been irrigated for centuries, many irrigation schemes were created by central planning from the 1950s to the 1980s. Large schemes were constructed to irrigate: from 1970 to 1989, irrigated areas expanded by 150 percent and 130 percent in the Amu Darya and Syr Darya River Basins, respectively. Water continues to be used highly inefficiently. In Uzbekistan, farmers withdraw an average of 14 000 m³ of water per hectare for irrigation, whereas rates in countries such as Pakistan and Egypt – not known for efficient irrigation – average around 9 000–10 000 m³/ha (World Bank, 2000).

It is also reported that, over the last decade, fisheries activities were mainly based on restocking and small-scale fisheries. In many situations, aquaculture may prove more appropriate than a managed fishery, because of the greater control over production and the confined nature of the production systems. Far more fish per unit area can be produced through aquaculture than through fisheries. In the context of irrigation canals, cages, pens and larger enclosures are the most appropriate aquaculture production systems. Enclosures could be extensively or more intensively managed, but for cages and pens, only semi-intensive or intensive management practices are considered appropriate.

Turkey is among the largest producers worldwide in terms of fisheries and aquaculture production and management of water sources. Policies and other legislation in force on fisheries and aquaculture management in the country can provide an example for other countries.

An example for other countries: Turkey

Turkish fishery production was 544 773 tonnes in 2005, comprising: marine fisheries, 61 percent; aquaculture, 22 percent; inland fisheries, 8 percent; and the remaining 9 percent from other marine organisms. Turkey produces approximately 0.6 percent of the total world fishery production.

Pelagic species dominate marine landings in Turkey, particularly anchovy, bonito, horse mackerel, sardines and bluefish. Since around 60–70 percent of the total landings (by volume) are anchovy, any change in their distribution and catch in any one year or season has a significant impact on the total annual catches (Prime Ministry, Republic of Turkey Turkish Statistical Institute, 2005).

The number of aquaculture farms increased from 1 in 1971 to 1 487 by the end of May 2007. A major increase has also been observed in the production capacity of aquaculture farms. As of May 2006, there were 1 191 farms producing inland fish, with a total capacity of 48 604 tonnes, and 296 facilities producing marine fish, with a total capacity of 82 076 tonnes of total 118 277 tonnes (MARA, 2007).

Turkish aquaculture has limited species diversity. Currently, only the following species are cultured commercially: rainbow trout (*Oncorhynchus mykiss*); seabass (*Dicentrarchus labrax*); seabream (*Sparus aurata*); carp (*Cyprinus carpio*); bluefin tuna (*Thunnus thynnus*) and Mediterranean mussel (*Mytilus galloprovincialis*). Some Mediterranean species cultured on experimental or pilot scales are common dentex (*Dentex dentex*), common seabream (*Pagrus pagrus*), common pandora (*Pagellus erythrinus*), sharpnout seabream (*Puntazzo puntazzo*), white grouper (*Epinephelus aeneus*), shi drum (*Umbrina cirrosa*), striped seabream (*Lithognathus mormyrus*), meagre (*Argyrosomus regius*), greater amberjack (*Seriola dumerili*), brown meagre (*Sciaenops ocellatus*), white seabream (*Diplodus sargus*), two-banded seabream (*Diplodus vulgaris*).

The catch from inland waters was around 46 115 mt in 2005, or 9.2 percent of the total annual fishery production. There are 11 commercially exploited freshwater species, eight of which are fish species: Terek (30 percent of total inland production), common carp (30 percent), sand smelt (11 percent), tench (4 percent), pike perch (4 percent), European chub (2 percent), transcaucasian barb (2 percent) and wels (2 percent) (MARA, 2007).

Mismanagement and pollution have been reported as having negative impacts on inland fisheries (but the impact cannot be quantified); the most seriously affected is reportedly the crayfish resource (Çelikkale, 1995).

Special Programme on Dam Lakes and Other Water Bodies

Turkey has a special implementation programme for using dam lakes and other water bodies for fisheries and aquaculture. In 2004, a new regulation came into force that enables the utilization of dams, lakes and irrigation reservoirs for fisheries and aquaculture. Currently, 17 dam lakes are used for cage culture and semi-intensive aquaculture. Identified fisheries areas are given to the fishers, especially fisheries cooperatives (Unal, 2007).

In 1980, MARA began to implement the “Project on Restocking of Inland Water Sources”. Kepez Fisheries Research, Development and Production Center were declared operative. The Mediterranean Fisheries Production, Research and Education Centre (AKSAM) is mainly producing carp fry for restocking of dams and other reservoirs. In 2006, 6.5 million carp fry were released in more than 250 reservoirs. State Hydraulic Works has two hatcheries and releases more than 24 million fry into inland water bodies annually.

In Turkey, with the opening of new water reservoirs used within the scope of the South-eastern Anatolia Irrigation Project (GAP) for irrigation and energy production, agricultural production has increased, and it has also become possible for fisheries to benefit from emerging water sources.

Conclusion

Fisheries authorities should study the development of new strategies to use irrigation systems for sustainable fisheries and aquaculture in Central Asian countries. In general, three strategies could

be followed for sustainable fisheries in the area: utilization of water reservoirs for semi-intensive or intensive aquaculture; development of traditional fisheries in irrigation systems, and the expansion of aquaculture in the irrigation system.

Inland water bodies may be classified as and are suitable for: **natural lakes**, restocking for fisheries or recreation; **reservoirs**, restocking for fisheries or recreation / extensive or semi-intensive and cage culture; **streams**, pond culture; **dam lakes**, cage culture, restocking and semi intensive culture; **canals**, restocking, intensive, semi-intensive or extensive culture, and cage or pond culture.

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The Regional Scoping Workshop on the Use of Irrigation Systems for Fish Production in Central Asia (Tashkent, Uzbekistan, 17–20 July 2007) was organized by the Scientific Information Center of the Interstate Coordination Water Commission (SIC–ICWC), in close collaboration with FAO and with assistance from the Ministry of Agriculture and Rural Affairs of Turkey (MARA). The Workshop was held in the context of a decreasing inland capture fisheries and aquaculture production in all of the Central Asian countries (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan), after independence from the former Union of the Soviet Socialist Republics in the early 1990s. Millions of rural households in the Central Asian region are dependent to some extent on inland water resources for their livelihoods; inland capture fisheries and aquaculture are potentially important sources of food, income and employment for many of them. The Workshop aimed to build awareness among policy-makers, administrators and representatives of the irrigation and fishery sectors on the need to share information and increase collaboration and review the current status of inland capture fisheries in irrigation systems at the national level in the five Central Asian countries. It also aimed to analyse recent achievements, constraints and opportunities for future increase in inland capture and aquaculture production in irrigation systems in each of the countries. The Workshop was attended by stakeholders from each of the five Central Asian countries. The Workshop participants produced a number of conclusions and practical recommendations in support of inland capture fisheries and aquaculture rehabilitation and development in irrigation systems in Central Asia.



ISBN 978-92-5-105958-6 ISSN 0429-9337



TR/M/0075E/1/03.08/1340