March 2011

FOURTH INTER-GOVERNMENTAL MEETING ON THE ESTABLISHMENT OF THE CENTRAL ASIAN AND CAUCASUS REGIONAL FISHERIES AND AQUACULTURE COMMISSION

Issyk Kul, Kyrgyzstan, 22 – 24 June 2011

DRAFT CONCLUSIONS AND RECOMMENDATIONS OF THE REGIONAL STUDY ON THE FEASIBILITY OF RESTOCKING AND DEVELOPMENT OF CULTURE-BASED FISHERIES IN CENTRAL ASIA

Abstract:

Culture-based fisheries have been successfully developed across the world in order to increase productivity of capture fisheries, with five to tenfold increases in productivity per hectare not uncommon. Fish farming too has shown to be an important contributor to national food security, rural employment and income generation.

Unfortunately, political upheaval, the disruption of historic fish supply chains and limited state budgets combined halted many of the restocking programmes in the CACFAC region during the 1990s. This is unfortunate, as a number of important waterbodies in the region offer great potential for such activities. As a consequence, this study was tasked with providing an overview of regional waterbodies and historic and contemporary restocking experiences - using case studies from Kazakhstan, Kyrgyzstan and Uzbekistan - with a view to suggesting potential ways in which national governments and CACFAC might support the rehabilitation of culture (and, by extension, capture) fisheries in the region.

Seven overarching principles are identified (ecosystem compatibility; compatibility with other uses; best available science and information; social and economic benefits; collaboration with the culture production sector; the regulatory process; public information) - and accompanying recommendations are made - to guide culture-based activity and restocking in the region.

Background, justification and methods applied

Programmed, large scale, restocking of fish in reservoirs and lakes in Central Asia generally ceased in the 1990s as the newly independent governments – faced with substantive shortfalls in fiscal revenues – reduced the monetary and technical support afforded to the fisheries sector. This decision was, in part, influenced by the less than satisfactory experiences of past restocking programmes – the failure to following stocking recommendations, insufficient knowledge of the local ecosystem and predator-prey relationships, the accidental introduction of new species and disease (among others) – experiences which also served to make governments hesitant to invest in restocking. Yet restocking can play an important role in helping the regional countries to meet local food security objectives, while also generating employment and incomes in some of the poorest parts of the region.

In order to convince the regional governments to reconsider restocking the waters of Central Asia as a policy option, FAO (with support from regional and international experts) conducted a study on restocking and the rehabilitation of culture-based fisheries in 2010. Production, environmental, social and economic aspects of fish stocking and culture based fisheries in the region – with a particular focus upon Kazakhstan, Kyrgyzstan and Uzbekistan - were examined with a view to providing insights which would help support future decision taking and policy making processes in the sector.

The desk study, which made use of existing knowledge and reviewed documentation available across the region, was structured to address the following Research Questions (RQs):

RQ1: What are the lessons to be learned from failed and successful examples of culture-based fisheries in Central Asia in the past?

RQ2: What are the possibilities for culture-based fisheries in Central Asia based in the current environmental, economic and social situation?

RQ3: What is the overall feasibility of culture-based fisheries in the selected Central Asian economies?

RQ4: What advice/guidance can be given to governments in Central Asia in supporting the development of culture-based fisheries?

The Study was conducted by the FAO Subregional Office for Central Asia. Experts involved in the study were Professors Andy Thorpe and David Whitmarsh, and Dr Ben Drakeford and Dr. Chris Reid of the University of Portsmouth (United Kingdom), Dr. Bakhtiyor Karimov, Institute of Zoology, Academy of Science (Uzbekistan), Dr. Serik Timirkhanov, Kazakh Scientific Research Institute of Fisheries (Kazakhstan), Kuanych Satybekov (Kyrgyzstan) and Raymon van Anrooy (FAO). The desk study makes use of case studies drawn from Kazakhstan, Kyrgyzstan and Uzbekistan; case studies that provide a good insight in the current situation in the region as whole.

The complete report of the study is being finalized and will be published in the Russian and English language in 2011 as a FAO Fisheries and Aquaculture Technical Paper.

Conclusions and Recommendations from the Regional Study

The Central Asian region is characterised by low levels of annual precipitation[1], average annual summer temperatures that range from 30° C (Kazakhstan) up to 40° C in the Fergana Valley of Kyrgyzstan, and winter temperatures that can fall as low as -20°C. This [already precarious] natural environment has been substantively modified by human activity, most notably the Soviet drive for self-sufficiency in cotton which converted the region into a 'huge cotton plantation in the 1960s and 1970s' (Karaev, 2005:3). This was most apparent in what is now Uzbekistan, where seed cotton production grew from 300,000 tonnes in the 1950s to peak at over 3 million tonnes in the mid-eighties (Abdullaev *et al*., 2005:113). As natural precipitation was insufficient to satisfy crop water requirements, water was abstracted from the two main regional rivers (the Amu Darya and the Syr Darya) and their tributaries and an extensive system of irrigation and feeder canals emerged. In Kazakhstan, 3.3 million hectares of land was administered by 96, 400 km of irrigation and 14,900 km of drainage canals, a network that absorbed over 70 per cent of the country's national water resources (FAO, 2002:4). In Uzbekistan the irrigated area ascended to 4.3 million hectares (Umarov, 2003). Water management became a must, and to facilitate production a whole series of reservoirs were built on the region's rivers – Nurek in Tajikistan, Kapchagay in Kazakhstan, Toktogul in Kyrgyzstan, and Tudakul in Uzbekistan - stockpiling the glacial meltwater for the time when it was needed to irrigate the ever expanding cottonfields[2].

The main ecological casualty of this expansion was the Aral Sea, whose surface area fell 70 per cent (to 17,382 km$^{2)}$, whose volume declined 90 per cent, and whose salinity increased ten-fold between 1960 and 2006 (Micklin, 2007). This had a devastating effect upon local livelihoods as communities now found themselves (proverbially) 'high and dry' – the Sea's main fishing port, Aralsk, found itself almost 100 km from the Aral's waters. GEF (2002:111) suggests lower water tables and increased soil salinity has cost the immediate region US$1,754 million in crop losses annually. Human health in the vicinity has deteriorated markedly too due to the ingestion of heavily mineralised water (increased kidney and liver diseases), dust storms sweeping up the pesticide residues that became exposed as the Sea dried up (increased respiratory problems), and a quadrupling of the infant mortality rate since the 1960s as poverty and malnutrition have become endemic features of the communities that remain (Whish-Wilson, 2002). Regional fish resources were decimated, as the increased salinity wiped out the indigenous Aral species and, despite the best efforts of Soviet scientists to introduce salt-water species into the lake, only the flounder (*Platichthys flesus*) prospered. The fate of the Aral spiny sturgeon[3] (*Acipenser nudiventris*) and the barbel (*Barbus brachycephalus*) was symptomatic of a wider malaise that affected the fisheries sector of the region. Dams blocked spawning migrations, deliberately and accidentally introduced species had devastating effects upon local fish populations (as indicated earlier in this report), and overfishing by an increasingly impoverished population in the post-independence period decimated remaining capture stocks on the majority of the region's waterbodies. If lakes, seas, rivers and reservoirs are to be replenished, fisheries to be resurrected, and the livelihoods of those living alongside waterbodies to be [partially] restored, then restocking and the development of culture-based fisheries will be necessary. Past attempts have met with limited success across the region. These attempts have not only served to illustrate the difficulties of restocking regional waterbodies (where

[1] These range from under 150 mm (6 inches) a year in Western Uzbekistan and East Turkmenistan, to 300-400 mm [12-16 inches] in East Uzbekistan, Kyrgyzstan and Western Tajikistan, while Kazakhstan receives an average of 581 mm [23 inches] p.a. Precipitation, however, tends to be more concentrated in the mountainous regions, while the drier valley regions are the centre of agricultural production (Usda, n/d).

[2] This expansion was checked in the independence period, as grain self-sufficiency (most notably in Turkmenistan and Uzbekistan) became a priority for the new Republican governments.

[3] Also known as the ship or thorn sturgeon.

fisheries are of secondary importance to agriculture and hydro-power needs and, post independence, open access has tended to prevail) and designing effective culture-based interventions (Research Question -RQ1 below) but have also provided useful insights into the feasibility of culture-based fisheries in the region given local environmental, economic, social and cultural constraints (RQ2 and RQ3). On this basis this technical paper offers some recommendations as to how governments can best support the development of an effective, ecosystem-appropriate culture-based fisheries policy in the region (RQ4).

RQ1: What are the Lessons to be Learned from Failed and Successful Examples of Culture-based Fisheries in the Past?

In Central Asia, the first examples of restocking date back to the 1920s and 1930s. Trout from Lake Sevan in Armenia were introduced into Lake Issyk Kul in 1931 and stellate sturgeon into the Aral Sea in 1933. As capture fisheries production rose over the following decades, the All-Union Ministry of Fisheries sought to complement capture production by announcing a large scale fish culture development strategy in the 1960s. Production expanded rapidly, with culture farm output across the region reaching 25,000 tonnes within a decade, although not every planned introduction was successful. While culture production continued to rise in the 1980s, the production of fish in some of the most notable waterbodies in Central Asia[4] being almost exclusively based on these introduced species by the time independence dawned. However, the removal of a centralised system of support to the sector saw many installations decay and sectoral output collapse (Thorpe and van Anrooy, 2009a).

In Kazakhstan, the growth of culture based production saw a number of scientific studies undertaken in the 1970s with a view to providing detailed fishery -technological specifications for pond-based aquaculture. Carps, in particular grass carp and silver carp, along with ciscos were the main species stocked in to waterbodies in Kazakhstan. Many of these early restocking attempts were not successful for a variety of reasons, but largely related to a lack of understanding of either the biology of the species stocked or the ecosystem interactions within the waterbody fish were stocked into. A good example here was the stocking of carp and ciscos into the lakes of North Kazakhstan. The main problem was one of competition between species - and this could have easily been avoided with a better understanding of the ecosystem interactions. While the environmental characteristics of the lakes appeared to be suitable, the population of competitor species (in terms of feed), and predators (in terms of recruitment), meant that the stocking of carp and ciscos may have actually decreased overall production. Bream were also introduced into the lakes, and while catches grew steadily from the late 1970s, there was little local market demand.

There have been other unfortunate examples of failed restocking programmes, such as the stocking of stellate sturgeon into Aral waters in 1933, an introduction that almost caused the eradication of the spiny sturgeon (through an introduced disease), a naturally occurring indigenous species. Despite this, several further attempts were made to form breeding populations of the stellate sturgeon, all of which have been unsuccessful for a number of reasons, but again largely related to either poor understanding of the species stocked, or a poor understanding of the waterbody the fish were stocked into.

Since 2004, Lake Yakush has been stocked with one million cisco fingerlings annually. By 2005, seven tonnes of cisco were landed, this rising to ten tonnes in 2008-9. However, the principal factor

[4] The fisheries of Lake Balkhash, the North Aral Sea, and the reservoirs of Bukhtarma, Zaisan, Kapchagay and Shardara.

attributed to the success of stocking cisco in Lake Yakush was the fact that the lake was not populated prior to the fingerlings being released, hence ecosystem interactions (such as predation etc.) were not an issue in this instance.

It is therefore clear that in Kazakhstan a better understanding of the environmental characteristics of waterbodies and ecosystem interactions was – and is - required to promote the success of future restocking programmes. This, in part, can be achieved by keeping accurate records of current restocking programmes so as to provide guidance on best practice for future stocking efforts.

In Kyrgyzstan, the primary emphasis of culture based production was to acclimatise high value species, in the first instance Lake Sevan trout, into major waterbodies such as Lakes Issyk Kul and Son Kul. The higher value species were introduced largely on a trial and error basis, given the lack of underlying scientific studies, and in some cases caused irreparable damage to the ecosystem and natural fauna of the lakes. As evidenced by the intentional stocking of pike perch in Lake Zhizhitskoye so as to prey on the non-commercial species found in the lake, the introduction of predators to waterbodies can cause irreversible damage if the populations formed affect the predator-prey relationship in the waterbody.

Latter introductions of pike-perch, peled and whitefish into Issyk Kul were more successful and during the 1970s catches were reported to be healthy for a number of the stocked species. This brought new problems however, because a successful culture based activity (in terms of increased production) becomes economically interesting to other parties and, if these fisheries are not well managed - as was the case with Issyk Kul - then overfishing/illegal fishing can significantly impact on future production. Furthermore, it also appears that breeding populations were not formed in many of the waterbodies that carp were stocked into. As a consequence, it was necessary to establish fish breeding facilities and extract broodstock from waterbodies where they had become established.

Although recent legislation has provided a more conducive environment for the restoration of culture based fisheries, the private nature of much of this enterprise – allied to a state that can only weakly monitor production activities - ensures there is only limited information available upon ongoing restocking experiences and hence what lessons can be learnt.

Similarly to Kazakhstan and Kyrgyzstan, early restocking programmes in Uzbekistan were generally not successful. The failure to follow stocking recommendations when releasing silver carp fry and fingerlings into the Arnasay Lake System during the late 1970s and 1980s, for example, led to decreased catches in the late 1980s.One notable success, however, was the introduction of the Baltic herring into the Aral Sea in the mid 1950s which quickly featured in large numbers in local catches. However, a number of accidental stockings of other species increased pressure on natural food resources and, only a few years after stocking, Baltic herring had largely disappeared from the Sea. The intended and accidental stocking of carp species has also been successful in the region and has increased species numbers in some waterbodies. This is largely because there is little competition for food between the stocked fish and naturally occurring species. The development of fish hatcheries to produce fry and fingerlings for restocking in Uzbekistan was limited during the 1970s and 1980s, largely because of water shortages (either because of high pumping costs or the priority accorded to irrigation and power generation). More recent culture experiences saw a number of private companies conduct small scale carp restocking in Talimardjan and Kattakurgan reservoirs. However, as the reservoirs were exploited for irrigation to the point of drying, the stocked fish perished.

Recent revitalisation of the sector can be traced to 2007/8 when an FAO led project convened stakeholders from across the sector to produce a *Draft Concept for the Development of Aquaculture*

and Fisheries in Uzbekistan (2008-2016). The decree proposed to increase production from existing fish farms, although the decree was silent on improving education and research in the culture sector.

To increase fish production in Central Asia is probably not that difficult, if facilities and funding are provided to do so**. What has proven to be the main challenge in Central Asian fisheries, both pre and post independence has been the lack of understanding of the waterbodies in the region. In many cases, fish farms have produced fish for restocking programmes that have had dismal results. Production volumes in the targeted waterbodies have often remained stagnant, and sometimes even been reduced, through introduction of disease, competition with indigenous species etc. Without investing in education and research and development, simply increasing the production of fry and fingerlings from fish farm facilities is almost pointless.** While the potential for culture based fisheries in Uzbekistan appears to be higher than in Kazakhstan and Kyrgyzstan (at the current time), there remain numerous obstacles to overcome in order to achieve sustainable and profitable culture based production.

RQ2: What are the Possibilities for Culture Based Fisheries in each Country based on the Current Environmental, Economic and Social Situation?

The vast waterbodies in Central Asia offer considerable potential to increase fish output to levels seen during the old Soviet era and perhaps beyond. However, production since independence has decreased significantly in the Central Asian countries of Kazakhstan, Kyrgyzstan and Uzbekistan due to a decrease in funding for fisheries development, a lack of clarity over strategies for the sector, and weak oversight of the fisheries that are currently in production. However, there are a number of issues that demand consideration.

Any attempt to rehabilitate the sector must primarily focus on the environmental aspects of production, otherwise the externalities associated with increased production may actually offset the benefits of restocking programmes. Our research suggests that despite substantive research on a number of regional waterbodies being undertaken during the Soviet period, a full understanding of the complete ecosystem of the various waterbodies in Central Asia is still lacking. Equally, the various interactions between the stocked fish and the indigenous species were either not fully understood and/or considered, as evidenced by the examples of failed restocking experiences in the three countries. To gather a full understanding of the ecosystem interactions within a waterbody requires significant effort however, because, as Lorenzen *et al.* (2001) note, the reasons for failed attempts are not always immediately clear. Accurate data on stock enhancements and stocking experiences is sadly lacking (or has been lost) in many Central Asian countries, and can only be obtained through experimental management when waterbodies are newly stocked. **The first step, therefore, is to gain an understanding of the ecosystem interactions when waterbodies are newly stocked and synthesize the data across the three countries so as to inform future restocking programmes.**

Assuming an understanding of the ecosystem interactions, the success of restocking programmes is determined by the species stocked. The introduction of non-indigenous species has caused problems around the world and has been highly detrimental to the functioning of many lake and river systems. A pitfall of previous regional restocking programmes would appear to relate be a bias in viewing the potential rewards of stocking species on the basis of short term economic gains rather than long term sustainable yields. Given the harsh environmental condition in Central Asian countries, where many

waterbodies cannot feasibly be used to produce fish, a full understanding of the biology of the current fauna and flora is critical to ensure that any attempt to increase productivity through restocking does not compromise native stocks. Ultimately, as stocking decisions are irreversible, serious consideration needs to be given to the species stocked.

Any culture based activity must be designed to promote long term sustainability and profitability. Thorough e*x ante* appraisals should therefore be undertaken so investors can see the likelihood of their investment returning long term profit. An understanding of the full costs and benefits is also needed. This is particularly true in Central Asian culture-based fisheries as they presently do not benefit from state funding or subsidy. The limited funding available for fisheries in Central Asian countries means that access to expertise and training, which can also be considered essential preconditions for successful project development, are lacking. The lack of available data on the regional fisheries sector is equally problematic as appraisals (such as cost-benefit analysis) rely on the use of data from past experiences (in terms of costs etc). If this data is not available, or inaccurate, then projects may appear to be feasible - or conversely infeasible – when this is not the case.

Since independence, national fisheries management capacity has declined (and ceased to exist in some cases) across the region. Moreover, the nature of the command economy inhibited the development of an entrepreneurial culture and, while private commercial activity has grown in the wake of independence, culture based fisheries was never going to be an attractive proposition for many emergent entrepreneurs given the limited incentives on offer. Yet it is this entrepreneurial or management capacity that is critical in determining the likelihood of a project's economic success. **It is therefore essential that culture based fisheries projects in the region also be underpinned by clear and transparent regulations regarding property rights to the stock (or waterbody) and the harvest. Further attention must be paid to researching – and developing - markets for the products produced (both currently, and in the future).** While fish consumption presently makes only a modest contribution to daily consumption of animal protein in the central Asian region, there appears to a significant market for imported fish in both Kyrgyzstan and Uzbekistan – suggesting that with the right marketing support culture production of new and existing species could help close this deficit.

In social terms, the development of culture based fisheries can impact upon three types of natural capital - *land, water and wild fish stocks*. On the one hand, the development of culture based fisheries can - through the installation of aquaculture facilities, for example - create local land shortages and/or damage the environment. On the other hand, such production may also deliver social benefits - by allowing previously underutilised land or water resources to be brought into full production. In Central Asia, the development of culture based fisheries under consideration largely focuses on cage culture in lakes/reservoirs and pond culture, and therefore the social effects of these developments is likely to have only a limited impact in land and terrestrial habitat terms. While culture based fisheries could in theory lead to increased competition for *water* resources between different stakeholder groupings, this is unlikely in the Central American context for two reasons. First, the prevalent form of production – carp culture in ponds – poses no additional demands for water. Second, fisheries production in these countries does – and is likely to continue - ranking well below agriculture and energy generation in terms of water allocation priorities. In terms of the social impacts of culture based fisheries on *wild fish stocks*, culture production is likely to increase fish supply without harming wild populations (albeit subject to the several caveats discussed concerning environmental aspects). The development of culture based fisheries may also bring several social benefits to the region. While investment in the

fisheries sector since independence has been minimal, if increases in fisheries output are complemented by the provision of improved infrastructure (such as roads), other industries may also derive benefits and see levels of employment increase.

RQ3: What is the Overall Feasibility of Culture-based Fisheries in the Defined Countries of Central Asia?

The vast waterbodies of Central Asia offer considerable potential to increase output through culture based activity. However, current and future restocking programmes are likely to fail unless the following problems are addressed:

1. The research available that documents past restocking programmes in Kazakhstan, Kyrgyzstan and Uzbekistan, clearly shows that there is a poor understanding of the ecosystem interactions of the waterbodies - and also a limited understanding of the species chosen for restocking (in particular in terms of how the species stocked will impact upon the ecosystem). As this report has shown, many restocking activities have failed because either the stocked species out-compete indigenous species (for food, habitat etc), or because the stocked fish itself cannot form breeding populations (through lack of food or predation, for example).

2. There are few examples of restocking activities that have increased total fish output without impacting on the waterbody in some negative way to date in the region. One exception was the stocking of bream (in Kazakhstan), which subsequently formed breeding populations without impacting on the already existent flora and fauna of the waterbody. However, this gain was nullified as there is no local market for bream. Therefore, culturists need to be sure that any fish they choose for culture is either already in demand in the local markets or is likely to be demanded in future (as export markets are not well developed in the region).

3. While there have also been instances where restocking activities have increased overall fish production and provided fish for important markets in the region, little detailed data exists documenting these activities. The only way of obtaining new data then is from new restocking experiences. The collection and subsequent synthesis of this new production data could therefore provide vital information for future restocking ventures, allowing culturists to understand why previous attempts have failed (or been successful), and perhaps allow the production of some “best practice” guidelines.

4. Any feasible culture strategy is critically dependent upon management – both at the enterprise and the sectoral level - and culture based fisheries will only develop effectively in the region if attention is paid to research and development and education. Funding will also be required in the short term to revitalise the facilities that are needed to produce the fry and fingerlings that form the basis of restocking programmes.

5. The selection of waterbodies to culture fish is critical, given that the use of water for irrigation and energy production will likely remain a higher priority than fish production. As the most suitable artificial waterbodies identified in this report for fish production are primarily already used for irrigation and energy production, further research into the characteristics of other waterbodies is required to source ones that do not have a primary use in those sectors.

Any restocking activity needs to consider the economic, environmental and social dimensions if restocking is to lead to higher production. The problems outlined above are common to all three countries this report has focused on. For a feasible culture based fishery to emerge in the region the primary task would appear to be education - to ensure that the correct fish are stocked in the most

suitable waterbody. To some extent the way forward will still be one of trial and error, as information regarding past experiences tends not to be available, but the long term success of culture based activity will depend upon increasing the level of education, research and development in culture based fisheries development. The waterbodies of Central Asia offer potential for culture based activity, but unless the above issues are given serious consideration, future culture activity is likely to suffer the same fate as past attempts.

RQ4: What Advice/Guidance can be given to Governments in Central Asia in Supporting the Development of Culture-based Fisheries?

It is recommended that the Central Asian governments, through the medium of the Central Asian and Caucasus Regional Fisheries and Aquaculture Commission (CACFAC), develop a set of overarching principles which guide culture-based fisheries and restocking activity in the region. These principles should include[5]:

A. Ecosystem Compatibility.

Culture-based fisheries development in the region should be compatible with the functioning of healthy, productive, and resilient natural [lakes and rivers] and man-made [reservoirs] aquatic eco-systems. Past research, however, shows that certain species are unable to reproduce or thrive in particular waterbodies (case of osman and carp in Lake Son Kul, silver and grass carp more generally in Kyrgyzstan, for example) – so repeated reseeding/stocking is required, while limited natural food reserves in many waterbodies across the region preclude the development of an intensive programme of culture-based fisheries in the absence of employing supplementary feed sources [see also point E. below]. Moreover, other introductions, both planned and accidental, have had profound effects on the local aquatic ecosystem – the Balkhash marinka and perch and the Eurasian minnow becoming endemic in the waters of South and South-Eastern Kazakhstan following their accidental release into local waterbodies. The introduction of carp cultured at the state fish hatchery of *Yangiyul* into Uzbek waters, for example, has also compromised the genetic fingerprint of the wild form of common carp previously found in the region. **It is therefore recommended that:**

- **National governments** take a lead in developing, implementing, and enforcing ecosystem-based conservation and management measures for culture-based fisheries, with **CACFAC** helping to coordinate the integration of such measures at a regional level[6].

- **National governments** support the stocking of only native – or currently naturalized – species in national waterbodies unless 'best available science demonstrated the insertion of new species (tilapia say) is unlikely to cause undue harm to wild species, habitats, or ecosystems in the event of an escape' (NOAA, 2011:8).

[5] These principles are based upon the set of criterion derived to guide aquacultural development by the US National Oceranographic and Atmospheric Administration (NOAA, 2011).
[6] Our experience suggests there is limited knowledge of ecosystem approaches to aquaculture and its management presently in the region, a lacunae that can be addressed within the training proposed under point C. below.)

- **National governments** develop, implement, and enforce conservation and management measures (where they do not presently exist) to maintain the health, genetics, habitats and populations of native species; to maintain water quality, and to prevent escapes and accidental introduction of cultured species into the local environment.

- **CACFAC** should, in line with its "5-Year Regional Work Programme (2011 -2015)" prepare a *Strategy for Responsible Fish Introductions and Translocations in Aquaculture in Central Asia and the Caucasus*, and support its implementation in the region.

- **CACFAC** should, in line with its "5-Year Regional Work Programme (2011 -2015)" develop regional best-practice approaches for rehabilitation of water bodies (including spawning and nursery habitats in rivers and lakes).

- **CACFAC** can be of assistance in promoting ecosystem compatability of aquaculture establishments (including those involved in culture-based fisheries) through the *Development of Environmental Impact Assessment (EIA) Methods for Aquaculture in Central Asia* as stipulated in its "5-Year Regional Work Programme (2011 -2015)"

B. Compatibility with Other Uses.

A particular problem in designing a Central Asian capture and culture fisheries programme relates to the multiple demands placed upon the region's scarce water resources. As noted, the majority of reservoirs in the region were constructed for either energy supply and/or irrigation needs, and the demands of these sectors dictate when – and how much – waters are released. While reservoirs such as Todakul and Talimarjan in Uzbekistan, for example, offer significant potential for culture-based fisheries due to the relatively high volumes (325 and 125 million cubic metres respectively) of water that remain once water abstraction for irrigation purposes is exhausted [the 'dead' level], others such as Uchkurgan and Kuymazar have much lower dead levels (16 and 47 million metres). It is not just the levels of residual water that impacts upon fisheries in the regional waterbodies, as water release during the summer (irrigation) or winter (hydro-power) can sweep fish [native and restocked], released larvae and fingerlings, and food sources, downstream.

A similar problem prevails when irrigation and drainage systems are prioritised – as with the Syrdarya-Sanzar-Zarafshan-Eski Angar- Kashkadarya-Karshi-Amudarya link – as the development of such networks can inhibit stocking/restocking of certain waterbodies as the benefits of such stocking programmes are dissipated across a much wider regional water system. Agriculture further exacerbates the development of regional culture-based fisheries through its impact upon water quality. Salinisation [mineralisation] of surface waters resulting from the reintroduction of drainage water from irrigated fields is a common problem in the region, affecting reproduction success – and with it, commercial productivity. The heavy historic use of pesticides also saw a deterioration in water quality, with research by Karimov (various) documenting the extent of pesticide accumulation in fish tissue. In Kazakhstan and Tajikistan, fish farms, which are almost all dependent upon supplied energy, have also suffered due to the uncertainty of power supply in the winter months – with sudden, unannounced, cuts in energy supply causing high mortality and a consequent reduced profitability. **It is therefore recommended that:**

- **National governments** take steps to promote greater coordination between their respective national Fisheries Departments and those other agencies/departments that have a stake in how the country's aquatic resources are used. This coordination should not just discuss optimal methods of water release, but also focus on how to improve water quality (ie; reduced mineralisation and biocide presence) by modifying production techniques.

- **CACFAC**, on behalf of the member governments, should represent fisheries interests at the regional level, liaising and advising the Central Asian Interstate Commission for Water Coordination (ICWC) and the respective Basin Water Organizations (BWOs) among others, so as to ensure the objectives and needs of the fisheries sector is both recognized and streamlined into the developmental activities of these other organizations.

- **CACFAC** should also, on the basis of stated national preferences regarding aquaculture development in the region, draw up a regional plan for the Support of Aquaculture so that both funds and technical support can be targeted more effectively to the sector. This would be in line with the "5-Year Regional Work Programme (2011 -2015)" of CACFAC which gives importance to the *Provision of Advice on the Formulation of Aquaculture Policies and Strategies at National Level in Specific CACFAC member countries"*.

C. Best Available Science and Information.

Management decisions for culture-based fisheries should be based upon the best available science and information. Unfortunately, the tremendous strides made by scientists during the Soviet period in undertaking technical studies on regional fish culture have not been maintained in the Independence period. In Kazakhstan, for example, the *2007 Republic Strategy of Acclimatisation and Fish Stocking* was formulated based upon original technical reports prepared in the 1970s. Equally, the national consultants involved in the preparation of this report have highlighted moreover that much of the technical and quantitative data (including data on the specific restocking programmes – in terms of costs, fingerlings cultured and released - and the annual catches from the various national waterbodies) has either been lost, is inaccurate or does not exist. The scenario is further hampered, as Karimov *et al.* (2009) report, due to the severe educational and training deficit that now exists in some of the republics, with 'extension and training facilities in support of aquaculture development and management non-existent'. **It is therefore recommended that:**

- **National governments,** via their respective Fisheries Departments, undertake a 'gap' analysis to identify just what technical and statistical data on culture (and capture) production currently exists, and – on the basis of national development strategies for the sector – what technical studies, extension support and the like is needed.

- **National governments**, on the basis of this gap analysis, support scientific studies which examine culture-based production technologies, practices, benefits, costs, and risks, so as to develop 'best practices' which can inform the attainment of sectoral strategy goals.

- **CACFAC** should synthesize and deliver information in a timely manner to the member countries on the current state of scientific understanding about the observed and potential impacts and benefits of culture-based production of the species selected for national aquaculture strategies. This would include monitoring, evaluating – and perhaps maintaining a

regional database - on the impact of aquaculture on predator-prey relationships, biodiversity, and other factors integral to the maintenance of healthy and productive ecosystems.

- **CACFAC** should work with member governments to improve scientific understanding of the effects of culture-based technologies and practices, and ensure the restitution of national (and/or perhaps regional) specialisms in extension techniques and training programmes necessary to attain sectoral strategy goals, solicit international funds (where necessary) to help in this.

- **CACFAC** should also take the lead in ensuring the regional dissemination of international health, quality and safety requirements (ie: HACCP), so as to enable regional producers – with national government and CACFAC support – enter the more lucrative international markets[7].

- **CACFAC, together with national governments,** should collect and disseminate information on best practices in restocking and culture-based fisheries from other regions.

D. Social and Economic Benefits

As intimated in the study, culture-based fisheries production has the potential to deliver a number of economic (to the producer) and social (to the wider community) benefits, and it is thus imperative that investment in the sector is channelled in such a way as to provide a net benefit to the nation, the local community arraigned around the waterbodies, and consumers of the products produced. **It is therefore recommended that:**

- **National governments** undertake an ex-ante baseline analysis of all proposals for new and/or expanded culture production activities, assessing the likely positive and negative social, economic and cultural impacts of the activity on all stakeholders in the immediate and longer-term before approving the activity.

- **National governments** (once the baseline study is concluded) actively support the establishment of new culture enterprises that not only create jobs, but could also provide; associated employment and revenue-generating opportunities upstream (fish processing companies) and downstream (local input suppliers), expanded product choice on the local market, reduced fish imports.

E. Collaboration with the Aquaculture Sector.

It is important that local operators – whether state or private - of aquaculture facilities be held accountable for protecting the environment, wild species, and human safety and, moreover, such operators should be obliged to regularly report to the national authorities on the nature and extent of the activities undertaken. This has been particularly problematic in the central Asian region in the Independence period. The lack of guidelines or regulations led to the uncontrolled expansion of cage-culture activity on Issyk Kul using inferior cage construction equipment and a consequent escape of

[7] This is based on the premise that production for export does not displace production for the domestic market, but rather complements it.

rainbow trout into the waterbody. In Kazakhstan, the assignation of rights – with few responsibilities – of waterbodies to multiple owners has triggered conflict and 'free- riding'.

Equally, however, state support to the sector has fallen short. Timirkhanov *et al.* (2010), for example, note how customs policies and tariffs have deterred the import of larvae, roe, feed, veterinary drugs, chemical reagents and culture equipment, allied the decision to sharply increase water use fees and a general lack of financial support to the sector in Kazakhstan have been strong brakes on its rate of growth to date. Feed is a particular problem, with the high cost of imported feed and the lack of a domestic feed industry that could supply the quantities required[8] causing producers to seek alternative, less effective, home-grown remedies. While this disconnect is in large part attributable to a combination of the transition from command to market economy, and the relative lack of interest by both private and public sector (until recently) in the sector, and is slowly being remedied (see Kyrgyzstan's *2008-2012 Strategy for Fisheries and Aquaculture Sector Development and Management in the Kyrgyz Republic*, and the *Policy and Strategy for Fisheries and Aquaculture Development for Poverty Alleviation in Tajikistan for 2010 – 2025*, for example), a further pro-active strategy is necessary in order to ensure an effective management framework is established where rights and responsibilities of sectoral stakeholders are clearly enunciated. **It is therefore recommended:**

- **National governments** work with aquaculture and fisheries operators to; (i) prepare and implement (where necessary), broodstock management plans, aquatic animal health plans, and a contingency plan for responding to emergencies, (ii) adopt recognized best management practices [in terms of husbandry, biosecurity etc.], and (iii) incorporate environmentally efficient and responsible management practices [to reduce input usage and waste discharge].

- **National governments** undertake regular inspections of all installations, and establish in partnership with private sector aquaculturists and fishers national codes of practice to guide the operations of the sector. In addition to the above, consideration should be given to setting national monitoring and reporting requirements for all operators (these should include, inter alia, reporting annual volumes produced, escapes, disease outbreaks, nutrient discharges, drug and chemical usage).

- **CACFAC** can help in this regard by collating (and distributing) information on best management practices and codes of practice within - and from outside – the region[9], and coordinating regional training programmes on the preparation of broodstock and aquatic animal health plans, and other salient culture, environment or management practices.

F. The Regulatory Process

It is equally incumbent on the state to ensure sectoral management decisions are taken in a timely, impartial, efficient and transparent manner. In Kazakhstan, for example, current legislation prohibits the state from contracting private aquacultural operations to undertake restocking activities on its

[8] While there is a feed plant (Semipalatinsk) in East Kazakhstan its main custom is with poultry producers and, while not averse to supplying culture fisheries, the terms of supply were not coincident with the needs of local culture producers.

[9] A first task perhaps is to see the extent to which *the FAO Technical Guidelines for Responsible Fisheries: Aquaculture Development* (1997) and the associated supplements both apply, and have been applied, in the region.

behalf – a bias that severely circumscribes the opportunities for private sector expansion. **It is therefore recommended that:**

- **National governments** constantly review all regulation pertaining to the sector with a view to ensuring policy coherence, reducing regulatory uncertainty and minimizing unnecessary regulatory burden on all aquaculture and fisheries operators. This includes the vetting of applications for new culture-based operations, and providing public notice of the same.

- **CACFAC** could play a major role in supporting modification and harmonization of legal frameworks in the region through offering technical advice on the modernization of laws and regulations governing fisheries and aquaculture.

G. Public Information.

Poaching is endemic across the region, as a number of reports have indicated (see World Bank, 2004; Sareiva *et al*., 2008). This epidemic is attributable to three factors, (i) the collapse in livelihood opportunities in the post-independence era, placing increase pressure on the harvesting of natural resource stocks (Thorpe and van Anrooy, 2009), (ii) the regulatory vacuum that ensued[10], and (iii) ignorance over the ownership of stocked species. The latter two causal factors have been obviated in the case of private culture activities in Uzbekistan where *the Programme on Measurements of Fisheries Sector Development in the Republic in 2009-2011* promoted the formation/registration of new fish farms and, as a consequence, the newly registered fish farmers have taken active steps to police and protect their newly assigned waterbodies. However, in the case of larger waterbodies in the region – particularly those which the state continues to restock – the ownership of stocked species is either unclear and/or poorly understood. **It is therefore recommended that:**

- **National governments** take action to communicate to the public the changes that are/have occurred in legislative and policy terms, and how these changes impact upon fishing rights in the national waterbodies.

- **National governments** increase awareness among the population on the importance of fish consumption as part of a healthy diet - and inform the public on the state of the fish resources (and the role of the fishery and aquaculture sector at large) in terms of its contribution to aquatic biodiversity, fish production, employment, income and poverty alleviation.

Possible options for the way forward

On the basis of the conclusions and recommendations described above, the Preparatory Meeting of the Central Asian and Caucasus Regional Fisheries and Aquaculture Commission may wish to consider the following options (either individually, or in combination), as a way forward in supporting on the development of culture-based fisheries in the region:

[10] Sarieva *et al.* (2008:17) suggest 'poachers' may have been able to extract as much as 250 tonnes per annum from Lake Issyk Kul in Kyrgyzstan due to the inability to police the fishing moratorium imposed there in 2005.

1. **To take note of the conclusions and recommendations made by the experts involved in the regional study - but consider that further action by the Commission on this subject is not required.**

2. **To discuss and adopt the Conclusions and Recommendations of the regional study - and pass them forward to the Inaugural Meeting of the Commission for endorsement by the Commission.**

3. **To request the Technical Advisory Committee (TAC) of the Commission - at its first meeting in 2012 - to look into ways in which the Recommendations proposed might best be followed up at the national and regional levels.**