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RESTOCKING AND CULTURE-BASED FISHERY

INTRODUCTION

1. This document reflects the outcomes of the Regional Training Workshop on the Provision of Technical Advice on Restocking and Culture-Based Fisheries which was held in Bishkek, Kyrgyzstan on 11-13 June 2019. It contains the key findings, needs, conclusions, and recommendations and a regional perspective on sustainable development and implementation of restocking and culture-based fisheries in the CACFish competence area.

2. Population growth, demand for greater food security and higher living standards, increased competition between different users for water resources, pollution from factories, cities, and farmlands, overfishing, climate change and other environmental pressures significantly affect the productivity of water resources. Successful aquaculture development contributes to increased fish consumption, improved nutrition, income diversity and rural development.

3. Restocking and stock enhancement has proven to be a useful intervention towards the management and conservation of inland fisheries. The underpinning concept is to produce fish (primarily via hatchery production) and release them into wild populations to increase their abundance, rebuild over-exploited fisheries and improve fish productivity. **Restocking** refers to the release of cultured juveniles into wild populations to restore severely depleted spawning biomass to a level where it can once again provide regular, substantial yields. This may also involve re-establishing a commercial species where it is locally extinct as a result of overfishing, or the release of juveniles reared in "conservation hatcheries" to help restore endangered or threatened species**. Stock enhancement** refers to the release of cultured juveniles into wild populations to augment the natural supply of juveniles and optimize harvests by overcoming limitations in recruitment.[1]

[1] FAO.2015. Report of the APFIC/FAO Regional Consultation: Improving the contribution of culture-based fisheries and fishery enhancements in inland waters to Blue Growth. RAP Publication 2015/08. 52 p.

4. Culture-based fisheries are defined as "Activities aimed at supplementing or sustaining the recruitment of one or more aquatic species and raising the total production or the production of selected elements of a fishery beyond a level, which is sustainable through natural processes". In this sense culture-based fisheries include enhancement measures, which may take the form of: introduction of new species; stocking natural and artificial water bodies, including the use of material originating from aquaculture production; fertilization; environmental engineering including habitat improvements and the modification of water bodies; altering species composition including the elimination of undesirable species, or constituting an artificial fauna of selected species; genetic modification of introduced species. Culture-based fisheries are capture fisheries which are mostly or entirely maintained by the regular stocking of seed fish. Culture based fisheries comprise two phases: (i) a farmed phase for the provision of stocking material; and (ii) a wild phase where the onward growth of the fish stocked depends on natural processes. Stocking is the release of fish, usually as fry or juveniles, into a water body to improve the fish stock and the fishery. Stocking material (seed) is usually obtained from aquaculture although stocking with seed captured from other water bodies is also common in some areas. Stocking is usually a repetitive exercise. Introductions are the release of new species to an environment, usually to introduce a new element into the fish community. Introductions are intentionally self-sustaining, and are thus only made once.[2]

5. Some of the main benefits from fish restocking or enhancement are as follows: [3]

- increasing the catch and catch rate of a species,
- improving fishing opportunities,
- restoring a depleted stock,
- restoration after catastrophic mortality events,
- compensating for nursery or breeding ground loss/degradation,
- shifting fishing effort from one species towards another species
- conservation or the reintroduction of critically endangered species, and
- displacing low-value trash fish (that compete with feed supplies) with high-value fish species.

6. Restocking and culture-based fisheries in freshwater lakes and reservoirs, as a means of enhancing fish resources, has been practiced extensively across Central Asia. Since the 1990s, political and economic developments have led to a decline in stocking and culture-based fisheries programs in the region. Recently, the effectiveness of restocking has once more become an important issue in the region. Despite the release of millions of juvenile fish, overall fisheries production keeps declining. This has raised questions of whether stocking is a good tool for sustaining capture fisheries. In the past, limited research has been undertaken to establish the survival rates of juvenile fish, and on the optimum release age and weight. In the past few years, some research has been devoted to these topics, but the results are difficult to obtain and analyze.

REGIONAL TRAINING WORKSHOP ON THE PROVISION OF TECHNICAL ADVICE ON RESTOCKING AND CULTURE-BASED FISHERIES

7. As part of the 2016-18 CACFish Programme of Work, a Regional Training Workshop on the Provision of Technical Advice on Restocking and Culture-Based Fisheries was held in Bishkek, Kyrgyzstan on 11-13 June 2019. It was attended by 40 participants from the following countries: Armenia, Azerbaijan, Georgia, Kyrgyzstan, Kazakhstan, Tajikistan, Turkey, Turkmenistan, Russian Federation, Ukraine, and Uzbekistan. The Interstate Commission for Water Coordination of Central Asia (ICWC) was invited to the workshop. Respective experiences of FAO Project "Towards

[2] Thorpe *et al*., 2011. Feasibility of restocking and culture-based fisheries in Central Asia. FAO Fisheries and Aquaculture Technical Paper. No. 565, Ankara, FAO, 2011. 106 pp.

[3] Western Australian Department of Fisheries (2013), Fisheries Management Paper No. 261, Policy on Restocking and Stock Enhancement in Western Australia.

Sustainable Aquaculture and Fisheries Development in the Kyrgyz Republic (GCP/KYR/012/FIN) was shared at the meeting.

8. The main objectives of the regional workshop on CBF were to:

- Review the current situation of member's and invited country's stocking activities,
- Exchange experiences among the participants regarding the main criteria for fish stocking and developing culture-based fisheries,
- Underline the contribution of stocking to recreational fisheries/sport fishing, and
- Identify/address related problems and provide recommendations for future consideration and implementation when stocking fish in the CACFish competence area.

9. The topics discussed were supported and complemented with case studies and country reviews. Case studies and country presentations drew further attention towards existing bottlenecks, experienced problems, and feasible solutions in the CACFish region. The following case studies were presented at the workshop:

- The ecological state of the water bodies of the Aral Sea basin and the impact of their fish productivity on transboundary watercourses',
- Restocking and recovery of the sturgeon population in Turkey,
- Towards sustainable aquaculture and fisheries development in the Kyrgyz Republic, and
- Empirical models for predicting fish yields in the waterbodies of the Kyrgyz Republic.

10. The workshop also included presentations of country reviews (Armenia, Azerbaijan, Kyrgyzstan, Tajikistan, Turkey, Georgia, Kazakhstan, Ukraine, Uzbekistan and the Russian Federation) on the status of restocking and CBF applications.

11. The workshop took note of the following key issues:

- The rationale, techniques developed and options/measures for Inland Fisheries Enhancement (IFE),
- Species selection criteria, factors for stocking success, and the environmental risks of stocking,
- The characteristics of water bodies and their impact on fisheries production,
- Trophic level (water productivity),
- Effects of age and stocking season on restocking,
- Control of untargeted fish species and the control/elimination of invasive species, and
- Contribution of fish stocking to inland fisheries development and regional income diversification.

12. The Meeting identified the following major challenges:

- It is especially important to take into consideration the fact that not all types of water bodies can equally support fisheries. Some water bodies in the CACFish coverage area and in other invited participating countries have marginal potential, or would be completely unable to support sustainable fisheries. The reasons for their limited development potential were summarised as follows:
    - Unfavourable hydro-climatic conditions that negatively impact river discharge patterns. Unpredictable annual and seasonal fluctuations in water levels and reductions in flood plain areas reduce the chances for productive natural spawning,
    - Flash floods are common in the region, and runoff in all sections of rivers wash out

fish populations and temporarily destroy the natural food sources for the fish, and

- Water-borne industrial pollution and the salination of reservoirs and rivers associated with irrigation systems are common problems found across the Central Asian region.
- There are many water reservoirs in the region. These are artificially formed water bodies that fundamentally change riverine aquatic ecosystems. The creation and maintenance of sustainable fisheries in a water reservoir depends on its primary use. Water reservoirs built for generating hydropower, accumulating rain, surface or underground waters require diverse water management systems. It is important to note that the fisheries potential of a reservoir is dependent on its primary use (power generation, irrigation, agriculture, etc.), the water supply, and the water level management system.
- The region has extensive irrigation networks. The contribution that irrigation canals can provide to fisheries production depends on their size, the carrying capacity of the water body, and seasonality.

- In addition to the hydrological suitability of the different water bodies for fisheries development, there are also technical, ecological, economic and social considerations and preconditions, which when combined, determine how CBF should be planned, implemented and evaluated.

13. The Meeting suggested the following actions and research priorities:

- The consolidated conclusion of the workshop was that the development of fish stocking and CBF programmes presents complex challenges, especially with respect to the ever-increasing demand and hence competition for shrinking water resources, due in part to climate change.
- Presentations/discussions highlighted the importance of:
  - The use of clear terms and technical definitions, understood uniformly by all concerned and effected stakeholders,
  - Gathering sufficient physical, chemical, biological, economic and social information on water bodies where CBF will be introduced or enhanced,
  - Establishing systematic decision-making processes to include the standardisation of procedures for setting objective goals, and estimating the positive and negative impacts of proposed fisheries enhancement interventions for a given water body, and
  - Addressing and developing recommendations to mitigate the negative impacts of anthropogenic activities on water resources. This is a key issue that should be viewed as a standard procedure when considering interventions to enhance inland fisheries.

14. Conclusions of the workshop were as follows:

- Stocking fish is one of the most important CBF actions, and represents a complex multidisciplinary process that takes into consideration environmental, ecological and socio-economic factors. The linkages between these disciplines should be considered when developing CBF systems, setting stocking rates, and establishing fisheries management objectives. The definitions used CBF systems are presented in Box 1.

Box 1: Definitions used in Culture Based Fisheries

Conservation – To maintain genetic diversity – usually to conserve endangered species or stocks.

Compensation – To provide for a phase in the life cycle that has been suppressed by human interventions such that the fish population would disappear without restocking.

Enhancement – To maintain the fish stocks above a level that would be naturally sustained in the presence of heavy exploitation.

Environmental improvement – To introduce a fish species that is expected to favourably modify the system.

Forage species – To provide a prey species to enhance the production of angling or commercially exploited species.

Increase diversity – To supplement the range of species available in a fishery.

Maintenance – To sustain stocks despite environmental or fishing pressures that prevent the fish population reaching the natural carrying capacity of the system.

Niche filling – To provide stocks to utilize a trophic or spatial resource which is perceived as unexploited.

Pest control – To provide a fish species to control flora or fauna perceived as unfavourable to man.

Put-and-take – To provide catchable-sized fish for rapid exploitation by anglers (requires minimal environmental input).

Put-grow-and-take: To provide fish that must first grow to a catchable size before being exploited by anglers (requires limited environmental input).

Re-population – Establishment of a stock of fish in waters from which it has previously been eliminated.

- The workshop presentations embraced all the important aspects related to CBF:
    - Rationale, techniques, and options/measures for IFE implementation.
    - Species selection criteria, influencing factors for stocking success, and the environmental risks of stocking:
        - Types, utilization and qualities of a water bodies and their capacity to support fisheries,
        - Trophic level (water productivity),
        - Effect of age and stocking season on stocking success, and
        - Control of untargeted fish species and the control/elimination of invasive fish species.
    - The contribution of fish stocking to inland fisheries development and regional income diversification.

- It was concluded that it is particularly important to take into consideration that fact that not all types of water bodies can support fisheries to the same level of production. Out of a total area of 8 162 100 ha of waters in the workshop participating countries, a considerable portion would be either marginal or unsuitable for fisheries development. The reasons for the unsuitability of some of the water bodies are outlined in Paragraph 12.

Technical and ecological aspects

- The climate and thermal characteristics/conditions of a water body determines the range of fish species that can be supported and the productivity of the fishery.
- Two chemical characteristics of surface waters, halobity and saprobity can be used estimate fisheries productivity. Of these, both salination and the over-enrichment of waters with decaying organic materials are common problems that reduce productivity.

- In order to develop a stocking plan (e.g. fish species, and stocking rates) for a water body, a Trophic Level Assessment (TLA) to characterise the productivity of water body, the existing food web and fish fauna should be undertaken. The assessment should be used to inform the stocking plan. In the absence of a TLA, it is not possible to develop an ecologically sustainable CBF management plan.
- To maintain the genetic diversity of a native fish strain in a large water body or river system, the stocked larvae/fry/fingerlings should be the progeny of locally captured brood fish.
- In natural lakes, the range of fish species that are stocked should be limited to those that are endemic. Historical practices that involved the introduction of new species or the use of genetic variants of existing species is not recommended.

Economic and social aspects

- The primary use of a water body (hydropower generation, irrigation, industrial, communal and drinking water supply, bathing, commercial and recreational fisheries) restricts the type and intensity of CBF.
- The location of a water body, or more precisely its vicinity to or remoteness from settlements limits its potential for fishery development and exploitation. Remote fishing areas are often difficult to access, and are often poorly served by public transport networks (e.g. roads, busses).
- A lack of fish seed supply, the distance to seed supplies, and access to high quality seed are commonly reported constraints to the development of CBF.
- The close vicinity of human settlements (village, town or city) to CBF sites presents an increased risk for illegal, unregulated and unreported (IUU) fishing. Solutions to the IUU fishing issue is the development of community-based fisheries management and fisheries co-management systems.
- Skilled, experienced specialists and field staff trained in CBF management are limited, as are the training opportunities for CBF at higher and vocational education establishments. The lack of a knowledge base and technical capacity in many countries limits the capacity to develop CBF programmes.
- CBF can significantly increase employment (positions such as warden, seasonal workers, etc.) and generate fishing tourism in areas and regions where living standards are usually low due to high levels of unemployment and limited work opportunities.
- Government support to CBF initiatives is often limited. For example, poor legislative and regulatory frameworks; problematic processes for privatizing/leasing water bodies; poor coordination with other ministries; inadequate research and teaching institutions.
- When state or local government ownership rights of a water body are leased out, the leases should be granted on approval of sustainable management (e.g. stocking, fishing, monitoring etc.) and business plans.
- The introduction and adaptation of action plans, techniques and practices from other regions or countries should take into consideration national and local experiences and traditions.

15. Recommendations of the workshop:

- The consolidated conclusion of the workshop was that the development of CBF pose complex challenges, and most notably, with respect to the impacts of climate change and the increasing demand and competition for the shrinking water resources in the region. The presentations/discussions highlighted the importance of:
    - Using clear terms and technical definitions, understood uniformly by all levels of concerned and affected parties;

- The need to gather sufficient physical, chemical, biological, economic and social data to optimise fisheries planning, and to ensure the adoption of appropriate CBF models;
- The need to establish standardised systematic decision-making processes for objectively setting goals and estimating the positive and negative impacts of a planned fisheries intervention on a given water body;
- The need to develop effective mitigation measures to address anthropogenic impacts water resources (qualitative and quantitative impacts). Mitigating these key impacts should be a viewed as a standard element in the design of enhanced inland fisheries systems.

- It was concluded that there are many factors that limit the development of CBF in the region. Though there are significant areas of inland waters in the CACFish region of competence, not all of the water bodies are suitable for CBF development. It is important to determine, which water bodies are suitable for CBF development, and at each locale, establish the most suitable development model e.g. commercial or recreational fisheries or combinations thereof.
- It was recommended that an inventory of water bodies suitable for CBF should be developed. The water bodies should be classified in terms of their CBF potential, and guidance should be provided on how they could most effectively be developed. This would include a uniform classification of water bodies, development options, and actionable roadmaps to assist decision makers, field professionals and local communities. Development options for small water bodies should be grouped according to their climate, physio-chemical and biological characteristics. Larger transboundary water bodies, or those with unique characteristics will require individual development plans that address the specific characteristics of the waterbody. Improved planning and implementation protocols for CBF whilst assisting decision makers and field personnel, will also improve the social acceptance and improve the public awareness of the interventions.
- The restocking programmes that are required under CBF require a supply of fish seed (larvae, advanced fry and fingerlings). While stocking options include eggs, larvae, advanced fry and fingerlings of different size classes, a reliable supply of these materials needs to be secured. Consideration should be given to improving hatchery facilities in the CACFish region of competence and where appropriate, the introduction of new hatchery technologies. Training in fish propagation techniques needs to be introduced, and where necessary improved.
- Where appropriate, cold water and saline tolerant stains of common carp should be considered for introduction into those waters that have been negatively impacted by climate change or anthropogenic activities.
- In addition to promoting ecological sustainability, CBF management plans should be designed to be economically sustainable and maximise the societal benefits.
- The lack of qualified personnel to develop and manage CBF in the region remains a significant constrain to the development of the sector. A training programme involving government agencies, national and international NGOs and interested stakeholders needs to be developed.
- Community-based fisheries co-management systems should be adopted to addresses issues of illegal, unregulated and unreported (IUU) fishing. Associations and social organizations, such as fishermen's and anglers' associations should be encouraged to work with government agencies in raising awareness of the impacts of IUU fishing, and to encourage the cooperation of local communities.
- Property and access rights to the fish stocks under CBF management systems need to be clarified and clearly defined in the fisheries management planning process.

- In order to support the development of CBF in the CACFish competence area, a development programme needs to be implemented in each country. The programme framework should comprise a series of actions that should be supported and coordinated through a regional TCP program. This programme framework should include the following:

An inventory of the current status of CBF activities in CACFish countries:

- A systematic national review of past and present CBF practices and operations.
- An inventory of the environmental, economic and social indicators that impact CBF operations.
- The development of criteria to categorise inland water bodies with respect to their potential to support CBF. The criteria will form the basis the development of a national fisheries database for inland water bodies that show potential for CBF development.
- Elaboration of a national CBF database of inland water bodies.

Needs assessment

- Classification of water bodies according to their potential to support CBF, their characteristics and potential production yield, and
- Prioritise water bodies for CBF development, and develop an implementation plan for their development.

Establishing technical guidelines and protocols

- Elaboration of a framework to support the implementation of financially and ecologically sustainable CBF systems. Based on international best practice, the framework should include management systems and protocols, financial arrangements, the development, implementation and evaluation of stocking programmes, environmental monitoring, establishing catch rates and harvesting, access rights and the control of IUU fishing.
- It was recommended that participating countries should establish national teams incorporating the necessary technical disciplines e.g. fisheries management, fisheries and aquaculture research, water quality and irrigation specialist etc. The team would be coordinated and supported/advised by subject specialists appointed and coordinated by the CACFish secretariat. The program should have the working title: “Enhancement of culture-based fisheries (CBF) in Central Asia”. The team would help in the development and implementation of a pilot study in the CACFish competence area.