

# Impact of climate change on culture-based fisheries of seasonal reservoirs in Sri Lanka and resilience capacities of rural communities

Technical brief



Culture-based fisheries (CBF) is a fisheries enhancement practice that can potentially be used to increase inland fish production in Sri Lanka. Its significance in fish production has been recognised by the government and under the fisheries development policy CBF has been identified as a priority area of development.

## What is CBF?

Culture-based fisheries is the practice of releasing hatchery-reared fish seed to natural and/or semi-natural water bodies for later recapture after a reasonable growth period. As the ownership of the fish stock is defined, CBF comes under the realm of aquaculture. In Sri Lanka, CBF is practiced in small village reservoirs, most of which dry-off during the dry season of the year (August-October). Fish fingerlings are stocked in December-February after the reservoirs have been filled by the inter-monsoonal rains in November-December. There are legal provisions under the Agrarian Development Act of 2000, to introduce CBF in village reservoirs, which come under the jurisdiction of the Department of Agrarian Development. Stocking decisions are made

in the “Kanna Meeting” (seasonal meeting arranged by the farmer organisation for making decisions on paddy cultivation) with the consent of all members of the farmer organisation to commence CBF in the reservoir. The aquaculture committee appointed by the farmer organisation is engaged in CBF activities from the stage of stocking to harvesting and marketing of the harvest.

## How does CBF help to rural farming communities?

CBF provides rural communities with:

- Subsidiary income for rural communities
- Fresh animal protein in affordable price
- New job opportunities

The following simple calculation indicates how CBF is important as a supplementary income generation activity of rural farming community of a seasonal reservoir (Table.1).

**Table 1. This hypothetical example assumes introduction of CBF in a small reservoir (10 ha at full supply level). Effective area of the reservoir for fish production is assumed as the half of the reservoir area (5 ha) due to heavy drawdown of the reservoir. Stocking density is assumed as 2,500 fingerlings per ha.**

Total number of fingerlings required	@2,500/ha*5 = 12,500
Survival rate	80%
Average weight of a fish	1 kg
Total fish catch (kg)	@12,500/100*80 = 10,000 kg
Price of 1 kg of fish	Rs. 150
<b>Net income</b>	@10,000*150 <b>= Rs. 1,500,000</b>
If one fingerling is Rs. 2.00	@12,500*2
Total cost for fingerlings	= Rs. 25,000
Fingerling transportation cost	Rs. 8,000
Other expenses	Rs. 5,000
<b>Total expenditure</b>	<b>Rs. 38,000</b>
<b>Gross income</b>	Rs. 1,500,000-38,000 <b>= RS. 1,462,000</b>

## What are the opportunities for CBF in village reservoirs of Sri Lanka?

In Sri Lanka, there are more than 30,000 ancient reservoirs, and over 12,000 of them are still functioning. Most of those reservoirs are scattered throughout the dry zone of the country and can be a biologically rich resource for the development of CBF. For the CBF development, water retention period should be at least six to eight months in the year and social acceptance is needed to start the activity. The ownership of the stocked fish is assured by obtaining an aquaculture license.

## Steps to start CBF in your village reservoir

- Make a decision in the “Kanna Meeting” with the consent of all members to start CBF in the reservoir.
- Liaise with relevant government authorities such as the National Aquaculture Development Authority (NAQDA), Department of Agrarian Development (DAD) and Grama Niladhari (village level administrative officer) etc about the new initiative.
- Seek the assistance of an Aquaculture Extension officer of NAQDA for obtaining fish fingerlings from an Aquaculture Development Centre or a “mini nursery”.

To work out the total number of fingerlings needed the following equation can be used:

$$\text{No. fingerlings required} = \text{Reservoir area (ha)} / 2 \times 2,500$$

- To optimise the resource use in the reservoir a composite culture strategy is used in the CBF. Major Indian and Chinese carps, tilapia species, common carp and giant freshwater prawn are used in CBF depending on their feeding habit. NAQDA aquaculture extension officer’s advice should be sought for the selection of species combination.
- Stock the required amount of fingerlings in the reservoir when reservoir is at its full supply level in “Maha season”. Generally fingerlings are stocked in December – February in seasonal reservoirs.
- As fish consume available food items in the reservoir, supplementary feeding is not necessary.
- Protect your fish from poaching.
- Stocked fish can be harvested when water level recedes in July-September.
- Plan the harvesting and marketing strategies. Get advice of the NAQDA aquaculture extension officer.

### Culture based fisheries in Sri Lanka under climate change scenarios

Climate change can be simply defined as the changes in the average pattern of weather over a long period of time. The observed changes include an increase of air temperature, regional monsoon variation, frequent droughts and a regional increase in severe storm incidence in coastal states. Also, rainfall changes in catchment areas of river basins bring about salinity changes in lower reaches of rivers causing changes in soil and water salinity.

Impacts of climate change on fisheries and aquaculture are significant as the aquatic environments are very sensitive to environmental perturbation. The biophysical

changes as well as socio-economic impacts on riparian communities are major challenges in aquaculture and fisheries sectors under the climate change scenario.

CBF depends on the water availability in the reservoir long enough to enable stocked fingerlings to grow to marketable sized fish. When the development of CBF is carried out in seasonal reservoirs, one of the major requirements would be to make available fish fingerlings for stocking at the correct time coinciding reservoir filling following inter-monsoonal rains in October-December (Figure. 1). As such reservoir filling at the correct time and reliable rainfall in the first monsoon and second inter monsoon are prerequisites for the development of CBF in seasonal reservoirs.

### Challenges to culture based fisheries in Sri Lanka

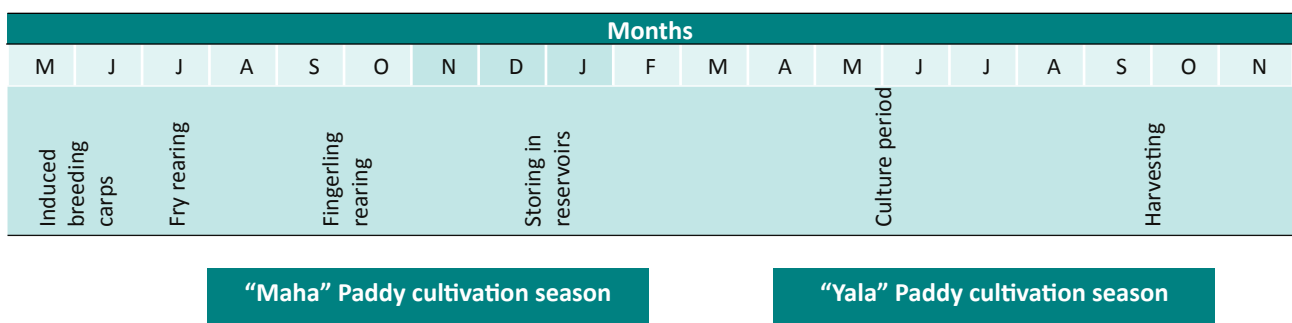
#### Frequent fluctuation of reservoir volume

Frequent fluctuation of water levels in seasonal reservoirs in the recent past can be observed from most of the selected reservoirs for this study. Figures 3 a and b show the changes of volume of Wawewgma Wewa reservoir in Hambantota district in the period of 1961-1970 and 2001-2010, respectively. Graphs indicate the frequent drying off of the reservoir in recent decades.

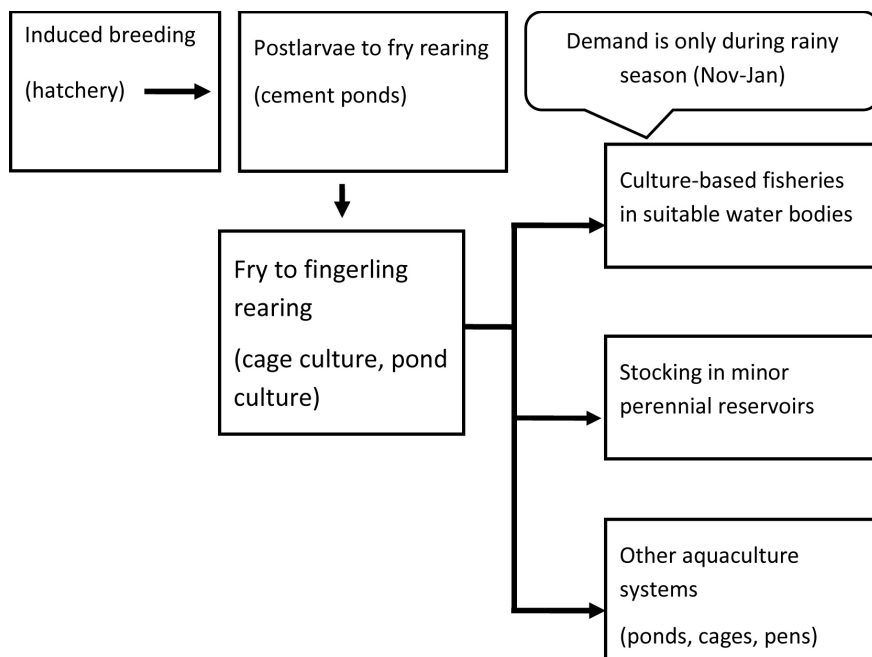
#### Increased drawdown of reservoirs

Figure 4 indicates comparatively high drawdown of water level from 2001 - 2010 compared to the 1960s. Among the all reservoirs the drawdown volume has been increased compared to the volume in the 1960s. Although the drawdown volumes of the reservoirs have been increased, reservoirs in Anuradapura and Kurunegala have less drawdown compared to reservoirs in Hamabamtota District. Several authors have revealed that the reduction of rainfall over the country in recent past (de Silva 2009; Ranatunge *et al.*, 2003). Eriyagama et al. (2010) indicated that the reduction of annual rainfall over the country from 1961 to 1990 compared to the period of 1931 to 1960 was 144 mm. As such an increased drawdown of the volumes in reservoirs would be expected with the climate change scenario.

Figure 1: CBF is a parallel activity with the paddy cultivation.



**Figure 2. Various components of fingerling production systems and different stocking opportunities in Sri Lanka.**



### Shifting of drawdown

Shifting of the drawdown period can be observed from the reservoirs in the last decade compared to the 1960s. Figure 4 indicates the forward shifting of drawdown in the period of 2005-2010 in Wewegama Wewa reservoir in Hambantota District. This shifting was observed in most of the reservoirs in the sample. The shifting of drawdown is a potential risk on the duration of the culture period of the stocked species in non-perennial reservoirs. Highly shifted drawdown periods can be observed in the Wewegama Wewa reservoir in Hambantota District (Figure 4), with a shift of one month in 2005 to 2010 compared to 1960s pattern.

### Impacts

This creates uncertainty of water availability in reservoirs and stocking of fingerlings at the correct time was problematic due to non availability of water in reservoirs when fingerlings are ready for stocking. This issue also alters culture period (shortened culture period and/or inability of harvesting due to reservoir filling).

Increased drawdown and the shifting of the drawdown period in seasonal reservoirs would impact on the sustainability of the CBF in seasonal reservoirs. Early draw down leads to shortened culture period causing marketing difficulties and low production. Frequent fluctuations of reservoir volume potentially create the stressful conditions to stocked fish species and may increase the mortality due to disease and increased vulnerability to predators and poaching.

The frequent fluctuation can create intolerable water quality extremes causing massive deaths of stocked fish. Therefore, identification of strategies to improve the resilience of vulnerable fish farming communities to climate change impacts is important for the sustainability of CBF in seasonal reservoirs.

### Farmer adaptation measures for climate change impacts

#### Improve communication with relevant authorities

Good communication with the authorities will facilitate the knowledge transferring of climate change impact to rural communities and enable farmer communities to be aware about future climate change predictions and plan agriculture and CBF activities effectively.

#### Identification of susceptibility of the reservoir for climate changes and adaptation accordingly

CBF activities should only be undertaken in seasonal reservoirs where there are reasonable prospects that the water level will remain sufficiently high long enough for the fish to grow to marketable size.

#### Collective decision making on CBF in “Kanna meetings”

Collective decision making will understand the different resource uses about importance of water management strategies their responsibilities in shearing common resource for multiple uses.

Figure 3. Fluctuation of reservoir volume of Wewegama Wewa reservoir in Hambantota district. (a) and (b) indicate the fluctuation of reservoir volume from 1961 to 1970 and 2001 to 2010.

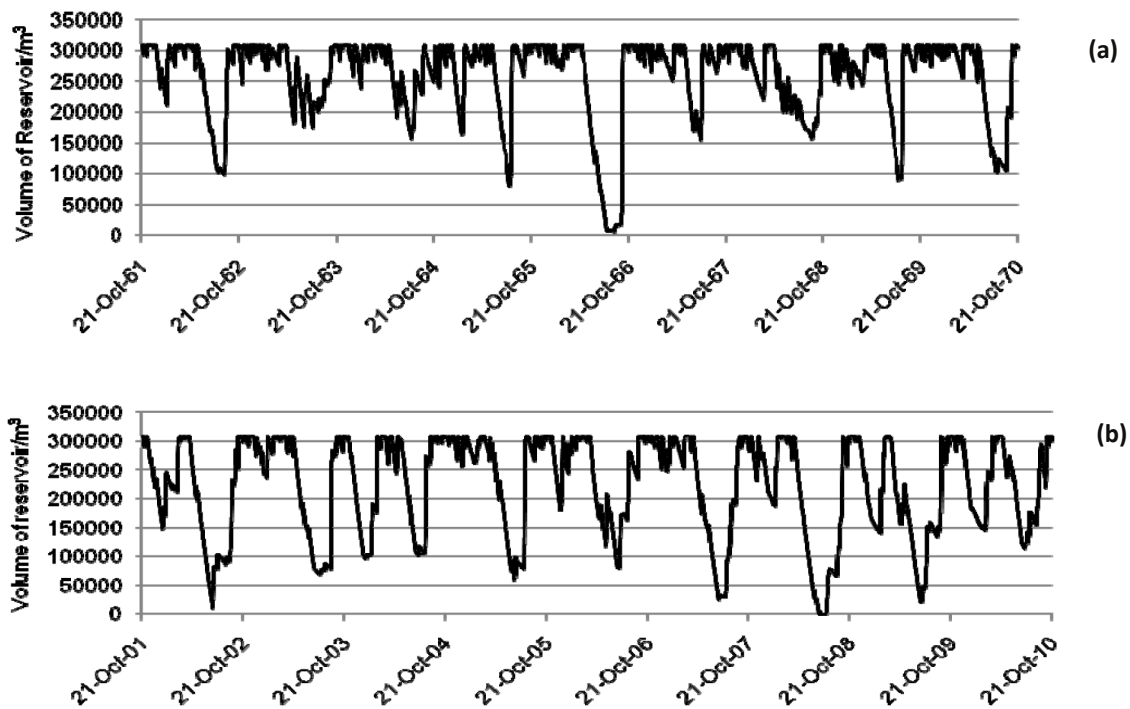
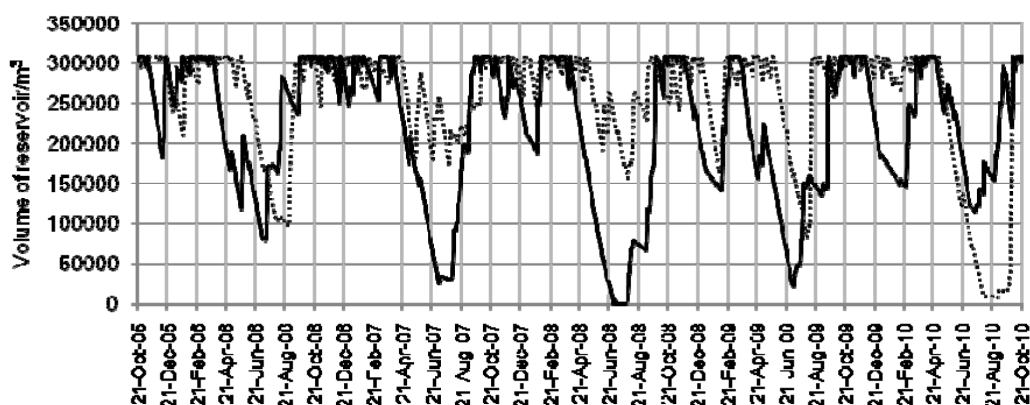


Figure 4. Increased drawdown and Shifting of drawdown period of Wewegama Wewa in 2005-2010 compared to 1965-1970. Dotted line indicates the fluctuation of reservoir volume in 1965-1970.



### Adapting to effective water management strategies

Based on the future predictions and the past experiences effective water management practices should be adapted by the farming communities to increase the water retention period of the reservoir. Scheduling water release and adapting to low water consuming crops are some examples.

### Changes of the stocking patterns has to be adapted based on the future climate change predictions

Sometimes current cropping season may have to change according to climate change impacts and farming communities have to prepare for such shifting in cropping

seasons and patterns. Identification of alternative means of stocking (perennial reservoirs, minor perennial reservoirs, fish pods etc.) is useful to enable fingerlings to be stocked out during the instances where the seasonal tanks are not filled on time.

### Value addition

Improvement of value addition and product development for harvested fish would be an alternative to overcome marketing problems of less grown fish species. Capacity building in the postharvest processing and motivate woman to prepare value products are some alternatives instead of direct marketing.



Close communication between government organisations facilitates the planning of CBF (Pahala Talambuwa wewa, Mahawa, Kurunegala District).



“How do we adapt to climate change?” Identification of adaptive measures at the farmers workshop conducted at Batticaloa, Eastern Province.

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