



# HLP

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# POLICY BRIEF

## Development of Inland Fisheries in Village Tank Cascade Systems in Sri Lanka

### Key messages


The following policy recommendations aim to empower local communities, enhance fishery productivity sustainably, and promote the value of small indigenous species in securing food and nutrition security while conserving biodiversity within VTCS.

- Establish fisheries management societies comprising members of farmer organizations (FOs) from the members of the farmer organizations (FO's) of the commanding area of each village tank for responsible management and sustainable use of fisheries resources in VTCS.
- Introduce a subsidiary gillnet fishery under existing legal provisions to responsibly exploit Small Indigenous Species (SIS) for food and nutritional security.
- Introduce Culture-Based Fisheries (CBF) to enhance fish production in each village tank.
- Establish a national-level fisheries management coordinating committee to oversee VTCS, resolve multi-sectoral conflicts, and ensure coordinated management at the national level.
- Enhance the marketing infrastructure to promote both fresh and dried fish produced from VTCS to improve economic opportunities for local communities.
- Recognize the importance of SIS as a protein source supporting food and nutritional security, as well as biodiversity conservation efforts.



### What is a Village Tank Cascade System (VTCS)?

The small village reservoirs (tanks) have been constructed in the past in the undulating landscape having well-defined micro-catchments, to collect rainwater (Panabokke et al. 2001). They often form a connected series within a micro- or meso- catchment of the dry zone landscape for storing, conveying, and utilizing water from seasonal rivulets, which are known as village tank cascade systems (VTCS). Dharmasena (2020), considering its socio-ecological significance, a VTCS is defined as an ecosystem having human intervention where water and land resources are organized within the micro- catchments of the dry zone landscape, providing basic needs to human, floral and faunal communities on a sustainable basis. At present,



1162 functional village tank irrigation systems are reported to occur in different parts of dry zone of the country (Sirimanna and Prasada 2021).

### **The efficiency, effectiveness, and resource footprint of VTCS**

In 2018, VTCS in the Dry Zone of Sri Lanka was designated as a “Globally Important Agricultural Heritage System” (FAO 2018), due to the attributes of national and global importance such as their role in the country’s agricultural production, supporting agro-and wild-biodiversity, constituting a unique buffer against natural disasters and climate change. The VTCS also contributes to efficient water management with flowing water from one tank to another, through a network of tanks and streams.

These systems are managed and maintained by local villagers and are virtually unparalleled to any other irrigation system in the world (Panabokke et al. 2001). The VTCS provide many environmental services from their plant and animal biodiversity. In the recent past, under the Agrarian Development Act No. 46 of 2000 and the Amended Act No. 46 of 2011, legal provisions are vested to manage village tanks by both the government and farmer organizations.

In many VTCS, some traditional cultivation systems that have been evolved as adaptations to droughts, are found even present day. For example, an experienced village leader defines the cultivable area of paddy during the drought using a traditional measuring scale called ‘diyaketa pahana’. This farming system is known as ‘Bethma’ farming, which helps conserve the available irrigation water. This system also helps to minimize conveyance losses to the fields far away from irrigation channels, and to reduce the vulnerability of the crop from water scarcity (Geekiyanaage and Pushpakumara 2013).

### **The importance of VTCS in ichthyofaunal diversity.**

In Sri Lanka, there are 97 freshwater fish species of which

61 are endemic species. Of these, 12 ‘point endemic’ species were listed as Critically Endangered (CR); 24 range-restricted species were Endangered (EN); and nine species were Vulnerable (VU). In addition, five species were Near Threatened (NT); two were listed as Data Deficient (DD); and the remaining were listed as Least Concern (LC) (see Appendix I). This means that 74% i.e., approximately three quarters of the freshwater fish endemic to Sri Lanka, were found to be threatened with extinction. There are over 30 exotic fish species in Sri Lankan freshwater. They were introduced both intentionally (mainly to enhance inland fisheries) and accidentally (by the aquarium industry). Some of them have become invasive in many natural and human-made habitats, making a direct impact on native freshwater fish either by competing with them for resources or directly through predation.

### **Small indigenous fish species (SIS) and other native fish species in reservoirs.**

The native freshwater fish species, depending on the exploitation through subsistence fisheries, can be arbitrary categorized into two groups: large indigenous species (LIS) and small indigenous species (SIS). The major species under these two categories are given in Appendix II.

Indigenous fish species found in the dry zone reservoirs of Sri Lanka are those which are categorized as ‘least concern’ in the IUCN red data list (Goonatilake et al. 2020). Only a handful of species (e.g., *Clarias brachysoma*, *Ompok lakdiva*, *Dawkinsia singhala*) are endemic but they are also under ‘least concern’ category as they are common having a wide distribution (Goonatilake et al. 2020; see Appendices I and III).

There is a clear-cut segregation of the occurrence of freshwater fish species in tanks and reservoirs (lentic habitats) and rivers and streams (lotic habitats) as shown in Appendix IV. Consequently, there is no adverse impact on the ichthyofaunal diversity in inland freshwaters through the exploitation of native fish species present in village tanks.

## Fish and fisheries in VTCS for supporting food, nutritional and livelihood security.

### **Exploitation of SIS**

In Sri Lanka, inland management strategies implemented by fisheries authorities have been directed towards gillnet fisheries targeting exotic cichlid species, which prevented the exploitation of small indigenous species (SIS). Previous work has demonstrated that the introduction of a subsidiary fishery using 15 to 52 mm stretched mesh gillnets for SIS would be useful to provide a supplementary income for fishing communities and provide an additional source of food fish from Sri Lankan inland waters (Amarasinghe et al. 2016). This would not have any adverse impact on the existing fishery of the larger sized fish species such as tilapia and exotic carps.

This untapped fishery potential is not realized in the inland fishery of Sri Lanka mainly due to the regulatory constraints. According to the Inland Fisheries Management Regulations of 1996 Gazette Extraordinary No. 948/25 and dated 1996.11.07, minimum permissible mesh size of gillnet is 85 mm.

The SIS, which are often eaten whole are important sources of minerals, in particular calcium and iron, and have high vitamin A content. It was estimated that through the exploitation of SIS, an additional 4,500 tons of food fish could be obtained from reservoir fisheries.

The abundant SIS occurring in VTCS are *Amblypharyngodon grandisquamis*, *Dawkinsia singhala*, *Laubuka lankensis*, *Puntius chola*, *Rasbora microcephalus*. There are legal provisions to issue licenses to identifiable group of fishermen under the Fisheries and Aquatic Resources (Amendment) Act No. 35 of 2013.

### **Culture-based fisheries development in VTCS**

Culture-based fisheries (CBF) strategies rely on stocking of adequate number of hatchery-reared fish fingerlings of desirable species which are capable of optimally utilizing natural food available in natural or quasi-natural water bodies for subsequent capture. Small village reservoirs, including VTCS are biologically productive water bodies and can be utilized for the

development of CBF. A reasonable success has been achieved in Sri Lanka in the development of CBF in these water bodies (Amarasinghe and Nguyen 2010).

### **Description of the problem that policymakers should address**

In village irrigation systems having command area (i.e., irrigable area) of less than 80 ha, including VTCS, which fall under the jurisdiction of the Department of Agrarian Development, legal provisions are available in the Agrarian Development Act No. 46 of 2000 and the amended Act No. 46 of 2011 for incorporating the fisheries and aquaculture in the village reservoir management. In village reservoirs, including those in the VTCS, the residents of the village who are involved in agriculture or agriculture-related activities are entitled to membership in the farmers' organizations (FOs) that are constituted under the Act. However, the lack of commitment from the Agrarian authorities prevents utilization of the potential contribution of this sector to the food and nutritional security of rural communities. Also, as CBF is recognized as a type of aquaculture, there is a risk of identifying CBF income as taxable income, and as such, there should be tax relief for levies collected by reservoir FOs.

### **Current and proposed policies**

Sri Lanka government placed high priority for the development of aquaculture and culture-based fisheries. To facilitate CBF development, a new Parliamentary Act, named as 'Aquaculture and Culture-based Fisheries Act' is proposed, under which there are several provisions for multi-sectoral coordination. Under Part XI of the proposed act, "Management of Culture-based Fisheries", Section 63 states that there shall be a culture-based fisheries management coordinating committee.

The conservation priorities of fauna and flora including freshwater fish are endorsed, mainly based on IUCN criteria, by the biodiversity secretariat of the Ministry of Environment, and declare conservation zones. The VTCS however are not included under the conservation zones.

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**Appendix I. Freshwater fish species in Sri Lanka, their species status and threat status. CR: Critically endangered; EN: Endangered; VU: Vulnerable; NT: Near threatened; LC: Least concern; DD: Data deficient**

Family	Scientific name	Common English name	Species status	Threat status
Adrianichthyidae	<i>Oryzias carnaticus</i>	Deep-bodied ricefish	Native	DD
Adrianichthyidae	<i>Oryzias dancena</i>	Spotted ricefish	Native	DD
Anabantidae	<i>Anabas testudineus</i>	Climbing perch	Native	LC
Anguillidae	<i>Anguilla bengalensis</i>	Long-finned eel	Native	NT
Anguillidae	<i>Anguilla bicolor</i>	Level-finned eel	Native	NT
Aplocheilidae	<i>Aplocheilus dayi</i>	Day's killifish	Endemic	EN
Aplocheilidae	<i>Aplocheilus weneri</i>	Werner's killifish	Endemic	EN
Aplocheilidae	<i>Aplocheilus parvus</i>	Dwarf panchax	Native	LC
Bagridae	<i>Mystus ankutta</i>	Yellow dwarf catfish	Endemic	EN
Bagridae	<i>Mystus nanus</i>	Striped dwarf catfish	Endemic	LC
Bagridae	<i>Mystus zeylanicus</i>	Sri Lanka mystus	Endemic	LC
Bagridae	<i>Mystus gulio</i>	Long-whiskered catfish	Native	LC
Belonidae	<i>Xenentodon cancila</i>	Freshwater garfish	Native	VU
Channidae	<i>Channa ara</i>	Giant snakehead	Endemic	VU
Channidae	<i>Channa kelaartii</i>	Brown snakehead	Endemic	NT
Channidae	<i>Channa orientalis</i>	Smooth-breasted snakehead	Endemic	VU
Channidae	<i>Channa punctata</i>	Spotted snakehead	Native	NT
Channidae	<i>Channa striata</i>	Murrel	Native	LC
Cichlidae	<i>Etroplus suratensis</i>	Green chromide	Native	LC
Cichlidae	<i>Pseudetroplus maculatus</i>	Orange chromide	Native	LC
Clariidae	<i>Clarias brachysoma</i>	Walking catfish	Endemic	NT
Cobitidae	<i>Lepidocephalichthys jonklaasi</i>	Jonklaas's loach	Endemic	EN
Cobitidae	<i>Lepidocephalichthys thermalis</i>	Common spiny loach	Native	LC
Cyprinidae	<i>Amblypharyngodon grandisquamis</i>	Large silver carplet	Endemic	LC
Cyprinidae	<i>Dawkinsia singhala</i>	Filamented barb	Endemic	LC
Cyprinidae	<i>Dawkinsia srilankensis</i>	Blotched filamented barb	Endemic	EN
Cyprinidae	<i>Devario annnataliae</i>	Natali's danio	Endemic	CR
Cyprinidae	<i>Devario micronema</i>	Kitulgala danio	Endemic	EN
Cyprinidae	<i>Devario monticola</i>	Agra danio	Endemic	CR
Cyprinidae	<i>Devario pathirana</i>	Barred danio	Endemic	EN
Cyprinidae	<i>Devario malabaricus</i>	Giant danio	Native	LC
Cyprinidae	<i>Esomus thermoicos</i>	Flying barb	Native	LC
Cyprinidae	<i>Garra ceylonensis</i>	Stone sucker	Endemic	NT
Cyprinidae	<i>Garra phillipsi</i>	Phillips' garra	Endemic	CR
Cyprinidae	<i>Horadandia atukorali</i>	Hora dandia	Endemic	VU
Cyprinidae	<i>Labeo fisheri</i>	Mountain labeo	Endemic	EN
Cyprinidae	<i>Labeo heladiva</i>	Sri Lanka labeo	Endemic	LC
Cyprinidae	<i>Labeo lankae</i>	Orange-fin labeo	Endemic	EN
Cyprinidae	<i>Laubuka insularis</i>	Knuckles labuca	Endemic	EN
Cyprinidae	<i>Laubuka lankensis</i>	Lanka labuca	Endemic	NT
Cyprinidae	<i>Laubuka ruhuna</i>	Southern laubuca	Endemic	EN
Cyprinidae	<i>Laubuka varuna</i>	Western laubuca	Endemic	EN
Cyprinidae	<i>Pethia bandula</i>	Bandula barb	Endemic	CR
Cyprinidae	<i>Pethia cuningii</i>	Cuming's barb	Endemic	EN
Cyprinidae	<i>Pethia melanomaculata</i>	Tic-tac-toe barb	Endemic	LC
Cyprinidae	<i>Pethia nigrofasciata</i>	Black ruby barb	Endemic	VU
Cyprinidae	<i>Pethia reval</i>	Red-fin two-banded carplet	Endemic	EN
Cyprinidae	<i>Puntius bimaculatus</i>	Redside barb	Native	LC
Cyprinidae	<i>Puntius dorsalis</i>	Long-snouted barb	Native	LC
Cyprinidae	<i>Puntius kamalika</i>	Kamalika's barb	Endemic	EN
Cyprinidae	<i>Puntius kelumi</i>	Kalum's Long-snouted barb	Endemic	EN
Cyprinidae	<i>Puntius layardi</i>	Layard's barb	Endemic	DD
Cyprinidae	<i>Puntius tetraspilus</i>	Long-snouted barb	Endemic	DD
Cyprinidae	<i>Puntius thermalis</i>	Swamp barb	Endemic	LC
Cyprinidae	<i>Puntius titteya</i>	Cherry barb	Endemic	VU



Cyprinidae	<i>Puntius vittatus</i>	Silver barb	Native	LC
Cyprinidae	<i>Rasbora armitagei</i>	Armitage's rasbora	Endemic	CR
Cyprinidae	<i>Rasbora dandia</i>	Striped rasbora	Native	LC
Cyprinidae	<i>Rasbora microcephalus</i>	Common rasbora	Native	LC
Cyprinidae	<i>Rasbora naggisi</i>	Naggisi's rasbora	Endemic	EN
Cyprinidae	<i>Rasbora wilpita</i>	Wilpita rasbora	Endemic	VU
Cyprinidae	<i>Rasboroides pallidus</i>	Pallaides rasbora	Endemic	EN
Cyprinidae	<i>Rasboroides vaterifloris</i>	Vateria flower rasbora	Endemic	EN
Cyprinidae	<i>Systemus pleurotaenia</i>	Black-lined barb	Endemic	VU
Cyprinidae	<i>Systemus asoka</i>	Asoka barb	Endemic	CR
Cyprinidae	<i>Systemus martenstyni</i>	Martenstyn's barb	Endemic	EN
Cyprinidae	<i>Systemus "Richmondi"</i>	Redfin olive barb	Endemic	EN
Cyprinidae	<i>Systemus spilurus</i>	Olive barb	Endemic	LC
Cyprinidae	<i>Systemus timbiri</i>	Thimbiri barb	Endemic	CR
Cyprinidae	<i>Tor khudree</i>	Mahseer	Native	NT
Eleotridae	<i>Eleotris fusca</i>	Brown gudgeon	Native	LC
Gobiidae	<i>Sicyopus jonklaasi</i>	Lipstick goby	Endemic	EN
Gobiidae	<i>Stiphodon martenstyni</i>	Martenstyn's goby	Endemic	CR
Gobiidae	<i>Awaous melanocephalus</i>	Scribbled goby	Native	LC
Gobiidae	<i>Glossogobius giuris</i>	Bar-eyed goby/ Tank goby	Native	LC
Gobiidae	<i>Oligolepis acutipennis</i>	Sharptail goby	Native	DD
Gobiidae	<i>Redigobius balteatus</i>	Rhino-horn goby	Native	DD
Gobiidae	<i>Redigobius bikolanus</i>	Speckled goby	Native	DD
Gobiidae	<i>Schismatogobius deraniyagalai</i>	Redneck goby	Native	EN
Gobiidae	<i>Sicyopterus griseus</i>	Stone goby	Native	EN
Gobiidae	<i>Sicyopterus lagocephalus</i>	Red-tailed goby	Native	EN
Heteropneustidae	<i>Heteropneustes fossilis</i>	Stinging catfish	Native	LC
Mastacembelidae	<i>Macragnathus pentophthalmos</i>	Sri Lankan spiny eel	Endemic	CR
Mastacembelidae	<i>Mastacembelus armatus</i>	Marbled spiny eel	Native	LC
Nemacheilidae	<i>Paracanthocobitis urophthalma</i>	Tiger loach	Endemic	EN
Nemacheilidae	<i>Schistura madhavai</i>	Rakwana mountain loach	Endemic	CR
Nemacheilidae	<i>Schistura notostigma</i>	Banded mountain loach	Endemic	NT
Nemacheilidae	<i>Schistura scripta</i>	Scriptic mountain loach	Endemic	CR
Osphronemidae	<i>Belontia signata</i>	Combtail	Endemic	VU
Osphronemidae	<i>Malpulutta kretseri</i>	Ornate paradise fish	Endemic	EN
Osphronemidae	<i>Pseudosphromenus cupanus</i>	Spike-tailed paradise fish	Native	LC
Siluridae	<i>Ompok argestes</i>	Wet zone butter catfish	Endemic	VU
Siluridae	<i>Ompok ceylonensis</i>	Dry zone butter catfish	Endemic	LC
Siluridae	<i>Wallago attu</i>	Shark catfish	Native	NT
Synbranchidae	<i>Ophichthys desilvai</i>	De Silva's blind eel	Endemic	CR
Synbranchidae	<i>Ophisternon bengalense</i>	Swamp eel	Native	EN
Syngnathidae	<i>Microphis ocellatus</i>	Ocellated pipefish	Native	EN

Source: Goonatilake et al. 2020.

**Appendix II. Examples of LIS and SIS in Sri Lankan freshwaters.**

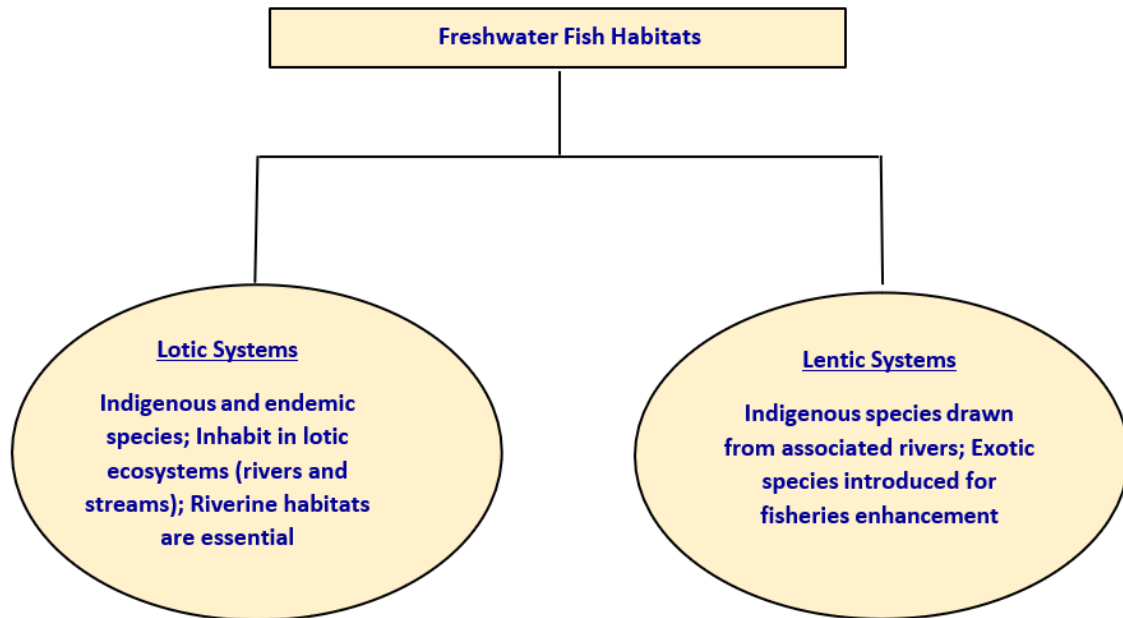
Large (>25 cm) indigenous fish species (LIS)	Small (<25 cm) indigenous fish species (SIS)
<i>Channa striatus</i>	<i>Dawkinsia singhala</i>
<i>Anguilla bicolor</i>	<i>Mystus nanus</i>
<i>Ompok bimaculatus</i> (= <i>Ompok ceylonensis</i> )	<i>Amblypharyngodon grandisquamis</i>
<i>Wallago attu</i>	<i>Devario malabaricus</i>
<i>Glossogobius giuris</i>	<i>Puntius dorsalis</i>
<i>Labeo dussumieri</i> (= <i>Labeo heladiva</i> )	<i>Esomus thermoicos</i>
<i>Systemus sarana</i> (= <i>Systemus spilurus</i> )	<i>Rasbora microcephalus</i>
<i>Channa ara</i>	<i>Puntius vittatus</i>
<i>Clarias brachysoma</i>	<i>Heteropneustes fossilis</i>
<i>Tor kuhdree</i>	<i>Anabas testudineus</i>
<i>Mastacembelus armatus</i>	<i>Puntius chola</i>
<i>Labeo lankea</i>	

**Appendix III. Examples of some habitats of freshwater fish, and species found in them**

Habitat	Examples of species found in these habitats
Fast flowing rivers/Streams	<i>Garra ceylonensis</i> , <i>Dawkinsia singhala</i> , <i>Dawkinsia srilankensis</i> , <i>Laubuka insularis</i> , <i>Rasbora naggsi</i> , <i>Systemus asoka</i> , <i>Sicyopus jonklaasi</i>
Moderately flowing rivers/Streams	<i>Laubuka ruhuna</i> , <i>Pethia reval</i> , <i>Puntius kamalika</i> , <i>Puntius kelumi</i> , <i>Puntius thermalis</i>
Slow flowing river/Streams	<i>Aplocheilus wernerii</i> , <i>Paracanthocobitis urophthalma</i> , <i>Belontia signata</i> , <i>Malpulletta kretseri</i> , <i>Lepidocephalichthys jonklaasi</i> , <i>Dawkinsia singhala</i> , <i>Pethia bandula</i> , <i>Puntius titteya</i> , <i>Rasboroides pallidus</i>
Stagnant/Still water	<i>Mystus ankutta</i> , <i>Clarias brachysoma</i> , <i>Dawkinsia singhala</i> , <i>Pethia reval</i>
Paddy fields	<i>Aplocheilus wernerii</i> , <i>Horadandia atukorali</i> , <i>Pethia reval</i> , <i>Macrogonathus pentophthalmos</i>
Irrigation canals	<i>Laubuka lankensis</i> , <i>Mystus zeylanicus</i> , <i>Systemus spilurus</i> , <i>Dawkinsia singhala</i>
Deep pools/Pools of large rivers	<i>Tor kuhdree</i> , <i>Walago attu</i> , <i>Channa ara</i>
Tanks	<i>Amblypharyngodon grandisquamis</i> , <i>Rasbora microcephalus</i> , <i>Systemus spilurus</i>
Marshes	<i>Amblypharyngodon grandisquamis</i> , <i>Horadandia atukorali</i> , <i>Ophichthys desilvai</i> , <i>Aplocheilus dayi</i>

Sources: Murray et al. 2001; de Silva et al. 2015.

**Appendix IV.** Clear habitat segregations between native freshwater fish species (riverine) and exotic cichlids (lacustrine)



Author contact: S. B. Athauda (sbathauda@agri.pdn.ac.lk)

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