CASE STUDIES IN WETLAND VALUATION #9: June 2004

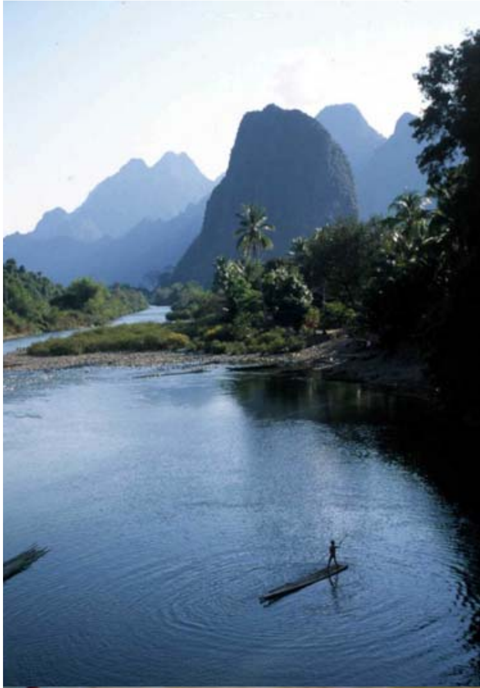
THE KALA OYA RIVER BASIN, SRI LANKA: where small irrigation tanks are not really small

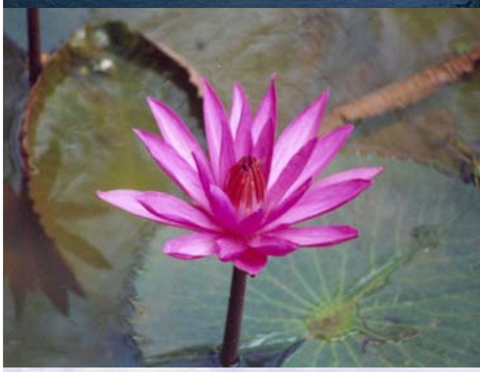
Sri Lanka's tradition of irrigation: providing vital support to biodiversity and livelihoods

Sri Lanka has one of the oldest traditions of irrigation in the world, dating back as far back as 500 BC. The famous dictum of the epic hero King Parakrama Bahu I (1153-86) states *"let not even one drop of water that falls on the earth in the form of rain be allowed to reach the sea without being first made useful to man"*. It was around these ancient tank (water storage reservoir) irrigation systems that the economy and human settlements of early Sri Lankan society were organised into a "hydraulic civilization". Unlike in the case of most ancient civilizations, which grew in fertile river valleys and floodwater retention areas, Sri Lankan hydraulic societies were based on reservoir systems and control devices or *biso-kotuwas* for the release of irrigation water. It has been reported that at the peak of its development, the ancient Sri Lankan hydraulic engineers were even called upon to serve in other countries.

Today's map of Sri Lanka, especially the Dry Zone, is dotted with literally thousands of ancient tanks of varying sizes and shapes, some operational and others long abandoned. These ancient tank systems have both ecological and biological importance. A key issue is seasonality and duration of water retention, which has a significant influence on their biodiversity and ecology. Due to natural processes water levels are very low during the dry season, and many tanks dry out completely before being filled again in the rainy season. Their use for grazing cattle during the dry season maintains high levels of nutrients in the tanks – which in turn supports high levels of aquatic biodiversity.

Traditional tank systems thus form a vital component of both the natural and man-made landscape in Sri Lanka. Providing irrigation water, domestic supplies and natural resources to millions of people, they also constitute one of the richest sources of wetland biodiversity in the country.





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Integrating Wetland Economic Values into River Basin Management

Yet traditional tank systems are also under severe, and increasing, threat – which is, in turn, both putting in danger livelihood security and threatening the status of biodiversity. These threats arise from multiple sources, including upstream water allocation decisions which marginalise traditional tank systems in favour of seemingly more productive uses such as "modern" large-scale irrigation and hydropower, as well as from siltation and sedimentation arising from unsustainable land use practices in upper catchments.

This case study describes an exercise that was undertaken in the Kala Oya Basin of Sri Lanka to assess the livelihood and biodiversity values of traditional tank systems. The Kala Oya Basin has been identified by the government as the pilot river basin to plan and implement integrated river basin management approaches in Sri Lanka. By articulating tank values, the study had a particular focus on integrating downstream wetland values into upstream land use and water allocation decisions, and showing that upper catchment conservation and water allocation to traditional tank systems can yield high, and quantifiable, economic returns.

Small Tank in the Kala Oya Basin

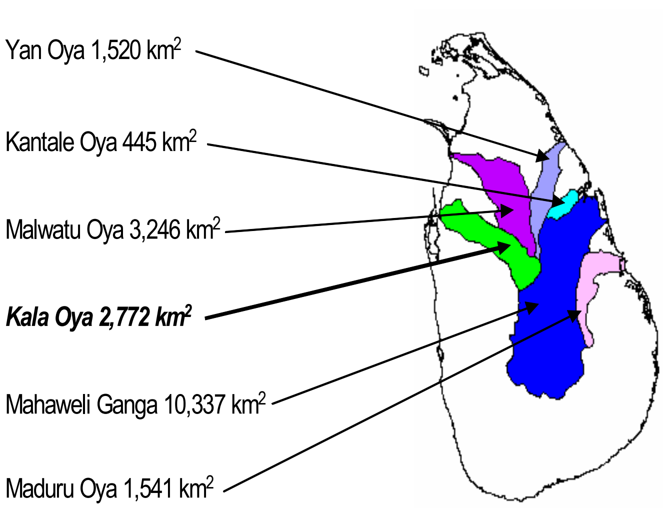
The Kala Oya Basin

Kala Oya covers an area of around 2,870 km^2. It is one of 103 river basins in Sri Lanka and is situated in the Northwestern dry zone of the country, which averages 1,450 mm average annual rainfall.

The elevation of the Kala Oya Basin varies from mean sea level to 600 m at its headwaters.

The Kala Oya Basin is long and narrow, having an average width of about 25 km and length of 150km. It receives water from Sri Lanka's longest river, the Mahaweli Ganga, to meet approximately 75% of its annual demand. Preliminary assessment of water resources of Mahaweli Authority of Sri Lanka (MASL) has provided a water budget with a net inflow of 800 MCM in the Kala Oya Basin. In the lower basin, the majority of water is allocated to irrigation – focusing on rice, the staple food in Sri Lanka. There are about 600 small irrigation tanks within the basin, as well as "modern" irrigation systems including the large-scale Mahaweli Irrigation Expansion Project. About 65% of water is allocated to these larger-scale irrigation systems.

The Mahaweli and Associated River Basins in Sri Lanka



The Kala Oya Basin contains a largely rural population of some 400,000 people, most of whom are engaged in farming as their main form of livelihood. Cultivation of rice and other crops is combined with fishing and the harvesting of wild plants and animals. There is a particularly high incidence of poverty in this area, with just under half of the population being classified as poor according to national indicators (their monthly income is less than $15).

Traditional tanks: a threatened component of the socio-economic, cultural and natural landscape

Traditional irrigation tanks have, for centuries, formed the cornerstone of cultural, economic and environmental life in Sri Lanka's rural areas. Even today, the concept of a tank village symbolises the vitality of water for the sustenance of communities.

Cascades are a series of interconnected tanks organized within the micro-catchments of the dry zone landscape. They serve multiple functions including irrigation, domestic supply, water for livestock and subsurface water for perennial cropping. The main features of a cascading valley are having adequate water in every tank even in a year of below average rainfall and instituting a regulated flow of water from one tank to another down stream, avoiding a sudden influx of large volume of water in order to minimize the risk to tank bund breaching.

The tank is the pivot upon which life in dry zone areas such as the Kala Oya Basin revolves. Situated on relatively higher land, tanks provide water for agriculture, domestic needs and other purposes. They tend to form the heart of the village, around which much social interaction and cultural business is conducted. Villagers also depends almost entirely on the tank for their sustenance.

Locally Harvested Tank Resources

Paddy fields are located below the tank, and often forest reservations are located above it as catchment protection. The forest provides villagers with firewood and timber, meat and honey, as well as vital grazing for livestock. A part of the forest is, traditionally, used to grow vegetables and grains.

Despite their critical importance, traditional tank systems are under threat, both in the Kala Oya Basin and elsewhere. One major threat is insufficient allocation of water. For the most part, obviously commercial uses such as large-scale irrigation and hydropower tend to be prioritised when water decisions are made. Water scarcity, and the low perceived value of traditional tank systems, mean that small tanks are often seen as an economically unproductive use of water.

Land use practices constitute another problem for small tank systems. In particular deforestation and unsustainable agriculture around and upstream of tanks has resulted in soil loss, meaning that sedimentation and siltation rates are high, leading to the filling of downstream tanks.

Especially since the launch of the Mahaweli Irrigation Expansion Project in the early 1980s, lack of water in the dry season has been identified as a growing problem in the Kala Oya Basin. Mostly in terms of water for irrigation purposes and domestic use, but also to sustain a number of important environmental services provided by the wetlands. Following the expansion project, the area of agricultural land has increased and now includes previously unutilised land surrounding the wetlands. The farming of these buffer zones has left the wetlands vulnerable to sedimentation caused by run offs from the surrounding fields.

There is a real danger that unless current land use and water allocation decisions are changed, and due attention is given to the importance of maintaining and rehabilitating small tanks, the livelihoods of a large sector of the population will be undermined, and vital aquatic biodiversity will be lost.

Valuing tank ecosystems

The aim of this study was to articulate the value of small tank systems in livelihood and biodiversity terms. Working in close collaboration with the MASL, the primary river basin management institution in the country, it thereby intended to integrate downstream wetland values into land use and water allocation decisions in the Kala Oya Basin. At the same time as the valuation study was carried out, a number of training, capacity building and awareness exercises were carried out with MASL staff which focused on how and why to integrate ecosystem economic values into river basin management. This institutional partnership, and accompanying work in capacity and awareness, proved vital to the study's on-the-ground impact.

A first step was to determine the environmental and economic benefits associated with small tanks in the Kala Oya Basin. Tanks yield a range of direct livelihood values for surrounding villagers. Some of the most important benefits are associated with the provision of water for crops, livestock and domestic uses such as bathing, washing clothes and household water supplies. Additionally, the wild plants and animals associated with tanks are important for local subsistence and cash income. These resources include fish, reeds and edible plants, and the flowers that are collected for use in Buddhist temples and ceremonies.

Tanks also yield several important environmental services. As well as providing habitat and breeding grounds for birds, fish and other aquatic animals, tanks store water and help both to mitigate downstream flooding and maintain and replenish sub-surface and groundwater reserves. The tanks, and the aquatic plants that grown in them, also play an appreciable role in nutrient retention and water treatment for surrounding farms.

The Value of Tank Water and Biological Resources in Rajangana and Angamauwa Sub-Catchments of the Kala Oya Basin (per tank)

Resource	% of households	Value per Household (US$/hh/yr)	Value per Unit Area* (US$/ha/yr)
Paddy cultivation	13%	177	161
Vegetable cultivation	7%	86	39
Banana cultivation	3%	1150	209
Coconut cultivation	13%	238	216
Domestic water	93%	226	1,469
Livestock water	13%	369	335
Commercial water	2%	132	12
Fishery	16%	309	351
Lotus flowers	10%	106	72
Lotus roots	7%	235	107
		Total	**2,972**

* *Total inundated area*

A variety of methods were used to value these benefits for two of the sub-catchments of the Kala Oya Basin – the 429 tanks in Rajangana and Angamauwa. Because little information about tank values was already available, these relied on the collection of original data from local villages and depended heavily on participatory approaches to livelihood assessment and economic valuation. While wetland resources that could be bought or sold (such as various plants and fish) were valued according to their market prices, crops and livestock benefits were valued using effect on production techniques, and domestic water use was valued according to costs of collection and transport. Due to insufficient data, indirect benefits were not valued in cash terms but were estimated according to indices of magnitude.

The results of the valuation study showed that tanks in the Rajangana and Angamauwa sub catchments of the Kala Oya Basin yield an average value of US$ 425 per household per year in terms of water and aquatic resource use, or almost $3,000 per hectare of inundated area. The valuation study also showed that these benefits were particularly important for poorer households, who lacked access to their own wells and for whom alternative sources of income and subsistence were scarce.

Cost-Benefit Assessment of Alternative Tank Management Scenarios

Scenario	Net Present Value (NPV) Investment cost (US$ '000)	Operating costs (US$ '000)	Incremental tank benefits (US$ '000)	Quantifiable net benefit (US$ '000)	Indirect use trends (index)	Accumulated Natural Capital
S1: Do nothing	0	0	0	**0**	-7	⬇⬇ NC1
S2: Raise spill	0.4	0	24.2	**23.8**	-4	⬇ NC2
S3: Raise spill and rehabilitate tank reservation	23.3	12.5	64.6	**28.8**	6	⬆ NC3
S4: Remove silt and rehabilitate tank reservation	50.3	12.5	120.7	**57.9**	7	⬆⬆ NC4

Making sense of wetland values in relation to decisions about water and land use in the Kala Oya Basin

Articulating the economic benefits of traditional small tanks makes a strong argument, and provided important data, for including these values into land and water use decisions in the Kala Oya Basin. In particular it helps when the relative returns to different water uses is calculated and compared, and when land use decisions are made.

A recognition that the degradation of small tank wetlands would also result in the loss of water storage for irrigation and domestic use as well as environmental services has led to efforts by the MASL to take action to renovate and conserve small tank systems in the Kala Oya Basin. However these decisions tend still to be based primarily on irrigation needs, and not so much on broader livelihood and environmental considerations.

The results of the Kala Oya study were thus also used to demonstrate the way in which environmental economic valuation could be integrated into decisions about how to choose between different tank management options. To date, the preferred tank management option of the MASL has been to mechanically raise the spill of sedimented tanks in order to rapidly restore their capacity for water storage.

In fact, this tank management option may neither be the most cost-effective nor the most economically desirable one if a broader and more long-term perspective is taken. One reason for this is that raising spills does not in itself solve the problem of tank sedimentation and wetland degradation – it merely postpones it, and does nothing to address its cause.

Based on the valuation study that had been carried out, four different scenarios were evaluated in order to allow an extended cost-benefit analysis of different alternatives for small tank management. These took account of the investment and recurrent costs of different options for tank management, as well as marginal changes in broader livelihood and environmental benefits associated with maintaining the water storage capacity and biodiversity status of small tanks. These scenarios included:

- **Scenario 1: Do nothing.** Here, sedimentation loads remain the same if not increasing and tank wetlands continue to deteriorate.
- **Scenario 2: Raise spill.** Here, the water body will grow and additional land will be flooded, but sedimentation loads remain the same if not increasing.
- **Scenario 3: Raise spill and rehabilitate tank reservation.** Here, the water body will grow and additional land will be flooded and future sedimentation loads reduced, thus prolonging the lifespan of the wetlands.
- **Scenario 4: Remove silt and rehabilitate tank reservation.** Here original tank capacity and seasonality is restored and future sedimentation loads will be reduced, thus prolonging the lifespan of the wetlands and restoring its environmental goods and services.

The extended cost-benefit analysis included both quantitative and qualitative indicators of costs, benefits and accumulated natural capital associated with each of these four scenarios. It showed that without rehabilitation of the tank reservation, any solution to loss of water storage would be short-term, and would also yield lower total economic benefits. In contrast, although costing more, scenarios that involved rehabilitating tank reservations would yield higher net present values, indirect use indices and accumulated natural capital measures.

Option 4, desilting tanks and rehabilitating their reservations, clearly yields the highest net benefits, in both livelihood and environmental terms. Additionally, it also has the likelihood of being the most sustainable and technologically appropriate, because it relies on recurrent works that can be easily carried out using labour-intensive techniques and do not require large mechanical equipment and infrastructure.

This document was produced under the project "Integrating Wetland Economic Values into River Basin Management", carried out with financial support from DFID, the UK Department for International Development, as part of the Water and Nature Initiative of IUCN - The World Conservation Union.

This project aims to develop, apply and demonstrate environmental economics techniques and measures for wetland, water resources and river basin management which will contribute to a more equitable, efficient and sustainable distribution of their economic benefits at the global level and in Africa, Asia and Latin America, especially for poorer and more vulnerable groups.

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Using economic values to promote catchment management and water allocation to sustain small tank systems

The findings of the Kala Oya study underline the importance of looking at livelihood and environmental values when land use and water allocation decisions are made.

They also illustrate the linkages between different parts of river basins, and show how land and water decisions made in one area can have significant economic, livelihood and environmental impacts on other locations and human populations.

The study of small tanks in the Kala Oya Basin provides an example of how such values can be incorporated into decision-making about real-world interventions to sustain wetland benefits as part of river basin management. It shows how taking account of biodiversity and livelihood values can help in making more fully-informed management decisions about land and water that can, in the long-term, prove to be more desirable, and more sustainable, in both socio-economic and environmental terms.

This case study is adapted from Vidanage, S., Perera, S. and M. Kallesøe, 2004, Kala Oya River Basin, Sri Lanka: Integrating Wetland Economic Values into River Basin Management, Environmental Economics Programme, IUCN Sri Lanka Country Office, Colombo.