# Countering Climate Change: Maintaining Food production in Jaffna, Sri Lanka


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## INTRODUCTION

The Jaffna Peninsula which is the northernmost tip of Sri Lanka, has an area of about 1000 square km and being relatively flat has no rivers and is totally dependent on the annual rainfall of about 1270 mm, of which about 87% falls during the north-east monsoon from October to December, for recharge of the water table in the underground aquifer. In the past, water was drawn from wells for domestic and agricultural use by well sweeps, but from the 1950's onwards pumps have been used to draw water from these wells. There are about 100,000 wells in the Peninsula. This over pumping for agricultural use has drawn down the fresh water stored in the limestone aquifer resulting in sea water percolating into the wells through the fractured limestone, as no part of Jaffna is more than about 15 km from the sea.

Of the 1000 sq km area of the Jaffna Peninsula, about 60% is occupied by residential usage, home gardens, roads, parks, public buildings etc., about 13% (13,700 hectares) is cultivated with food and subsidiary crops and about 13% (13,000 hectares) is cultivable with rain-fed rice paddy. 4% of the land is not arable due to soil salinity and the balance 10% of the Peninsula is occupied by two lagoons, which are presently saline. (Ref. 1) At present about 30% of the wells in the Jaffna Peninsula are saline. Recent reports from agricultural experts state that more than 4500 hectares of fertile agricultural land have turned saline and have become unsuitable for cultivation.

It is anticipated that due to climate change causing rising sea levels and drought the present trend of losing arable land in the Jaffna Peninsula due to soil salinity will progressively increase, causing further losses in food production. It is therefore necessary to consider what urgent measures could be undertaken to combat climate change and maintain (and increase) food production in the Jaffna Peninsula. An appropriate solution is to complete the 'River for Jaffna Project'. Construction work on this project was carried out in the 1940s and 1950s, but it was never completed due to lack of funds and now lies in a totally abandoned state.

Within the Jaffna peninsula there are two large lagoons, the Vadamarachchi lagoon and the Upparu lagoon with surface areas of about 77 and 26 square km respectively. These are large shallow lagoons and cover a significant proportion (10%) of the peninsula's land area of 1000 square km. These lagoons have openings to the sea and are salt water lagoons but during the north-east monsoon rain water from their catchment areas also collects in them. The total catchment area of these lagoons is about 50% of the area of the Peninsula.

Paddy cultivation in the Jaffna Peninsula is essentially rain-fed cultivation. Cash crops and market garden crops are, however, irrigated using well water. The British Colonial Secretary, Sir James

Emerson Tennant in 1859 has described market gardening in Jaffna as follows and his description remains basically unchanged to this day except that pumps have, for the most part, replaced well sweeps:

*"In the immediate vicinity of Point Pedro (and the description applies equally well to the vicinity of Jaffna and the western division of the peninsula in general), the perfection of the village cultivation is truly remarkable; it is horticulture rather than agriculture, and reminds one of the market gardens of Fulham and Chelsea more forcibly than anything I have seen out of England. Almost every cottage has a garden attached to it, wherein are grown fruit-trees and flowers, the latter being grown in great quantities for decoration and offering in the temples. Each is situated in a well-secured enclosure, with one or more wells. From these night and day, but chiefly during the night, labourers are employed for raising water by means of vessels (frequently woven of palm leaves) attached to horizontal levers; something like the sakkias used by the peasants on the Nile for a similar purpose, except that in Jaffna two persons at least are required for each well, one of whom walks back and forward along the lever, whilst the other below directs the bucket in its ascent and empties its contents into a reservoir, whence by removing a clod of earth with the foot, it is admitted into conducting channels, and led to the several beds in succession. The value of these wells is extreme in a country where rivers and even the smallest stream are unknown, and where the cultivators are entirely dependent on the rains of the two monsoons. But such has been the indefatigable industry of the people in providing them, that they may be said to have virtually added a third harvest to the year, by the extent to which they have multiplied the means of irrigation around their principal towns and villages."* (Ref. 2)

The earliest known recorded observation about improving the fresh water situation in the Jaffna Peninsula was made nearly 350 years ago in a recently translated report by the Dutch Captain Hendrile van Reede, in which he states:

"*A dike to contain the sea at Condemanaer and Navacolli, with sluices to claim the rain water and a canal to the salt pans at Nieweli would create more useful arable land."* (Ref. 3)

Van Reede suggests a barrage at Thondamannaru and another at Navatkuli (Ariyalai) to convert Vadamaradchi and Upparu lagoons into freshwater lagoons, and a separate canal for salt water from the sea to the Upparu salterns. He was a remarkably perceptive man to realize this on a casual visit to Jaffna. Only a Dutchman with their long history of land reclamation would have thought of this scheme.

In 1879, the Northern Province Government Agent, Twyneham, proposed that dams be constructed to prevent salt water from entering the lagoons, but before it could be implemented there was a severe cyclone and flooding, possibly a tsunami caused by the eruption of the volcano Krakatoa in Indonesia in 1883 which caused severe flooding in Jaffna and Twyneham withdrew his proposals. He feared that if the dams had been already constructed, the flooding would have been much worse.

In 1916 the Government Agent, Horsberg, suggested that as an experiment the culverts where the Point Pedro – Chavakacheri road crosses the Vadamaradchi lagoon be temporarily blocked by wooden gates, thus making the upper reaches of Vadamaradchi lagoon a freshwater lagoon. The work was done in 1920 and the scheme operated successfully for four years. Although it was decided to make the scheme permanent, this was never done, possibly due to the great depression which followed and placed the Government in serious financial difficulties.

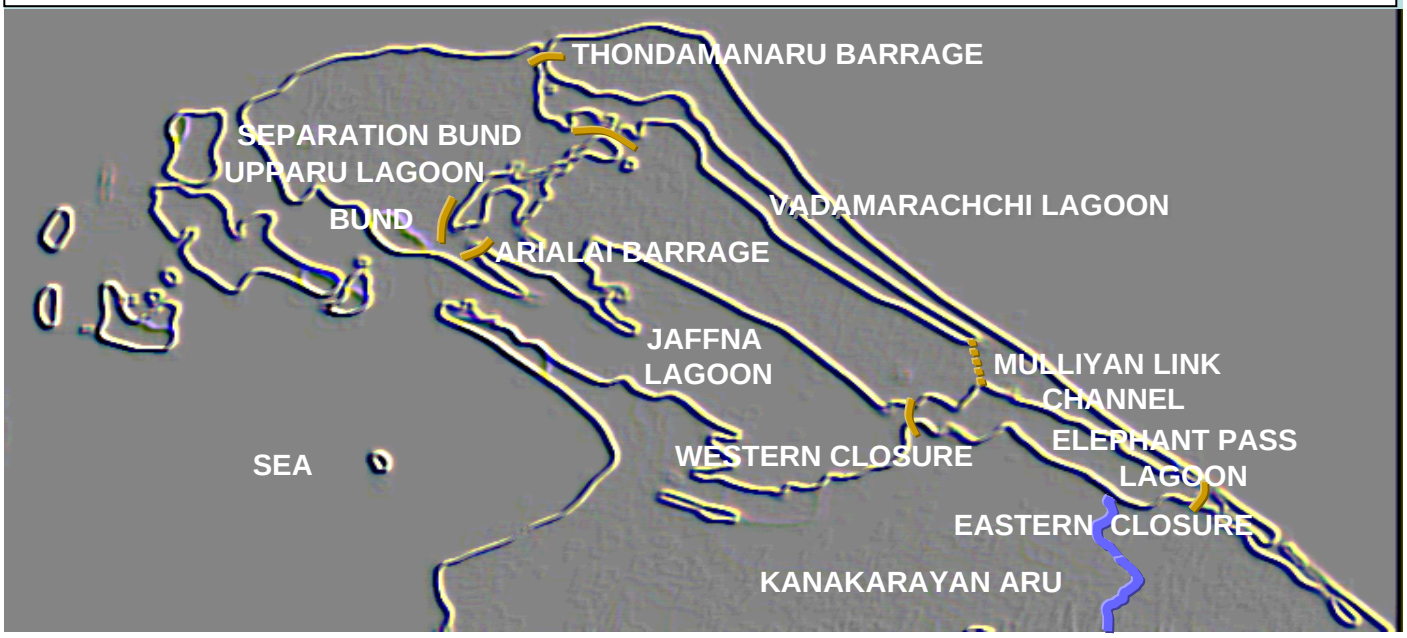
In the 1930s and 1940s the Divisional Irrigation Engineer, Webb, produced detailed plans for barrages at Thondamannaru and Ariyalai. The scheme was supported in the State Council by Balasingham who was a member of the Council, but the war intervened and construction work on the Thondamannaru Barrage commenced only in 1947 and was completed in 1953, and the Ariyalai Barrage was completed in 1955. However these Barrages are no longer functional as the wooden gates and stop logs have perished and sea water passes through them freely.

If we are to increase the availability of fresh water in the Jaffna peninsula we need to look at sources alternative to rain in the peninsula. South of the peninsula is the sea water Elephant Pass Lagoon which is relatively shallow but has a surface area of about 77 square km. It has a catchment area of about 940 square km in the mainland Vanni, mainly consisting of the Kanakarayan Aru and three smaller streams. During the north-east monsoon these streams discharge the surplus rain water from the Vanni into the Elephant Pass lagoon. From this lagoon this fresh water flows into the sea through the eastern end at Chundikulam and formerly also through the western end Elephant Pass bridge, and is at present being wasted.

During the 1960's a scheme was proposed to utilise the monsoon rain water running to waste from the Elephant Pass lagoon, for the benefit of the Jaffna peninsula.

SKETCH OF JAFFNA PENINSULA, SRI LANKA

SHOWING RIVER FOR JAFFNA PROJECT AREA




**KEY POINTS of the RIVER for JAFFNA Project**

Key points of the scheme and details of the work done at that time are as follows:

- Close off the openings in the road and rail bridges in the Elephant Pass causeway at the western end of the Elephant Pass lagoon to prevent fresh water going to the sea from this end. This work was completed.

- Build a bund at the eastern end of the Elephant Pass lagoon at Chundikulam to prevent fresh water going to the sea at that end and also provide a spillway to discharge excess flood water to the sea. This work was completed and Elephant Pass lagoon became a fresh water lagoon for a few years but unfortunately the bund was breached by subsequent heavy floods, thus allowing sea water access since then.

- Excavate a 12 metre wide, 4 km long channel, called the Mulliyan Link Channel, from the northern side of the Elephant Pass lagoon to convey fresh water from the Elephant Pass lagoon to the southern end of the Vadamarachchi lagoon, including regulatory gates to control the flow. Unfortunately this work was never completed. About 80% was completed when funds ran out and work stopped.

- Refurbish the existing Thondamanaru Barrage (where the northern end of Vadamarachchi lagoon joins the sea) to make it watertight, and improve the discharge gates to allow for discharge of flood water. This will make Vadamarachchi lagoon a fresh water lagoon. This work was carried out but the present condition of the barrage is that it is no longer watertight and allows sea water to enter the lagoon.

- Provide a spillway and gates at the southern end of Upparu Lagoon where it connects to the sea, near Ariyalai. This will make Upparu lagoon a fresh water lagoon. Provide a link channel between Vadamarachchi and Upparu lagoons so that fresh water from Elephant Pass lagoon can be supplied to Upparu lagoon. The spillway and gates were constructed but the present condition of the gates is that it is no longer watertight and allows sea water to enter Upparu lagoon.

It can be seen from the above that the scheme was only partially completed in the 1960's and the main key element of the Mulliyan link channel to convey fresh water from Elephant Pass lagoon to Vadamarachchi lagoon was never completed. In the brief period that Vadamarachchi and Upparu were fresh water lagoons the benefits to the peninsula were noticeable and many saline wells became potable water wells. The present situation is that the barrages at Thondamanaru and Ariyalai are no longer watertight and are allowing sea water to enter these lagoons freely.

**PROJECT BENEFITS**

The benefits of completing this project include the following:

- About 13,000 hectares of land can be cultivated with paddy in the Jaffna peninsula. The area presently cultivated is about 8000 hectares due to soil salinity and other reasons. This cultivation is entirely rain fed unlike paddy cultivation on the mainland which is watered by irrigation channels. As it is rain fed, the yield per acre in Jaffna is very poor and is only about one-third of the average yield per acre on the mainland. If the Vadamarachchi and Upparu lagoons become fresh water lakes, the water table and water quality in the wells will improve, and using lift irrigation it will be possible to irrigate these paddy fields without depending purely on the rain and the paddy land now lying fallow can also be cultivated. The potential for improvement in yield and rice production is staggering.

- About 4400 hectares of land bordering the Vadamarachchi and Upparu lagoons are uncultivable at present as they are saline. When these become fresh water lagoons, after the salt is leached out of the soil, it will be possible to cultivate this land with cash crops and paddy.

- There will be a dramatic improvement in the water quality of the 30% of the Jaffna wells which are now saline. In many cases the water will become suitable for domestic use and agricultural use, increasing the acreage under agricultural cultivation.

- In the existing wells it will be possible to increase the amount of daily pumping without the water going saline, thus increasing agricultural cultivation and livestock production.

- Fresh water prawn farming can commence on the banks of the lagoons, with potential for export earnings.

- Converting Elephant Pass lagoon into a 77 sq km fresh water lagoon will provide fresh agricultural possibilities on both sides of the lagoon i.e. the Jaffna peninsula side on the north, as well as the Vanni side on the south, once the salinity has been leached out of the soil.

## WORK NEEDED TO COMPLETE THE SCHEME

K Shanmugarajah who was Chief Engineer of this project in the 1970's has written a comprehensive book on this project. (Ref. 4) The book details the history of the project, contains detailed designs, details of the work carried out and work remaining to be done. Detailed cost estimates have also been included. The cost figures given below are from that book. At 1991 rates, the cost of completing the project was estimated as Rs 280 million, and projected to cost Rs 350 million in 1995. This estimate will have to be updated to present day costs. Probable present day total costs would be of the order of US $ 10 million.

A project of this magnitude will require foreign aid funding for implementation. If funds for the full project are not immediately available, phased implementation could be considered in the following steps:

### Step 1: Recondition Thondamanaru Barrage

Replace and repair perished wooden gates and lifting devices etc. If this barrage is made watertight Vadamarachchi lagoon will become a fresh water lagoon fed with rain water from its 300 sq km catchment area.

### Step 2 : Recondition Ariyalai Barrage

Repair and replace perished planked bays and replace with screw operated gates. Repair breaches in separation bund between Upparu lagoon and Ariyalai saltern. Repair separation bund between Vadamarachchi and Upparu lagoons as required. This will make Upparu lagoon a fresh water lagoon fed with rain water from its 220 sq km catchment area.

### Step 3 : Complete Mulliyan Link Channel

Complete excavation of Mulliyan Link Channel, form bund and roadway, causeway and provide control regulator. Estimated cost of this work at 1991 rates was Rs 42 million plus administration and facilities costs. Provide link channel between Vadamarachchi and Upparu lagoons. When this work is completed there is a possibility that the water in the Elephant Pass lagoon at the height of the north east monsoon may be sufficiently low in saline content, even before the Spill cum Causeway at Chundikulam is completed, to enable it to be diverted to Vadamarchchi and Upparu lagoons as required.

**Step 4 : Complete Spill cum Causeway at Chundikulam**

At the eastern end of Elephant Pass lagoon at Chundikulam, complete the spill cum Chundikulam causeway, zoned embankment, and flanked embankment with gravel road. The spill plus causeway will be 2100 metres long and the bund 1400 metres long. Estimated cost of this work at 1991 rates was Rs 93 million plus administration and facilities costs. When this work is completed Elephant Pass lagoon will become a fresh water lagoon.

Repair and improve 8 km long access road from Paranthan-Mullaitivu road to Chundikulam causeway.

## ATTEMPTS AT SCHEME APPROVAL

In January 1983 a report was submitted to the President of Sri Lanka, J R Jayewardene urging the completion of the scheme. The President convened a meeting in May 1983 at which he directed the Government officials present to implement the scheme. He also appointed K Shanmugarajah, a co-author of this paper, as Consultant for the Project. Unfortunately the 1983 internal disturbances occurred shortly thereafter and the implementation did not proceed.

In July 2003 the then Minister for Irrigation and Water Management, Gamini Jayawickrema Perera, after visiting the project site was to submit a cabinet paper for the completion of the project. He described it as an “all embracing solution for water problems in Jaffna”. Due to change of Government shortly thereafter, no further progress was made on project implementation.

In October 2007 at the Annual Sessions of the Institution of Engineers, Sri Lanka, held in Colombo, a Resolution was passed by an overwhelming majority with only one dissenting vote. The Resolution urged the Government to complete this Project. This Resolution has been conveyed to the Government.

A presentation on the River for Jaffna Project was also made by the principal author of this paper, Thiru Arumugam, in November 2007 in Colombo, Sri Lanka at the Nobel Peace Prize winning Pugwash Organisation’s Workshop on *Learning from Ancient Hydraulic Civilizations to combat Climate Change.* A resolution worded as follows was passed at this Workshop, proposed by Ambassador Jayantha Dhanapala, President, Pugwash Conferences on Science and World Affairs and seconded by D L O Mendis, a co-author of this paper:

*This Pugwash Workshop resolves to recommend to the Government of Sri Lanka that the project known as A River for Jaffna that was started some fifty years ago, and almost completed, but is now in a state of disuse and abandonment, should be restored without delay, as a most important step towards including Sri Lankans of the Jaffna peninsula in the development and enjoyment of the natural resources of the country, thereby contributing to early achievement of a durable peace.*

This Resolution will receive global publicity when the Proceedings of the Pugwash Workshop are released in the near future.

When this project is finally completed there will be a complete transformation in the agricultural productivity of the Jaffna Peninsula and the quality of life will also be greatly improved by solving to a large extent the problem of salinity in wells.

**References:**


(1) Sanmugam Arumugam, *Development of Ground Water and its exploitation in the Jaffna Peninsula,* Transactions of the Institution of Engineers, Ceylon, 1970.

(2) Reproduced from D L O Mendis, *Evolution and Development of Water and Soil Conservation Ecosystems – from Ancient Dry Zone Forest Garden to Modern Jaffna Market Garden,* p 88, Sri Lanka Pugwash Group Publication, 2001.

(3) Hendrile van Reede, Captain to the Dutch Governor of Ceylon, Rijckloff van Goens, *A Report of the journey from Colombo to Manaar, Jaffnapatnam and its subordinate posts and forts,* 01 December 1665.

(4) K Shanmugarajah, *Water Resources Development Jaffna Peninsula,* Fast Books, Australia, 1993.