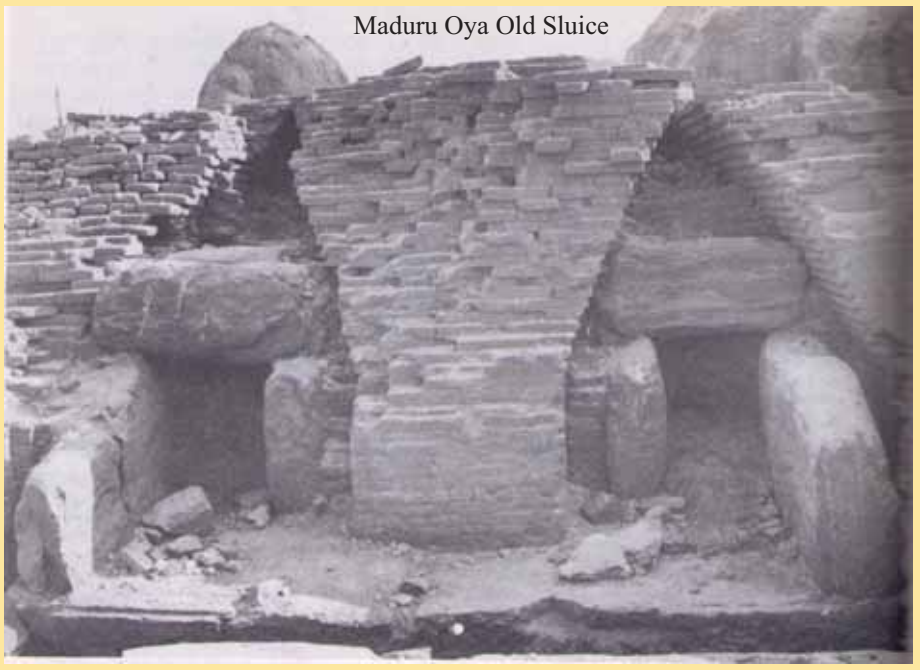
The Biso Kotuwa (Sluice Tower) of Irrigation Reservoirs

A glimpse of the glorious past and marvelous water management skills exhibited by the civilization


Maduru Oya Old Sluice

In the initial settlements of the dry zone of Sri Lanka, irrigation played a vital role to nurture the fledging Aryan Sinhalese civilization. At that time, without any artificial storage of water, human existence in the NCP (North Central Province) of Sri Lanka would have been utterly impossible, thus emphasizing the need for the evolution of some indigenous irrigated agriculture in Sri Lanka.

DLO Mendis (1986) explains this development of irrigated agriculture in Sri Lanka by seven stages of evolution. They are as follows:

Stage 1– Rainfed (Chena) agriculture
Stage 2 – River Diversion using a temporary diversion structure (say stick dam)
Stage 3 – Permanent Structure using dressed stone masonry
Stage 4 – Construction and operation of spillways and weirs
Stage 5 – Invention of *Sorowwa* (Sluice Tower) with *Biso Kotuwa*
Stage 6 – Construction of small, medium and large reservoirs across non-perennial *Oya* (Creeks)
Stage 7 – Damming of perennial river with river diversion through a sluice or the twin tank method

RL Brohier (1975) explains the process of evolution of the hydraulic (canal based) civilization by four stages namely :

Stage 1 – Rainwater tanks with water bailed out
Stage 2 – Small tanks and *Ela* (Canals)
Stage 3 – Large tank (Reservoir) submerging some small tanks
Stage 4 – Weir across major streams and *Yoda Ela* to reservoir. Continued beyond the tank to another reservoir. Transbasin canals also provided.

However, our ancient dam builders learnt to build permanent dams across the rivers and *Oya* to make their irrigation tanks.

In the design stages of these reservoirs and dams, various aspects have to be thoroughly and meticulously investigated before going onto construction. Some important aspects would be the amount and the pattern of rainfall of the area, the catchment area of the watershed basin, the topographical features that suits the dam site and the location of a sluice site etc.

In deciding on the location of a sluice, one would have to follow a certain criteria and in the process some crucial decisions would have to be taken. Ideally, the sluice site has to be positioned at the lowest possible point of the tank bed area for the dead storage to be the minimum. But at the same time, it has to be positioned at the highest possible point of the irrigable area so that irrigated water would flow easily under gravity to it's entire command. Whether this subtle decision of where to locate the sluice, was taken today or some 1500 years ago, the criteria stood the same. Under the modern technology, the present day engineers located where the sluice site should be for a proposed irrigation reservoir in restoring an ancient abandoned tank, and it has so happened many a times that the ancient dam builders also have located their sluice sites at the very same spots. While the soil extractions were done to construct the sluice of the Wahalkada Wewa Reservoir in Anuradhapura District in 1973, the Irrigation Department came across the remnants of the old sluice. The same thing was heard while the Maduru Oya sluice was under construction during the early eighties. That simply shows the talent, the ingenuity and the technical know-how of the ancient Sri Lankan water engineers!


Parakrama Samudra D 1 Channel

The cleverness of these engineers is best exemplified by the invention of a sluice called the *Biso Kotuwa* between (400-300 BC). This *Biso Kotuwa* is the equivalent of a 'Valve-Pit' which functions in the regulation of the outward flow of water from a reservoir, and RL Brohier (2012) in his book 'Seeing Ceylon' reveals that the *Biso Kotuwa* has the meaning 'the enclosure where the water level lowers'. That implies the possible methodology adopted by the ancient operators. As Henry Parker (1909) describes in his book 'Ancient Ceylon' that it was this invention of *Biso Kotuwa,* and he goes on to emphasize that this invention alone permitted the Sinhala irrigation engineers to proceed boldly with the construction of large number of irrigation reservoirs in NCP located in the dry zone of Sri Lanka, that still rank among the finest and greatest works of the kind in the world. Henry Parker (1909) continues further to state that without some efficient means of regulating the outward flow of water through the sluices, the provision of reservoirs for storing water could never have been extended beyond the minor tanks . As a result, in the dry zone emerged three main complex irrigation systems, namely Malwatu – Kala Oya, Mahaweli – Amban Ganga and Walawe – Kirindi Oya irrigation systems. Today, Sri Lanka has a massive number of tanks spread out in 13 districts of the dry zone irrigating paddy cultivation. Among the largest ancient tanks are Kantale Tank, Minneriya Tank, Parakrama Samudra and Kaudulla Tank with capacities of 114,000 ac.ft, 110,000 ac.ft, 109,000 ac.ft and 104,000 ac.ft respectively. The largest modern tank in Sri Lanka remains to be Senanayake Samudra with a capacity of 770,000 ac.ft, while the other modern tanks such as Victoria, Randenigala, Maduru Oya, Samanala Wewa, Lunugamwehera, Uda Walawe and Kotmale reservoirs have the gross capacities of 585,000 ac. ft, 692,000 ac.ft, 483,500 ac.ft, 206,000 ac.ft, 198,500 ac.ft, 238,000 ac.ft and 141,000 ac.ft respectively. According to historical descriptions, the construction of large reservoirs had been started in Sri Lanka in the 1st century BC during the reign of King Wasabha (67 – 111 BC). As per the historical records, King Wasabha had built 11 large reservoirs including the Willachchiya Tank and two irrigation canals including the Elahera Canal during his term in office. According to a British colonial irrigation engineer Henry Parker (1909) who had worked in Ceylon for many years under the British rule, the first great reservoir of the world ever constructed was PanduWewa of Sri Lanka built by King Dappula II during the reign (807 – 812 AD), and PanduWewa has had 1,360 acres of irrigation under its command.

All these construction of huge reservoirs were possible, only because of the invention of the *Biso Kotuwa* by the Sinhala irrigation engineers of the past. This invention showed the capability, efficiency and the effectiveness of the system to the world at large, in handling high pressures at bigger heads of water, and it could be described as 'leap-frog' in technology at that point of time.

Now let me proceed to analyze what the *Biso Kotuwa* actually does? Once the water is stored up in small or large reservoirs, it has to be diverted to paddy fields for irrigation. So there should be a hole or an opening of some sort from the tank bund to perform this task. But we have to accept the fact that there is a difference in sending water at a depth of 10 ft as compared to sending water at a depth of say 30 ft. of head. That is simply because of the massive pressure difference involved between 10 to 30 ft of head of water. In this instance, the operation of the water issuing techniques that is being used for a depth of 10 ft cannot be adopted for a depth of say 30 ft as it becomes complicated. Now, the water issuing technique that was adopted for these complicated bigger heads of water, was pioneered, designed and practically tested by our ancient Sinhala water engineers of Sri Lanka, and it could identified and introduced as the valuable innovation of this *Biso Kotuwa* some 2200 years ago.

The out going water from small low head reservoirs, has traditionally being issued in Sri Lanka through what is called the *Keta Sorowwa*. In a *Keta Sorowwa*, there