THE WATER RESOURCES DEVELOPMENT MAP OF CEYLON, 1959

by

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Abstract

A map described as The Water Resources Development Map of Ceylon was published in 1959 by the Survey Department. This map has been used since then to identify suitable locations for construction of large reservoirs, of which the Uda Walawe and Lunugamvehera reservoirs are notable examples.

It has been pointed out that the basis for location of many large reservoirs on this map was a single basin or within basin balance of water and land resources. Moreover, the ancient irrigation systems that exist in the dry zone of the country have not been adequately taken into account as existing assets, when planning water resources development projects in modern times. It has been shown that this reflects an erroneous hypothesis that the small village tanks that are an important feature of the ancient irrigation works, were only a stage in the evolution and development of irrigation systems, and should therefore be replaced by large reservoirs whenever and wherever possible.

Suitable sites for large reservoirs had been identified on the one mile to an inch topographical survey sheets by examining the 100 foot contours shown therein. When an apparently suitable site was found the yield in the catchment area above was worked out from available rainfall figures, or occasionally from available river gaugings, and the proposed capacity of the reservoir determined. The potential irrigable command was then hypothesized from the yield, and the potential irrigable area below the dam site checked to see whether it matched the proposed capacity of the reservoir.

It has been repeatedly pointed out that this basis for alleged 'water resources development planning' is unscientific and irrational in as much as it restricts planning to individual river basins, without adequate consideration of trans-basin diversion. Moreover, it has been pointed out that trans-basin diversion projects designed and constructed in ancient times at least 1500 years ago, still function very satisfactorily.

Two large reservoirs, Uda Walawe and Lunugamvehera have been constructed in the southern area solely on the authority of this map. The wrong location of the Uda Walawe reservoir was pointed out at the time it was being built in 1967, and the preferred alternative upstream location also identified. The incorrect location of the Lunugamvehera reservoir was pointed out long before the site was even investigated, and the preferred alternative upstream location also identified. However, in spite of directions given by the Prime Minister's Ministry of Planning and Economic Affairs to the Ministry of Irrigation, the alternative site was never investigated, and Lunugamvehera reservoir was constructed. It is argued that these wrong locations have been the cause of environmental degradation and given rise to violence in the southern area in recent times.

A large trans-basin diversion canal has been shown on this map called the North Central Province canal or NCP canal which it is alleged could take water from the proposed Moragahakande reservoir to irrigate lands in the north. It is argued that this canal can never function satisfactorily, and if constructed could lead to further environmental degradation and violent conflict in the northern areas.

Introduction

The Water Resources Development Map of Ceylon published in 1959 by the Survey Department had been prepared by the Irrigation department over a number of years. The one mile to an inch topographical survey of the island, one of the outstanding achievements of the British colonial era due to men of the calibre of Major Thomas Skinner, shows contours at hundred foot intervals, besides other natural and man-made features. Of the natural features, the river systems show perennial rivers called 'ganga' and non-perennial rivers called oya or ara in Sinhala, and aru in Tamil. Of the man-made features, the ancient irrigation works consisting of river diversion systems, and storage reservoirs, are the most notable. River diversion was achieved by means of a stone diversion weir called an amuna in Sinhala or anicut (from the Tamil), in English. The reservoirs were small, medium or large scale. There are said to have been as many as 30,000

small village tanks in the approximately 15,000 square miles of the dry zone of Sri Lanka, many of them in the ancient Ruhuna rata. The large reservoirs in the ancient Raja rata were inter-connected by systems of large trans-basin diversion channels. (Brohier, 1937). Most of that system still functions very effectively, having been restored in a piece-meal fashion in British times.

It has been pointed out that these ancient irrigation systems have not been properly utilized when preparing the 1959 Map. Instead, quite often a new large reservoir was located on the Map so as to submerge and eliminate some existing small ancient irrigation systems in that area. Two such large reservoirs already built, Uda Walawe and Lunugamvehera, are now faced with what are euphemistically described as water management problems. Socio-economic disturbances on a hitherto unprecedented scale have also erupted in these areas, which cannot be simply explained away as being due to what has been described as 'the inevitable socio-economic differentiation of gravity irrigation'. (Pfaffenberger, 1990).

The reason for eliminating the small tanks was that it was believed that the small tank was a stage in the evolution and development of irrigation systems and should some day be replaced by a large reservoir. (Brohier, 1956, Needham, 1971, 369). It has been shown that this is a wrong hypothesis for the evolution and development of irrigation systems and an alternative seven stage hypothesis has been proposed. (Mendis, 1986 etc.) Small tanks are now being introduced as night storage reservoirs and balancing reservoirs in the layout of modern irrigation systems, but this is not the same as the purpose and function of the ancient small village tanks that were essentially the heart of the village settlement.

The method adopted in preparing the 1959 Map had been the following. The 100 foot interval contours on the topographical survey sheets were examined to find suitable sites in each catchment where embankments could be built. (Figure 1). The catchment area above such a site was then measured on the map, and the probable yield at the proposed dam site estimated from rainfall or river flow records available in the Hydrology division of the Irrigation department at the time. Next, the irrigable command area below the proposed site was measured on the map, and an appropriate balance between reservoir capacity and irrigable area established.

It has been pointed out that preparation of the 1959 Map on this basis of a within basin or single basin balance of water and land resources is unscientific and irrational. (Mendis, 1989). Nevertheless, this Map continues to adorn the walls of all the high level decision-makers in the Ministry of Irrigation and the Irrigation Department, from the Minister and the State Minister, downwards. Most probably it also hangs on the walls in the World bank and other foreign centres of economic power that control our economy, and until it is removed from those places it will not be removed from our own walls. If that is the case, there is no hope for changing the wrong basis for our water resources development planning for sometime to come. It is sincerely hoped that this in fact is not the case.

Uda Walawe

The gigantic Uda Walawe reservoir was under construction when it was realised that it was being built in the wrong location. (Mendis, 1968, p. 131 et seq.). It was argued that if 'rational principles of water resources development planning had been followed, the correct location for a large reservoir would have been found some ten miles upstream of the present location. (Ibid, 135) (Figure 2). These principles (Kuiper, 1965) were quoted as follows (Ibid, 134):

1. Define the purpose of the engineering project. Formulate its useful end which makes the creation of the project a desirable objective.

2. Plan the project in accordance with its established purpose. Investigate alternative proposals, and select the project that will most effectively fulfil the purpose.

3. Design the project in the most efficient manner and in accordance with appropriate criteria of safety.

4. Construct the project, according to its design, while applying suitable standards of workmanship.

5. Operate the project, thus bringing the useful end of the engineering plan into concrete existence.

At that time the alternative location was not universally acceptable, but today by far the large majority of engineers agree that it is the preferred location.

Lunugamvehera

The Lunugamvehera reservoir in the lower reaches of the Kirindi oya was built according to the proposal of bureaucrats and technocrats in the Irrigation Ministry and Department. Directions given by the Prime Minister's Ministry of Planning and Economic Affairs to the Ministry of Irrigation to investigate an alternative upstream site at Hurathgamuwa were blatantly ignored. (Figure 3). The full import of this violation of responsibility and misuse of power by certain government officials has still not been fully understood. It is to be hoped that as the socio-economic crisis in the south inevitably worsens in the years to come, there will not be a belated witch-hunt to find scapegoats. Rather, it is hoped that remedial measures

will at last be found by high officials in the Ministry and Department of Irrigation based on rational principles of water resources development planning, and that politicians will have the courage to implement such proposals in the long term interests of the long suffering people of the southern area.

Environmental degradation in the south

It has been argued that environmental degradation in the south can be traced to the wrong location of the two new large reservoirs, Uda Walawe and Lunugamvehera. This has been explained in terms of the new concept of irrigation ecosystems. 5 irrigation ecosystems have been identified from the seven stage hypothesis for the evolution and development of irrigation systems (Mendis, 1986 etc.), namely:

1. Seasonal cultivation under inundation or flood irrigation.
2. Seasonal cultivation under permanent river diversion and channel irrigation.
3. Seasonal cultivation under irrigation from small village tanks.
4. Two seasons cultivation under irrigation systems of types 1, 2, or 3, in its command area, and constituting a macro irrigation ecosystem.
5. A complex of macro irrigation ecosystems made up of interconnected large reservoirs and channels as in the ancient Rajarata.

In all probability these irrigation ecosystems were stable and sustainable under a comparatively low input low output system of production. However, there is evidence from ancient Peru that there were similar stable and sustainable irrigation ecosystems capable of very high outputs, even higher than outputs from modern unstable systems dependent on large inputs of energy in the form of fertilizer, pesticides, and tillage power. (Stevens, 1989) Whether this was also possible in the ancient irrigation ecosystems of Sri Lanka has to be studied, and such studies are long overdue.

It has been claimed that environmental degradation in the south has been responsible at least in part for some of the violent conflict in the area in the recent past. (Mendis, 1988, Mendis, 1989, Mendis, 1990a, b, Mendis, 1991, a,b). This is all the more reason why the subject should be given maximum publicity and free and frank discussion encouraged on all aspects of the problems.

Moragahakanda and the NCP Canal

Another large reservoir shown on the 1959 Map is the Moragahakanda reservoir across the Amban ganga. A transbasin canal has been traced from this reservoir that is supposed to take water to the north. There is a touching faith in the belief that this proposal will solve the problem of seasonal water shortage in the north, right up to the Jaffna peninsula. In fact, such a belief is not likely to be realised even if the Moragahakanda reservoir and the NCP canal are built.

The proposed Moragahakanda dam is sited at the location of the ancient Elahera anicut across the Amban ganga. The Elahera anicut and canal were built by King Vasabha in the 1st century. The Minneriya weva (reservoir) and the Giritale weva which lie in adjacent dry valleys and are supplied by this canal, were built a couple of hundred years later by King Mahasen the Tank builder (as he is known), in the 3rd century. Further down, the extension of the Elahera canal, the Minneriya - Kantalai yoda ela was built by King Agga Bodhi I, in the 5th century, and the Kantalai tank itself was built by his successor King Agga Bodhi II in the 6th century. (Figure 4) Thus it is clear that the ancients built river diversions systems before they built large reservoirs to be augmented by them.

In modern Sri Lanka, however, the large storage reservoir takes precedence over every other irrigation structure, and as stated above, the large reservoir was expected to replace small village tanks, which was the rationale for Uda Walawe and Lunugamvehera. If Moragahakande reservoir is built there will immediately be a cry to build the NCP canal, which will be a politically high explosive subject especially in the present context of an on- going civil war in the north. The subject has therefore to be discussed absolutely dispassionately and objectively.

The NCP canal has been traced on the central ridge that separates the western seaboard from the eastern seaboard in the northern part of the island. It runs through land dominated by the reddish brown soils which are highly permeable. Evaporation losses are also high in the region through which the canal is traced. There will therefore be very high conveyance losses along this channel if it is not lined. A fully lined canal will reduce seepage but not evaporation losses. It may therefore be considered necessary to carry the canal through pipes even though this will be a costly solution. New technologies for construction of large prestressed concrete spun pipes are available. In fact an alternative proposal for the Minipe Right Bank diversion canal several years ago was put forward by a tenderer for a battery of spun pipes (Mendis, 1984).

A closed conduit like a battery of spun pipes will certainly reduce conveyance losses, and also make the system more manageable. An open canal will be almost impossible to manage as there will be theft of water all along its course. Thus it is more than likely that the present north south conflict will be augmented by a west east conflict over irrigation water if the NCP canal is built. But in the

absence of any other proposal to make water available to the north, the NCP canal is looked at as most desirable solution, and any criticism of this proposal may even be misunderstood as an attempt to prevent life-giving water from being made available to the north. Then is there any other alternative more feasible than the NCP canal from Moragahakanda reservoir to solve the problem?

Indeed there is, but it involves as yet untried technologies that have to be studied and researched before a practical proposal can be presented. The underlying limestone strata in the northern dry zone have very large solution caverns which sometimes hold water. The basis for the futuristic proposal is to use these underground caverns to store water for lift irrigation in the northern areas. As for a new source of water, the following may be considered: Sri Lanka's location on the map is such that the northern areas are occasionally subject to violent cyclonic storms that cause very high surface runoff on account of the very high precipitation in a very short period of time, which surface reservoirs cannot hold. The runoff from such cyclonic storms therefore necessarily causes a great deal of damage to the irrigation systems, which have to be repaired under special financial provision often described as flood damage restoration votes.

If a new concept of underground storage of irrigation water is adopted, the source of some of this water could be the occasional storms that cause such damage to surface irrigation works. Since the concept is new, the technology may not be readily available, and will have to be made to measure as it were. Here is where Sri Lankan engineers, both Tamil and Sinhalese could get together to work out a solution. It is submitted by this author that this could also be a lasting contribution to communal amity in this strife-torn country, to which the 1959 Map has also contributed its share.

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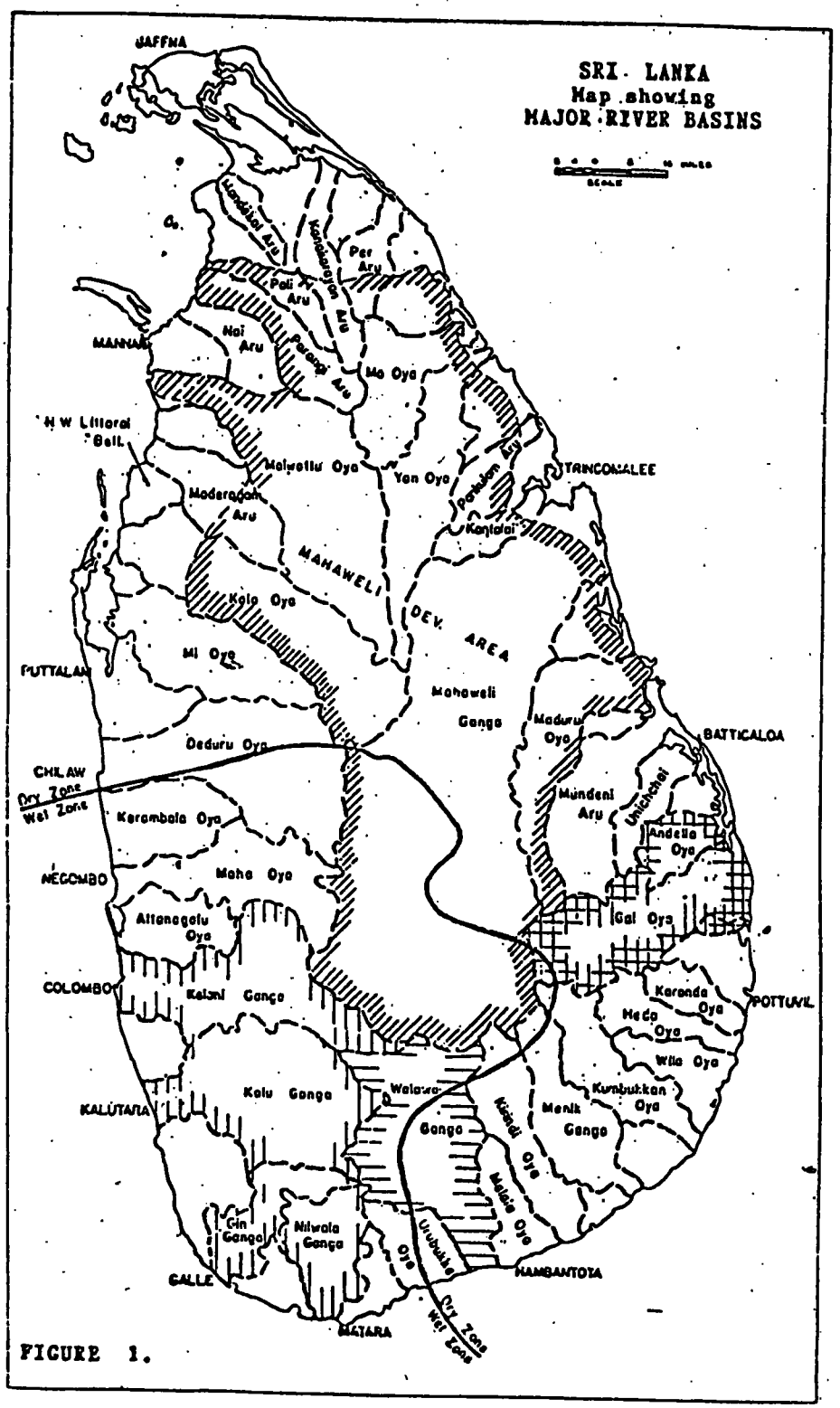
SRI LANKA
Map showing
MAJOR RIVER BASINS
JAFFNA
MANNAR
N W Littoral Basin
PUTTALAM
CHILAW
Dry Zone
Wet Zone
NEGOMBO
COLOMBO
KALUTARA
GALLE
MATARA
TRINCOMALEE
BATTICALOA
POTTUVIL
HAMBANTOTA
MAHAWELI DEV. AREA
Mahaweli Ganga
Kala Oya
Mi Oya
Deduru Oya
Kerambala Oya
Maha Oya
Attanagalu Oya
Kelani Ganga
Kalu Ganga
Gin Ganga
Nilwala Ganga
Malwatu Oya
Yan Oya
Mundeni Aru
Gal Oya
Karanda Oya
Heda Oya
Wila Oya
Kumbukkan Oya
Menik Ganga
Kirindi Oya
Malala Oya
Urubokka Oya
Dry Zone
Wet Zone

FIGURE 1.

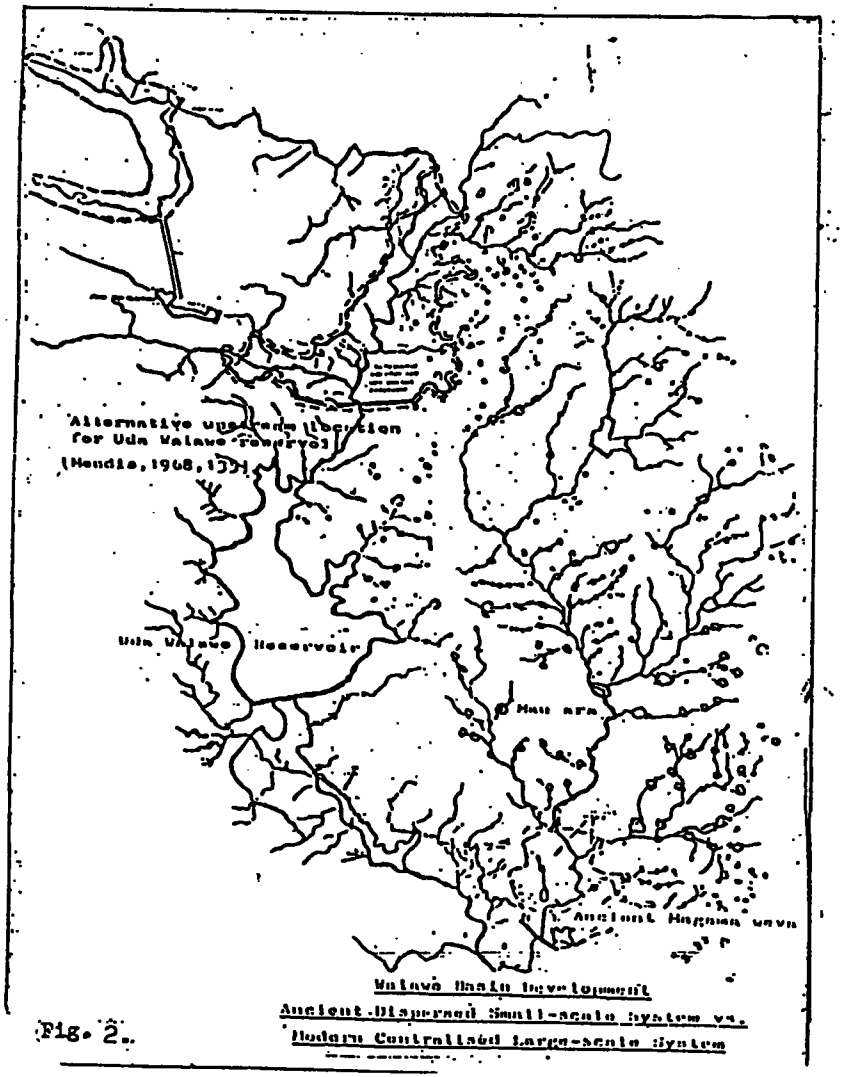

Fig. 2.

Walawe Basin Development
Ancient Dispersed Small-scale System vs.
Modern Centralised Large-scale System

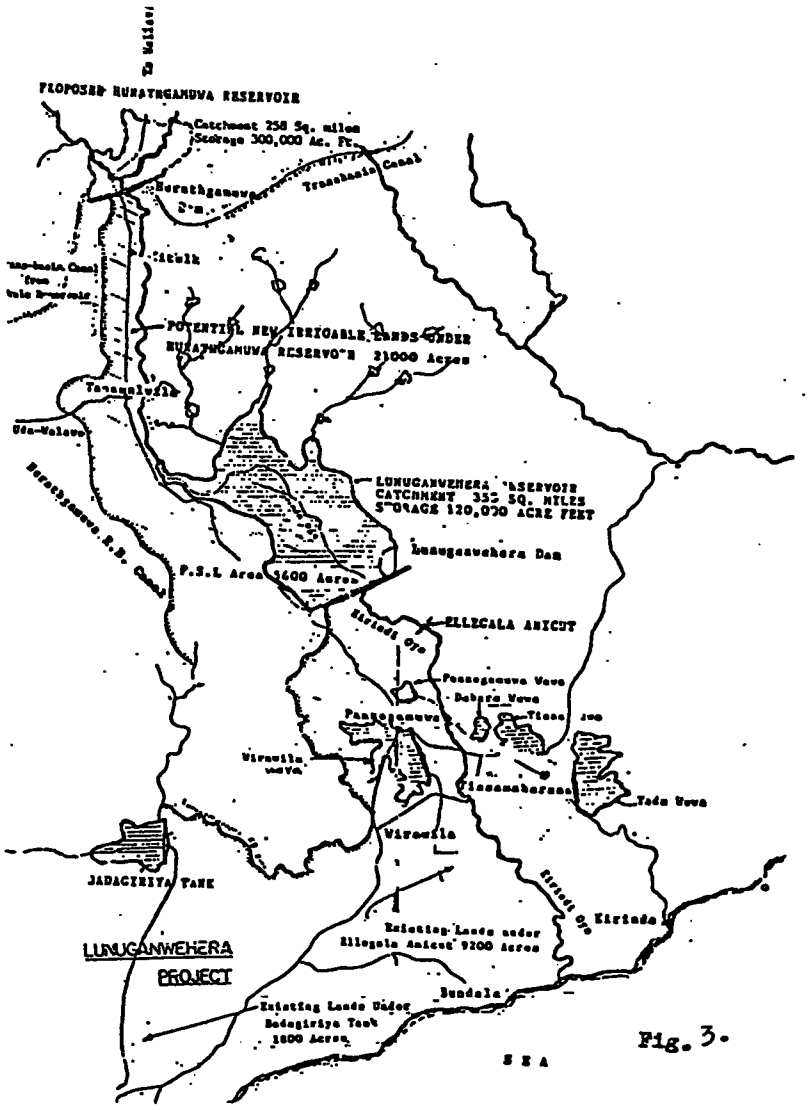

Fig. 3.

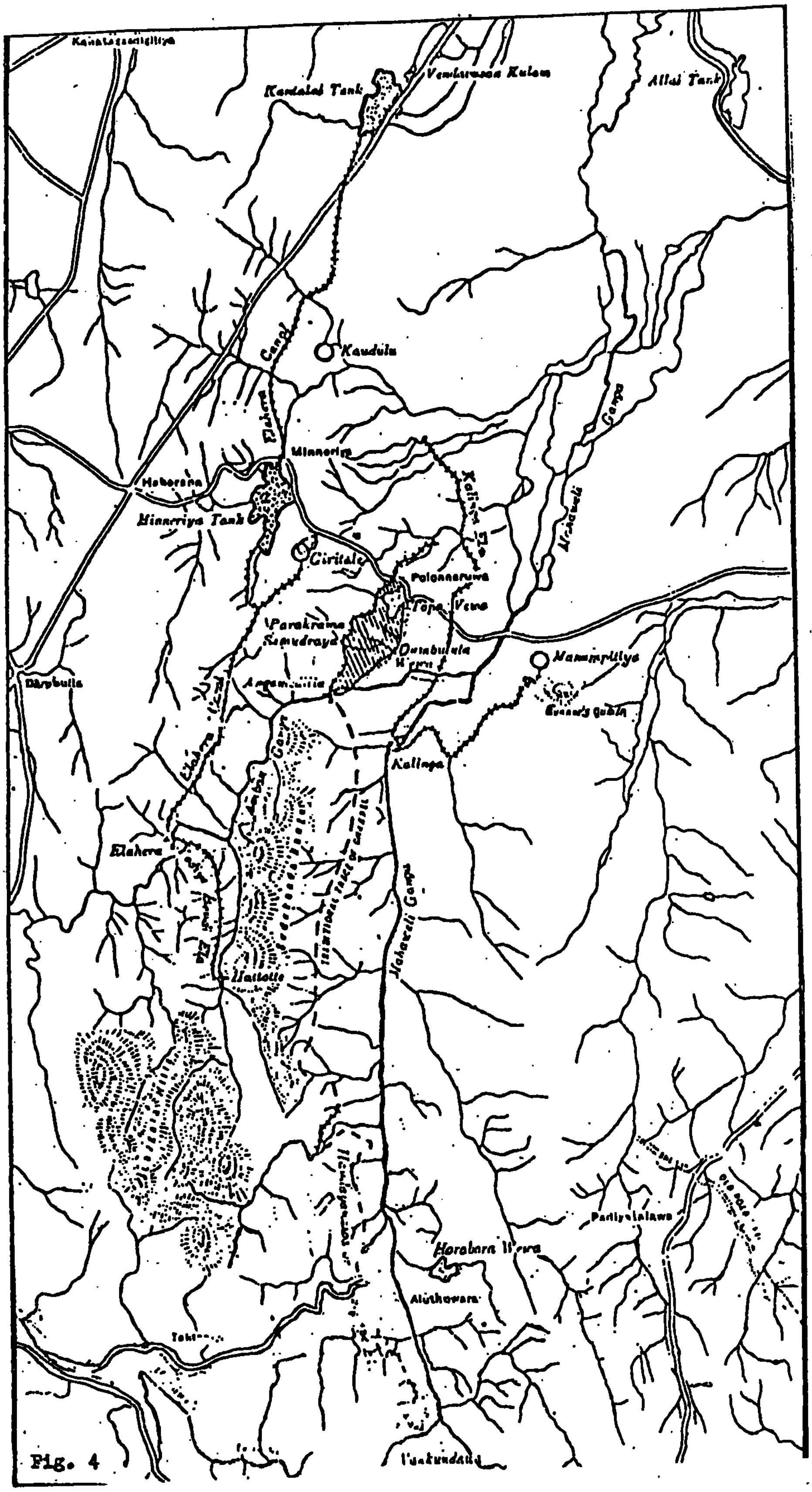
Kandalai Tank
Allai Tank
Canal
Kaudulu
Elahera
Ganga
Minneriya
Haberana
Minnrriya Tank
Giritale
Polonnaruwa
Topa Wewa
Parakrama
Samudraya
Dambulla
Kalinga
Mahaweli Ganga
Horabora Wewa

Fig. 4