HYDROPOWER DEVELOPMENT-ON TRANSBASIN DIVERSION TO SOUTH EASTERN DRY ZONE

by Mahinda Kurukulasooriya

Introduction

The Mahaweli Ganga, the most important river in Sri Lanka is the principal source of water for hydropower development and irrigated agriculture in the dry zone.

The 1968 UNDP/FAO Master plan for Mahaweli Ganga development programme envisaged the development of about 900,000 ac. of irrigated land and the installation of about 500 MW of hydropower.

Implementation of the Mahaweli development plan commenced in 1970 with the Polgolla Project and from 1977 under the accelerated Mahaweli Scheme, Kotmale, Victoria, Randenigala and Maduru Oya Projects are under construction.

The NEDECO (The Netherlands) implementation strategy study found that there would be excess water resources of Mahaweli Ganga for use in other areas after meeting the requirement of lands developed under the Accelerated Programme.

Earlier, the UNDP/FAO study identified a diversion plan utilising a long transbasin canal to benefit the North Central River Basins consisting of portions of the North Central & Central Provinces. NEDECO recommended an alternative plan with a much shorter transbasin canal which is economically more attractive. The report commented that, in spite of the considerably lower cost of conveyance this alternative suggested a rather low project economic rate of return.

Trans Basin Diversion study was set-up with the principal objectives of developing the best plan, both technically and economically, for diverting surplus water from the Mahaweli Ganga to adjoining transbasin areas and for distributing this water together with the local inflows to various potential sub-projects for developing lands under irrigation and generation of hydropower.

The work of a Report on Trans Basin Diversion Study was entrusted to a joint venture of consultants from Switzerland and West Germany. (ELECTRO-WATT, SALZGITTER AND AGRAR & HYDRO-TECHNIQUE).

Location and Designs of hydropower stations on conveyance systems (tunnels, Canals, dams) were carried out by the Author independently and not included in the Trans Basin Diversion Study Report.

Transbasin Diversion Areas

Three most probable areas for Transbasin Diversion were taken into consideration.

North West Dry Zone (NWDZ)

The Northenmost basin in the NWDZ is the Mee Oya Basin with over 10,000

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Ac. of land available for development, suitable for a wide range of field crops.

South East Dry Zone (SEDZ)

The South East dry zone belt includes the Gallodai Aru, Maha Oya, Rambukkan Oya, Magalawatawan Aru, Navakiri Aru and Andel Oya basins. These river basins include over 100,000 Ac. of new land available for development and 70,000 Ac. of existing lands which are cultivated at low yield and low cropping intensities as they receive inadequate or no irrigation benefits at all.

North Central River Basins (NCRB)

The NEDECO study found that the proposed Moragahakanda and Randenigala reservoirs were not needed for irrigation of systems A and H. These reservoirs together with the Tammannawewa (or Kapirigama), Malwatu Oya, Mukunewewa, Yan Oya, Kitulgala, Kanagarayan Aru, Pali Aru and Parangi Aru tanks in the NCRB and the Rotalawala, Angamedilla and Kiri Oya reservoirs in the Central area, would be able to supply water to irrigate a potential irrigable area of about 340,000 Ac. of new and existing lands, comprising irrigation systems I (140,000 Ac.), J (56,000 ac.), K (20,000 ac.), L (96,000 ac.), and M (28,000 ac.) in the NCRB.

On the basis of the findings of the Planning Report of the Consultants, it was finally decided to evaluate NWDZ and SEDZ with Gal Oya Scheme for transbasin conveyance.

Conveyance Systems

Excess water of Mahaweli Ganga would be diverted at Minipe to be conveyed to SEDZ (including Gal Oya Scheme) and the Bowatenne Diversion will fulfill the requirement of NWDZ.

SEDZ Conveyance System

One of the significant advantages in the SEDZ conveyance system is the possibility of conveyance of water from Minipe to Ratkinda reservoir by using the Minipe R.B. Canal. Water balance studies established the possibility of conveyance of water for SEDZ by using Minipe R.B. when the canal is not in use for systems B & C.

The tunnel constructed to convey 34 m^3/S from Ratkinda to Maduru Oya to meet the irrigation requirement of systems C have no additional capacity for the SEDZ. According to the water balance studies a second tunnel has to be dimensioned for a maximum discharge of 24.5 m^3/s.

Design of the tunnel was carried-out to extract possible maximum hydro-power. Optimum diameter of the tunnel was determined, and hydraulic losses computed along the tunnel.

The preliminary calculations could assure a small hydropower station of installed capacity of about 1000 kW ($Q = 24.5\ m^3/s$, $H = 5.3$ m).

Water conveyed to the Maduru Oya reservoir has to be carried under gravity to Senanayaka Samudra. For the smooth functioning of the conveyance from Maduru Oya reservoir, it is proposed to raise the dam crest level and water level by 2 m.

Conveyance of water from Maduru Oya to Gallodai Aru reservoir has been planned with a deep cut canal. Comparison of costs of an open canal in deep cut with those of a tunnel with access canals, clearly identifies the economic advantages of the tunnel.

The optimum diameter of the tunnel

has been fixed at D = 4.72 m, the hydraulic losses determined and it is evident from the simple calculations that the installed capacity of the hydropower station falls around 3000 kW. (Q = 56.0 m^3/s, H = 6.0 m).

For the purpose of conveyance and irrigation of downstream land, an earth dam is proposed at Gallodai. This reservoir acts as a level crossing. The irrigation releases are to be utilised for power extraction. A hydropower station with an installed capacity of about 2000 kW could be envisaged. The power extraction is seasonal and could meet the demand at a particular time. (Q = 8.3 m^3/s, H = 25.0 m).

Conveyance from Gallodai reservoir to the Maha Oya reservoir could be effected with the help of a deep-cut canal or a tunnel. For the purpose of power extraction, the hydraulic head is insufficient.

Water from Maha Oya reservoir (level crossing) is conveyed to Damane ela level crossing by a deep cut canal (L = 3.0 km, Q = 28.0 m^3/s) before connecting to the Rambukkan Oya level crossing reservoir with the help of a deep cut canal of length 0.5 km. For irrigation purposes Maha Oya L.B. Canal originates from Maha Oya reservoir and Maha Oya R.B. takes off from Damane ela reservoir.

An earth dam with an ungated spillway is proposed at Rambukkan Oya to create the level crossing reservoir. The irrigation releases from this reservoir are to be used for power extraction. The installed capacity of the hydro-electric station is around 562 kw (Q = f5.0 m^3/s, H = 13.5 m).

To extract power from the discharge of the deep-cut canal connecting Rambukkan-Magalavatavan reservoirs, and make use of the maximum hydraulic head available, a hydropower station was introduced. As means of conveyance, it has been found that a tunnel is less costly than a deep cut canal. The installed capacity of the proposed power station is around 816 kW (Q = 17.0 m^3/s, H = 6.0 m).

From Rambukkan Oya reservoir a tunnel is proposed to the Senanayake Samudra for Irrigation and Power.

At Magalavatavan earth dam, the irrigation releases to the R.B. and L.B. canals could be utilised for power extraction. Hence, a proposal is made to extract power and then to allow water to canals. Installed capacity of the station is in the vicinity of 3000 kW (Q = 34.0 m^3/s, H = 20.0 m).

NWDZ Conveyance System

The North West Dry Zone conveyance is meant to irrigate land in Mee Oya basin with diversion from Bowatenne (water would pass through Polgolla tunnel to Ukuwela power station, where it would be discharged into Sudu Ganga, a tributory of Amban Ganga which flows into the reservoir at Bowatenne).

In fact, under fixed diversion policy, no additional water for NWDZ will be taken out of the Mahaweli Ganga at Polgolla. Rather, water diverted for use in systems D and G will be replaced by the inflows of the Kalu Ganga, and thus released for transfer to the NWDZ.

It is proposed to create a reservoir at Moragahakanda, on the Amban Ganga immediately downstream of Bowatenne in order to regulate the river and to provide more water to NWDZ.

A second tunnel has to be driven from Bowatenne for the water to be discharged into Dambulu Oya and flow to Kalawewa.

The left bank canal from Kalawewa built to serve the system H scheme in the Kala Oya valley, which extends as far as Mahakatnoruwa tank, a distance

of 27 km, would be enlarged or in places duplicated to carry water to the NWDZ.

Water from Mahakatnoruwa tank for NWDZ would be carried to the nearby Kudakatnoruwa tank by a short section of deep-cut canal.

A short distance south of Kudakatnoruwa tank, the NWDZ conveyance canal would cross the Siyambalagamuwa Oya and then turn to follow a westerly route to Galgamuwa tank. The distance of Kudakatnoruwa to Galgamuwa canal would be 11.5 km.

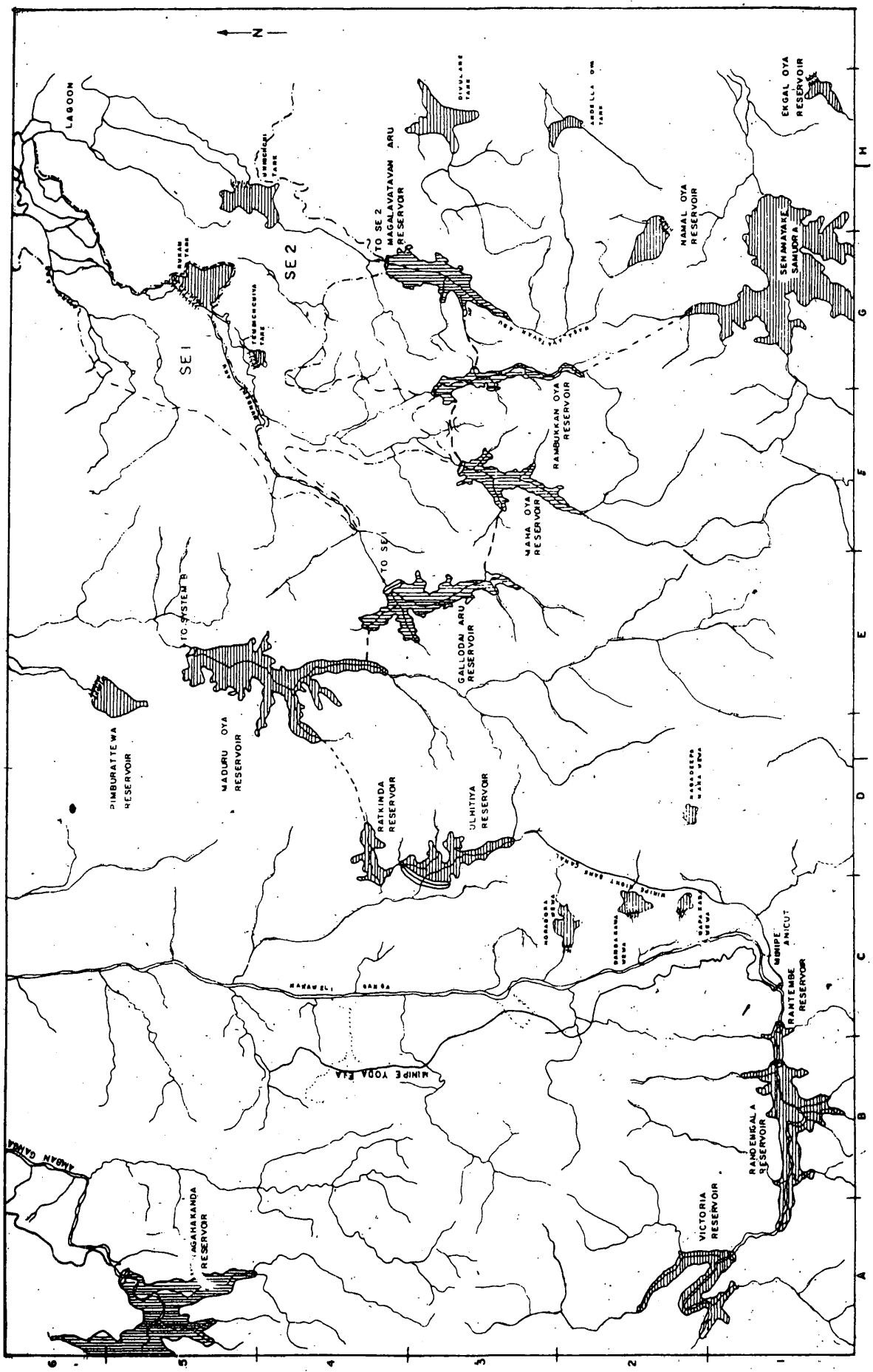
Conclusion

In a water resources development project, conveyance canals, tunnels, reservoirs etc. should be located and designed to extract the maximum power possible from water.

An attempt was made to design canals and tunnels to locate hydropower stations for extraction of power and the total installed capacity of stations approximately amounts to 10 MW.

Extraction of hydropower may enhance the economic rate of return of the project.

This could be a golden opportunity for the inhabitants to have electricity, otherwise deprived due to heavy expenditure required for long transmission lines.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