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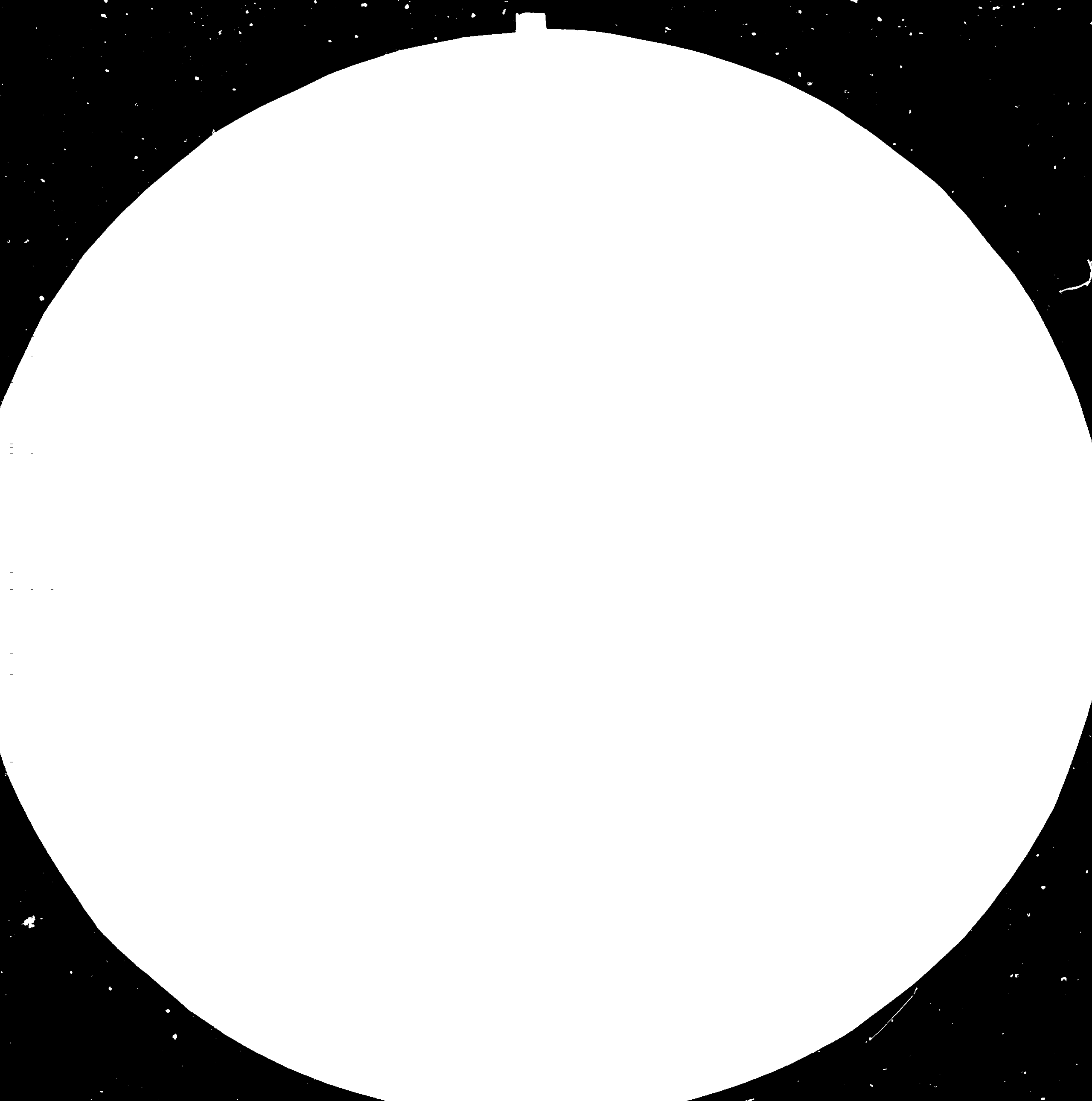

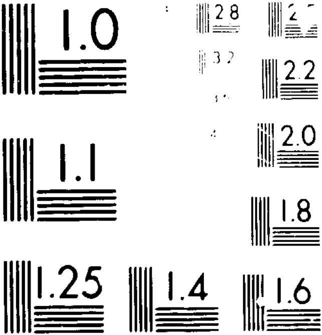

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SMALL HYDRO POWER DEVELOPMENT,

The Democratic Socialist Republic of Sri Lanka*

by

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1. Sri Lanka is a tropical island with a land mass of about 25,300 sq.miles. It is subjected to two monsoons; the South West monsoon prevailing from April to September and the North-East monsoon from October to March.

2. The area subject to the S-W monsoon covers about 20% of the total area whilst the balance 80% receives the N-E monsoon. The former is partly influenced by the N-E monsoon as well, and the average annual rainfall in the S-W area is about 95 inches whilst in the N-E it is about 57 inches.

3. The two primary factors which determine hydropower potential are rainfall and altitude.

The following are the land areas in the island at different altitudes:-

	Monsoon areas in sq.miles.	
	S-W	N-E
EL 4000	500	400
EL 1000	1800	3000
EL 500	3500	12000

Above EL 4000, flows are small and storages are very limited and expensive for power development. Below EL 500 the topography flattens and the river gradients are too small for this purpose.

4. So it is the area more or less between EL 4000 and EL 500 which can be counted on for power. Of this too, it is the S-W monsoon area which receives practically double the rainfall of that in the N-E and is the zone most suitable for power development. This is about 3000(3500-500) sq.miles and it is only 12% of the total area of the island. Most of the precipitation in the other zone gets evaporated, and thus very little can be achieved there by way of power production.

5. Hydropower schemes are broadly categorised into two types - independent and subordinate. The former are those where water releases are not regulated by any other purpose while the operation of the latter are subject to releases of other interests like irrigation.

6. There are 12 hydropower schemes in Sri Lanka of the 6-200 MW range in operation and under construction managed by the Ceylon Electricity Board. Of these only 4 are independent schemes and the others are subordinate schemes associated with irrigation projects. Of these two are 6 and 10 MW located below EL 500 installed at the irrigation sluices. There are many irrigation sluices in operation, but the installation of power units at these sluices has posed a problem now, because provisions for such installations had not been made when they were constructed. So in the present context it is very necessary that the power production aspects should be considered when new irrigation sluices are constructed.

Mini Hydro Power

7. In 1930/40 there were some hundreds of mini hydropower plants (MHP) operating in the plantation (tea) sector. But since 1950 with the introduction of the large public sector hydropower schemes which are managed by the CEB, most of these MHPs were abandoned which is now considered, rather a shortsighted action of the past. The present policy is to give priority to the restoration of these plants. But the public sector hydropower is cheaper than the power from these MHPs because when pricing electricity, the costs of power from old hydropower stations have been integrated with those from new stations. So if MHPs are to be developed some financial assistance and incentives like tax concessions should be provided.

8. The Ceylon Electricity Board's policy is not to undertake the construction and operation of MHP range plants. It will offer consultation services towards the development of these power plants and check whether they will be affected when the other hydropower schemes are constructed. Other Government corporations like those operating in the estate sector and private enterprises are encouraged to develop MHPs.

In order to show them the know-how the CEB has constructed a 35 kw MHP with a head of 20M at Kegalle by the side of a main road.

Small Hydropower

9. The CEB's main concern at present is to concentrate on the Small Hydropower (SHP) development. There are about 30 to 40 identified schemes in the range of 1 to 20 MW range. Though these schemes are small, the effort needed to get through one of them is not all that small. The Nilambe Hydropower Scheme which the Chinese Government has undertaken to construct on an aid programme for the CEB is a scheme in this category. The Scheme is of the division type with daily regulation. The design head is 110 M, the power discharge 3.6 m^3/sec. Total installed capacity 2 sets of 1.6 MW = 3.2 MW and the yearly energy output is about 15 Gwh. It is considered that active Sri Lankan participation in this project with the Chinese will help in the development of other SHPs a great deal.

Economic Viability

10. The economic viability of Mini hydro schemes is very interesting to go into. When they are considered as a source of power in the CEB's power system, they cannot be taken as independent sources of power by themselves. Their contribution to the power system should be studied along with other sources of power in the system.

11. Sri Lanka's hydropower system supported by reservoirs requires about 30% thermal standby to meet dry weather shortages in the hydro system and mini hydro (new stations) as most of the streams have very little flows or no flows in the dry season.

12. See the illustration, for example with a major hydro installation of 900 MW and mini hydro 50 MW. It shows that in the wet season there is an excess thermal capacity of 350 MW. (made up of 33% of 900+50).

13. Mini hydro plants are run of the river plants and most of the streams in Sri Lanka have practically no flows for power generation in the dry season - 6 months in the year. So their contribution to power generation is only in the wet season when 350 MW of thermal installation will be available.

14. As this large excess thermal installation is available in the wet season, the economies of mini hydro depends on the cost of a Kwh unit of mini hydro as against the fuel cost only of a unit of thermal power. Present day fuel costs of a Kwh unit are in the region of: gas turbines Rs2.25, diesels Rs1.50 heavy diesels Rs1.00, steam oil Rs1.20, steam coal Rs0.70.

15. As the CEB's power system is to go in for coal power generation in a big way in the 1990s, a Kwh unit from a mini hydro plant will have to be less than the cost of a pound of coal 6000 Kcal/Kg required to produce a Kwh unit. That is at today's prices it is about Rs0.70.

16. Following this economic picture MHP is not an economic proposition at today's fuel prices, but the MHP installed today could become economical at a future date when fuel prices rise.

17. For independent MHPs in a remote village where the CEB power supply is not available, a stand by diesel of the same capacity will have to be provided to work during the dry season which is practically one half the year. In remote villages in Sri Lanka where CEB power is not available, there are invariably no substantial flows in the streams for the purpose of power development.

18. Civil Engineering

There is ample civil engineering expertise in Sri Lanka to develop mini and small hydro power schemes. What is badly lacking here is management and finance. It is because of these aspects that foreign teams come in to do these works. It is not considered that any advanced technology has to be applied to these developments. Much can be achieved by way of cutting down costs in civil engineering if schemes are well planned and the construction teams are properly organised.

19. Electro-Mechanical Equipment

Demand for electro-mechanical equipment associated with Mini and small hydro power schemes are not big enough for Sri Lanka to go in for research and development and manufacturing in this field.

20. In this case China and India where manufacturing skills and cheap labour are available should be able to assist the other countries in the region by supplying equipment at low cost. It is very important to have equipment of robust, simple construction to minimise maintenance costs. Plant efficiency of these small machines is not all that important.

2 . I have to point out here that the Chinese and Indian equipment work well in their own countries, because they have the expertise and organisation for prompt attention to repair. It is not so in other countries where such facilities are not available. Therefore it is more important to think of robust and simple equipment rather than plant efficiency.

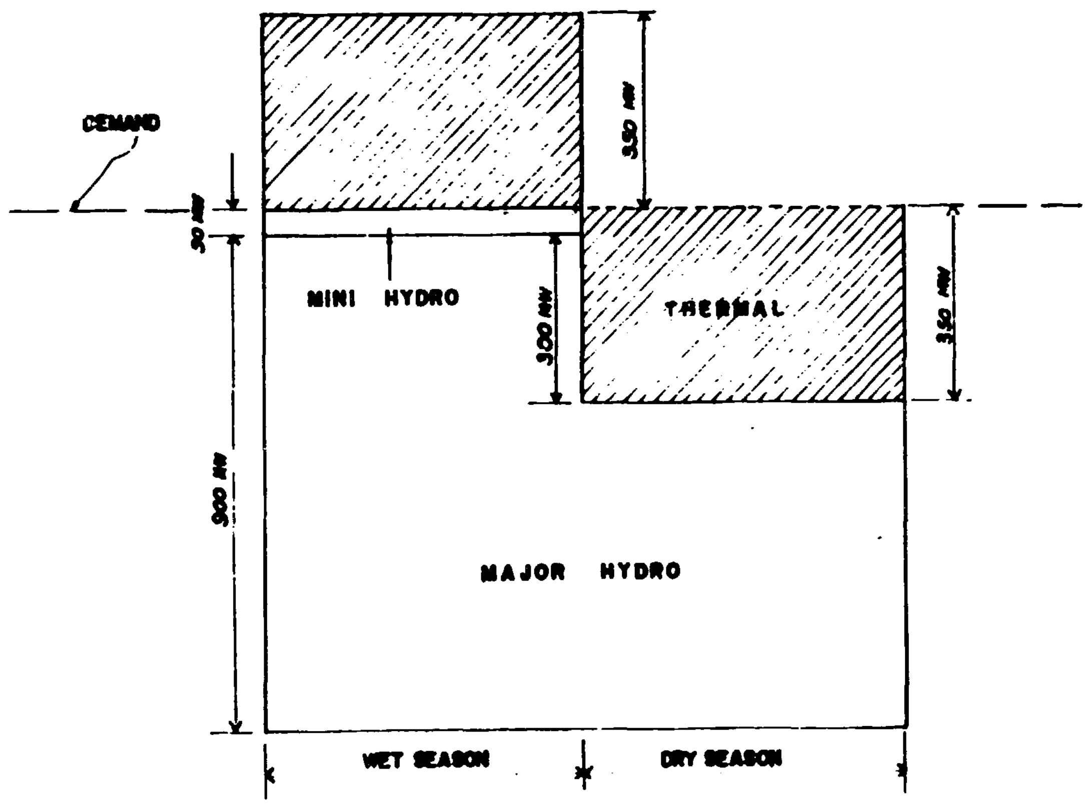
22. Some manufacturers may claim that their small machines have a better efficiency than others by 1 or 2%. But due to inferior workmanship and lack of spare parts if they have to be kept shut for months or sometimes years, their purpose is negated. The small turbines of British manufacture installed as early as 1920/30 which were not dismantled are still running well. They may not have a high plant efficiency but that is the type of machine required by us sturdy, reliable and trouble free.

23. In fact the most important draw back in the promotion of mini and small hydropower development today is the high cost of electro-mechanical equipment. It is in this respect, as has been suggested here, that China and India could play a great role in assisting the countries in the region by providing them with low cost reliable machines.

INSTALLATION	HYDRO		900MW
	MINI HYDRO		50MW
			950 MW
	THEMAL REQUIREMENT IN DRY SEASON	$\frac{900}{3}+50$	350MW

		WET SEASON	DRY SEASON
POWER AVAILABILITY			
	HYDRO	950 MW	600 MW
	THEMAL	350 MW	350 MW
		1300 MW	950 MW
DEMAND		950	950
		350 MW	0 MW

RESERVE POWER 15% IS NOT USED HERE TO SIMPLIFY CALCULATIONS.



ROLE OF MINI HYDRO IN SRI LANKA'S POWER SYSTEM

CEYLON ELECTRICITY BOARD
E. CARLO FERNANDO
17. 05. 88