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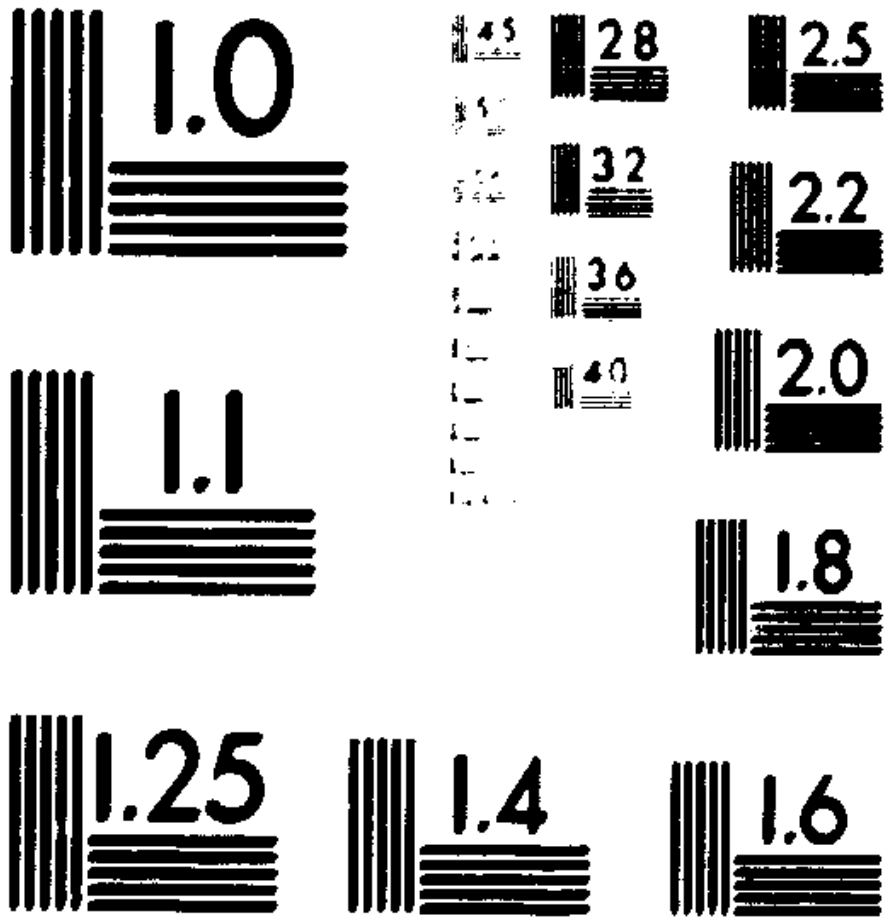

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COUNTRY PAPER: SRI LANKA* (small hydropower)

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1.0. Introduction

Sri Lanka situated between the Lattitudes of 6°- 10° - North and Longitudes of 80° - 82° - East is characterised by geoclimatic fratures of central hills rising over 2500 m with steep slopes providing drainage basins for around 100 rivers, to emanate in association with areas of annual rain fall of over 5000 m.m.. However the average annual rainfall varies between 2500 - 4000 m.m. in the dry and the wet zones respectively. These and many other factors such as large irrigation projects have lead to the development of many of our hydro resources. For the past few decades hydro power constituted a major resource adaptable for both mini and major type of development. The realisation of this fact is and was the primary consideration of our country's effort towards the development of commercial energy through the exploitation of indigenous resources for its economic activities.

With the development of our tea industry and rubber industry which are two of our major foreign exchange earners mini-hydro power plants were developed. Most of these plants were used to provide motive power to almost all our tea factories and a good number of Rubber factories. Some of these were used to produce electricity for useage in the factory and staff quarters in the estate. Almost all these plants were erected in the pre-independence era and most of it came from England. Most of these plants dates as far back as 1920. These Mini Hydro (you may even call them Micro Hydro) power facilities of the pre-oil era were simple yet rugged and took advantage of the characteristics of the terrain in locating the factory and the power plant as a single unit where harnessing of maximum power potential was not the primary consideration. They proved their effectiveness over time though were less efficient compared to present day developments and required minimal maintenance and not too highly qualified or trained staff for their erection, operation and maintenance.

This time proven technology which successfully made it possible to harness an inddigenous resource, unfortunately was displaced by the then cheap fossil fuels. Subsequent development of hydro power under major hydro power development projects and the extension of the national grid network to these agro industrial areas was responsible for the 2nd stage of displacement of the oil fueled Prime Movers by electric motors. Although this amounted to the useage of an indigenous resource Viz. hydro power, it still deprived the country of harnessing the mini-hydro potential to added economic advantage. The second stage of displacement to some extent had been the result of a short sighted policy consideration applied at a time of cheap and abundant energy which prohibited the use of grid electricity as a stand-by supply, to other forms of energy delivery.

In recent years as a consequence of the rapidly rising imported fossil fuel prices and very high costs associated with the development of major hydro facilities and extension of the national grid network and the long lead time required for such activities, development of small and mini hydro - power potentials are receiving considerable attention in Sri Lanka.

In the national plans and policy approaches for the energy sector development mini-hydro development receives high priority and the present development effort is concentrated in the following.

(a). Revival of those abandoned mini-hydro power facilities in tea estates where most of the equipment and structures of the original facilities are yet in existance in fairly good condition.

(b). Revival of other sites where high power and energy potentials are available.

(c). Identification and development of potential mini-hydro sites as applied to

i. Stream and river flows.
ii. Irrigational water releases from major irrigation tanks and sluices.
iii. Irrigational canal flows and canal drops.

There is growing awareness of the need and relevance in the development of the Mini-hydro power particularly for the agro industrial sector. The country also accords priority to mini-hydro power development, yet the progress achieved so far has been rather insignificant. The primary reason for this is the lack of adequate resources. The implementation of a large number of mini-hydro projects scattered in many remote parts of the country, demands the simultaneous development of all available resources. The popular concept that mini-hydro is small and therefore manageable could not be accepted as it would still make demands on all the different types of expertise, materials, trained personnel etc. in quality though not in the same quantities as in a major hydro power development project. For mini-hydro to make any impact in any country's energy scene a large number of mini-hydro projects will have to be considered for implementation within a given short span of time. In such a situation the demand on a country's available resources would indeed be beyond the limits of attainability.

Sri Lanka's already scarce financial, materials, and trained man power resources are committed to the major multipurpose power and irrigation development projects under the accelerated Mahaweli programmes. Even if financial resources could still be found for well conceived cost effective project proposals, yet the acquisition or the development of the man power resources needed for their implementation would indeed be a difficult task to accomplish in a short time span.

This paper outlines many such priority areas which needs an immediate and sincere attention if SHP development is to survive. If not we are neglecting this once a vital source of energy in our region for more superior, sophisticated, capital intensive source of energy.

2.0. Priority subjects to be addressed :

The establishment of the Regional Network for Small Hydro Power in itself underlines the necessity for co-orporation and dissemination of information for development in our region and the respective countries where small hydro power activities are concerned. The vital areas of dissemination of information could include the following.

a). Emphasis on Training Courses to develop human resources.
b). Manufacturers and suppliers of SHP equipment in the region.
c). Encouragement and incentives for the publication of all R & D activities already accomplished in the region.

2.1. Education & Training Needs :

Education and training needs steam from the national goals objectives and aspirations and the scope of activities that has to be undertaken to realise these goals and objectives. Such activities and parameters for consideration with regard to the mini-hydro power development would encompass.

a). Identification of potential sites.
b). Collection and analysis of hydrological topological and geological data.
c). Power and Energy potential evaluation.
d). Diversion dams and storage facilities.
e). Intake structures and water conveyance systems.
f). Penstocks and surge tanks.
g). Turbines and generators.
h). Speed, load and voltage control equipment and protective gear.
i). Power house and ancillary equipment.
j). Energy supply and demand features and load despatching equipment.
k). Cost benefit and other economic considerations financing mechanisms.

l). Construction management.

m). Operation, Maintenance, trouble shooting and overhauling.

n). Social and environmental aspects.

Mini hydro power generation is highly site specific to be viable technically and economically. The particular site that would provide maximum power potential may not necessarily be the site acceptable on optimum cost benefits. Mini-hydro stations could be located on small streams, at canal drops, anicuts, at head works of irrigation dam sites etc. Preliminary field data such as flow details, available head, load centres in the vicinity, existance of power lines etc. will be useful in the identification of potential sites before attempting any detailed investigation.

Collection of flow data and assessment of yield is essential for the successful development of mini-hydro potential. In cases where these data is not available which is true of many cases assessment of yields by correlation of rain fall and run off, or use of empirical relations or the adaptation of data from similar catchment, etc. may have to be resorted to. River or stream gauging may become necessary. Flow duration curves for a good bad and average year or a representative year could be constructed from daily flow data collected over a sufficient length of time.

Topographical surveys covering the areas required for Head works, water conveyance systems, Power House and Tail Race are required to provide the ground features etc. In canal drop type of mini-hydro schemes upstream and downstream water levels, flow profiles, cross sectional details of canal bed with slope etc. are needed. For the collection of these details survey and levelling techniques in the civil engineering practice will have to be deployed. Head and tail race water elevation for various discharge, sumberging areas, capacity curves, gross head availability etc. will have to be worked out.

Detailed geological exploration as in major hydro schemes is not warranted in most mini-hydro schemes. However basic knowledge of the geology would be helpful in deciding the location of the dams water conveyance systems and Power House etc.

Basic engineering knowledge will be required to compute from the data collected, the power and energy potential available from a particular mini - hydro site. The analysis of the information will also provide the basis for deciding the number of units that would be fixed, although the present trend is to adopt a single unit.

Basic knowledge of the types of turbines, generators, control mechanisms and their characteristics, capabilities, advantages and disadvantages etc.are important considerations for education and training. Different types of dam structures selection criteria for local and alternate materials that could be used in construction, design of intakes, water conveyance systems surge tanks, penstocks, use of appropriate and alternate materials and special design considerations for the penstocks etc. are other areas where enhanced knowledge and understanding is required to be provided to undertake mini-hydro programmes successfully.

The success and the economics of a mini-hydro scheme in a remote location wouod depend on the load demand characteristics of the area serviced and to the extent to which the proposed scheme could satisfy these load requirements. Therefore careful assessment of the present and the future power and energy needs of the area will be required for the proper planning of the scheme and also for phasing out of the development in steps to make use of the resources to the best advantage.

Mini-hydro schemes with small or daily service type of storage, water availability and the energy requirements will have to be matched so as to be able to meet the demand in the best possible manner if very expensive alternative energy options are to be avoided, which could negate the whole economics of mini-hydro generation. The engineering knowledge that has to be imparted should therefore essentially cover the improvement of the abilities of the individual to successfully resolve such challenges in planning.

Basic knowledge in principles of economics, statistical analysis, computer modelling etc. are other areas of specialisation in planning and programming of mini-hydro power. The ability to evaluate a proposal on mini-hydro on its long term cost benefits is a fundamental requirement for the securing of the necessary finances from lending agencies etc.

2.2. Manufacturers and Suppliers of SHP Equipment

The feeling which is prevelent in most of our planners still which presumably is inherited by us from our colonial rulers, being that the best performing equipment can only be imported from developed countries is not only a myth but hazardous for the successful implementation of an effective SHP development project. It would be true to say that this was the case some decades back when the local industries in this region was at its infancy. There is sufficient evidence to believe that at present local manufacturing industry of small machinery has reached full maturity for us to be able to compete well with these high cost, high technology equipment from the developed countries. It would be unwise to state here that these equipment are redundant but the fact should be emphasised that each piece of equipment should be evaluated on its cost effectiveness.

The above should always be complimented with a proper alternative suggestion of encouragement, provision of incentives and popularisation of local machinery. Without such scheme to popularise, advertise and market the SHP equipment that could be produced locally the results may be discouraging. Hence the necessity for a proper scheme to popularise advertise and market these equipment is inevitable.

Popularisation could be achieved by demonstration. This could be done by Government sponsored projects or projects sponsored by an international funding agency, always using well proven technologies with simple, unsophisticated parts that could easily be substituted or manufactured by a local craftsman.

The advertising and marketing facilities would evolve with the popularisation effort and this could further be supported by distribution of brochures, news bulletines, and popular magazines.

2.3. Dissemination of R & D effotts :

Much effort is being wasted in this aspect mainly by duplicating the work carried out by already established organisations geared for these activities. On the other hand less R & D work is being undertaken in certain areas of SHP development such as cost reduction techniques, effective technologies and adaptability of already existing technologies.

The other aspect of R & D activities in the region should be to encourage the researchers to do much wanted and relevant research work and proper dissemination of this work henced it is very important that all research organisations be identified firstly under the RN - SHP sub focal points then also under the RN - SHP itself. It would be a worthwhile effort to coordinate these activities both at national level and at regional level and all the activities be properly documented so as to give wide publicity to such worthwhile activities and to encourage other users in the region the facility of availing themselves of the latest technique and technologies thus developed.

3.0. Research Project

High priority area in the region could be classified as follows :-

a). Simultation of climatological condition.
b). Remote controlled and un-attended operations.
c). System cost optimisation of SHP.

The above three priority areas are to a great extent interrelated to each other and needs greater attention in our future SHP development activities.

3.1. Simultation of climetological conditions

This is one of the most unreliable parameters of the design of a proper SHP project but nevertheless one of the most important in the whole exercise of the design. In almost all the cases of sites selected for SHP development it has been observed that the rain-fall patterns, river-flow data are very scarcity and unreliable. Nevertheless the designs will have to adopt some criteria of flow duration curves and other required data. Hence the need for the development of appropriate mathematical models or empirical relations is very essential. The development of such a programme is extensively dealt with under section 2.1 and it need be only emphersised here that this aspect has to be given much needed coordination by our eminent researchers in the region both in the organised establishments and in the Universities offering hydrology as subjects.

3.2. Remote controlling and un attended operations

It is our experience that many SHP projects fail to materialise for / the lack of available trained personnel to handle such projects and also for operation and maintenance of these plants. Many of the plants now abandoned or ruined are due to this fact. Therefore it will be a worthwhile exercise to focus our attention to the remote controlling facilities. Taking advantage of the fact that these SHP schemes could be connected to the National grid or could form themselves into local mini grids the possibility of remote controlling and centralised operation could be considered.

Telemetering and remote controlling has been in operation in our countries for sufficient length of time that the experience gained and the expertise developed is available. It would be only necessary to develop clusters of SHP projects to form themselves to be centrally operated by a few skilled and trained personnel. Thus eliminating numerous problems associated with the lack of trained personnel who are in most cases unwilling to serve in remote areas. It should also be mentioned here the advantage of eliminating all associated overheads involved with staffing a manned power plant.

3.3. System cost optimisation of SHP

This is one of the least addressed subjects in the field of research in our region. It has always been the case for some one other than the designer to evaluate the project where cost effectiveness is concerned mainly for funding purposes. The need for closer understanding of the cost VS. the design parameters is a pre-requisit for cost optimisation of a such project. Ready reconners and computer models should be developed and in cases where it is already developed it should be modified wherever possible to correlate the design parameters of the system with the cost and economic parameters.

The expertise available in our countries could be well utilised for the development of such econometric models to run on micro processors or results of such runs to be made available to our designers as ready reconners.

4.0. Country Specific Projects

Several projects which could be carried out within the country by taking a leading role could be identified as follows :-

a). To act as a focal point for information dissemination.
b). To scrutinize and forward suitable candidates for proper training within the guidelines set out in the section 2.1.
c). To coordinate activities of fellowship receipients
d). Organisation of seminars, meetings and workshops on SHP.
e). Monitoring on hardwear development effort.
f). Market penetration studies.

The above is a list of possible areas of corporation within the region but with our country's participation in taking a leading role. The above subjects are dealtwith in a preceeding section and need not to be ellaborated here. It should however be emphasised here that with the on going major development works being undertaken by the government at present it would be difficult to raise funds for such activities other than the services offered by personnel already employed in governmental institutions dedicated for the development of SHP activities.

5.0. Personnel and Organisations involved in SHP activities.

A survey is being carried out by the Ministry of Power and Energy to enlist ¨xperts, consultants, engineering companies, equipment manufacturers and civil works construction companies who could possibly take part in SHP development activities. This survey is still in progress and results are expected to be available in a very short time. Once a comprehensive list of the above is compiled it could serve in the selection onon personnel and organisations dedicated for SHP activities. The organisations which used to erect and maintain the already existing mini hydro plants in the country will be the main organisations to take a leading role in the future SHP development activities too.

6.0 Conclusions :-

The creation of the regional net work for small hydro power is to focuss attention where SHP activities are concerned. The effective link established through these organisations will in the future be the nervous system that would nurture the development of all future SHP development activities. To this end the Sub-focal point in Sri Lanka could play a major role in the future activities of the RN - SHP.