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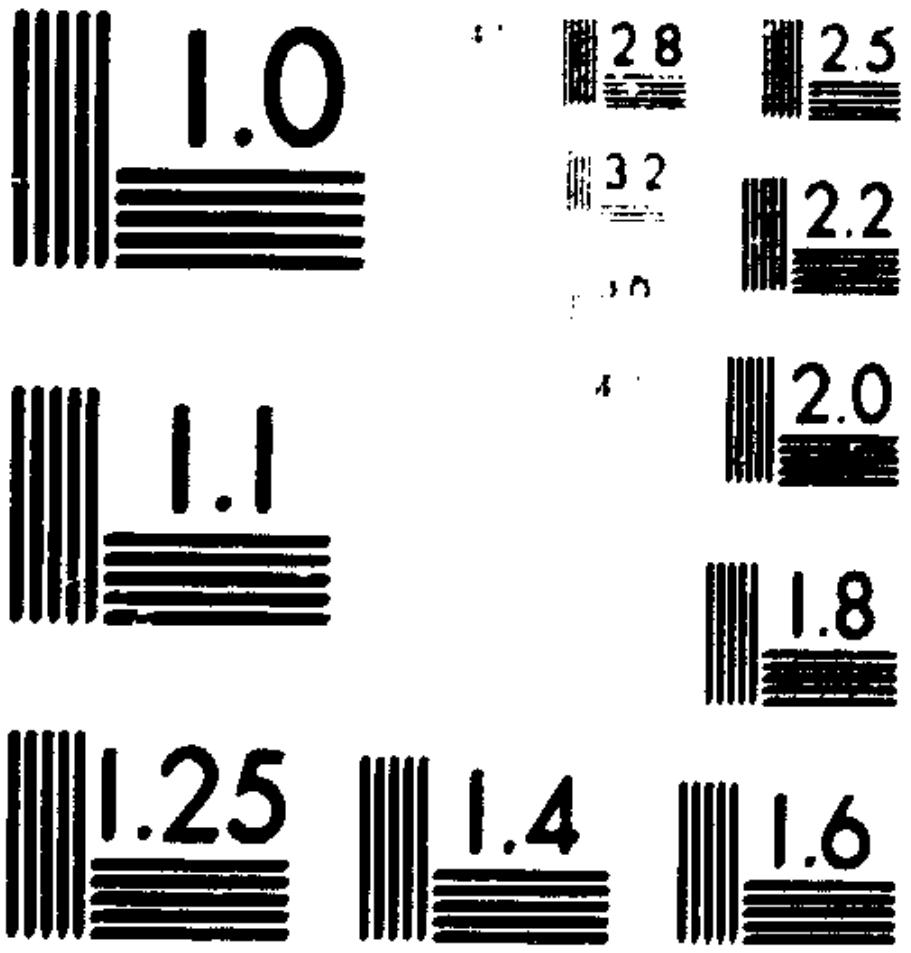

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Joint UNDP/UNIDO/ESCAP/China Senior Expert
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System and the Assessment of Priority Needs on
Research Development and Training in the field of
Small/Mini Hydro Power Generation

Hangzhou, P.R. China, 12-17 July 1982

COUNTRY PAPER - PAKISTAN *

by

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** Appropriate Technology Development Organization, Islamabad

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Introduction:

Energy furnishes a base and lends impetus to the pace of development and improvement in the quality of life; its availability in the needed form at the "selected time, place and convenient cost" is fundamental to its utilization.

Energy has now joined the classic factors of production; in fact, it is needed for any kind of growth. The process of economic growth is traceable largely to substitution of "energy-slaves" for muscle power. And the gap in living standards of affluent and developing countries can partly be related to inequities in energy supplies i.e. quantity of energy available and efficiency use.

Alternate Sources:

The staggering rise and tree-top stability in the price-level of fossil fuels and the fluctuation in production ceilings combined with prognostications of impending finiteness of resources, have made search and research for alternate energy resources — including retrieval of traditional technologies submerged by the eerie era of cheap and easy oil availability — a pre-requisite for survival and progress. The small may or may not be 'beautiful' but some total of 'smalls' can be quite useful in this context.

Small Hydel — A Desirable Option:

The small hydel plant based on "free" water power is a very desirable option for remote, geographically discouraging but suitable locations for a number of reasons :

(i) The people living in the remote and difficult terrain have

really not benefitted even from the trickle-down effects and deserve to be retrieved from past neglect.

(ii) The historical approach in energy planning i.e. expansion of large-scale, centralised systems, has created problems of unequal internal growth and disintegration of rural and non-commercial sectors.

(iii) The course of development influences behaviour of income distribution pattern while educational expansion in developing countries has not had very beneficial results in equitable income distribution; inequalities in household income — and remoteness from technology centres — are apt to be reflected in the learning outcomes. Hence, stimulating small agricultural and industrial enterprises would considerably increase employment creation (without negative effect on economic growth), awareness needs and desire/struggle to improve, beyond historical fatalism.

(iv) The renewable energy depends on energy "income", not as 'depletable capital', and constitutes both, an "input" and "output" of the development process. Indeed, the impact of small hydro power projects is over-proportional to the amount of energy (only) supplied.

(v) The technological progress in developing countries is greatly influenced by trickling down and adaptation of results elsewhere. The high cost of capital and limited risk-capability constitute severe constraint to experiment with science and technology — without reference to 'glamour' pressures of imports, which also hinder indigenous efforts.

Hence, there is continued need for optimal utilization of all energy sources, for sometime to come.

(vi) Experience with small-scale technologies in development strategy has borne out their usefulness alongwith insufficiency of its magnitude to propel faster modernisation.

The areas favoured by nature with small/mini-hydro potential are generally languishing in the past and need this transition phase to 'emerge' on the national scene to make their contribution in national development in a locally 'self reliant' manner.

Country Experience:

In Pakistan, the work on high head-low discharge near-perennial water falls has captured the fascination of the people; the acceptance has passed the teething phase and this power is now recognised as a practical, viable mode of cheaper light and motive power in the far-off "pocket " settlements.

40 micro hydel units, with total capacity of 340 kw (Av: = 8.5 kw) have been installed during the last 6-7 years providing light to 1150 households besides motive power for 39 small industrial units. Starting from a skeptical stare prompted, interalia, by "newness" of technology, the demand has now outpaced the outreach facility; in the process, some socio-cultural trends are perceptible i.e. more safety, longer working hours, better studies etc. as also use of ceiling fans, heaters, radio and television, irons and sewing machines which represent quantum jump in exposure to modern technology. The spirit of cooperation in the community has almost imperceptibly been enhanced. The change of

pattern is not without trail of micro problems in certain traditional occupations now under threat of extinction which necessiate change of 'skills' for survival.

Technology & Change:

There is no immunity from technological change, though technology may have no mind and will of it's own. However, it possesses its own latent determinism while it is conceived, created, applied, learned and transmitted by people according to their value-systems etc. It has inescapable socio-cultural implications which need to be eased and gradually attuned to local skills, socio-cultural acceptance and local constraints.

Accordingly, the following itemised points are for consideration:

1. Concept of Regional Network system on SHG - MHG activities and application in the member countries of ESCAP Region.

The time has come, not too early, for a Regional Centre to be established in this technology. Because of geography, besides other reasons, this form of energy may well be the only vaible one in its area.

The concept could incorporate following activities:

A. Clearing House:

(i) to document state-of-art;

(ii) to arrange data-flow i.e. constant exchange of information on problems, possibilities and development of this technology;

(iii) to maintain liaison with international, regional and national network/focal points.

B. R + D Coordination:

(i) to screen technologies in use in industrialised countries and/or emerging around the world for scope of adaptation in the Region – also including retrieval of overlaid ones for upgrading/adoption;

(ii) to coordinate R+D studies, analysis and reporting of experiences, including socio-cultural ones.

C. Dissemination:

(i) to organise specific symposia;

(ii) to organise/exchange visits of experts;

(iii) to organise training courses between/among countries of the Region.

D. Services:

(i) to provide advisory/consultancy services;

(ii) to organise studies on (a) institutional aspects e.g. involvement of government, community etc. (b) socio-culatural aspects and problems; (c) optimal utilization techniques of small/mini hydel energy available.

The literature about this technology alongwith others, is finding place among many publications and hence is likely to be submerged in the process. The Regional Centre could initiate a regular periodic publication specifically and entirely devoted to this technology and issues allied to it.

2. List of Actual needs for research and development in the field of SHG - MHG at the national level.

The small (micro) hydel activity in Pakistan has been confined to high head-low discharge situations mostly in power range of 5-20 kw by exploiting only part of run-off volume due to low initial demand.

Over the period, the supply and potential have contributed to enhanced awareness for demand, and release of desire for improvement in the quality of life has now started to exert pressure for greater availability, both in number of sites – more than 50 sites are already identified, awaiting installation – and potential at each site.

There is thus a definite need to evolve appropriate technology for high head-medium/high volume situation in the next phase of 25-100 kw range. The entire scope is not surveyed but there should be potential of 150-200 MW in this field.

On the other hand, there are about 4000 water falls in the canal network of irrigated (Command) area. These falls represent a situation of low head-high volume; the available head tends to a mean of 6 ft. (about 2 meters) and volume in the range from 100-5000 cusecs. The likely exploitable potential in near future would be at least 50 MW. It would be desirable to initiate the activity with sites of potential upto 100 kw.

Thirdly, there are mountain streams in the country with water available almost the year round, the velocity of run-off pretty high (more than 1 meter/second) and varying level of water in the channel with season – alongwith velocity adjustments.

The topography of these areas needs pumped water, 50-150 ft. above water level, to irrigate terraced lands, besides electricity for lighting and generally motive power for allied small industrial activity.

Water wheel has been an old approach with limited success and utility. The economic potential of these areas could be tremendously enhanced if "run-of-stream" (i.e. zero-head) could be exploited to generate power. The I.T.D.G.London have recently reported experimental development of a turbine for the purpose, which operates viably at minimum water speed of 1 m/sec. and depth of 1.5 - 2 meters.

Keeping these situations viz high head-medium/high volume, low head-high volume and zero-head,in view and recognising the built-in constraints i.e. unpredictability of load factor/load growth and difficulty of standardising the equipment; we in Pakistan feel the need for following R+D. (Turbine is locally fabricated while local fabrication of alternators is under feed-back improvements at R+D stage.).

A. Turbine (Runner):

(a) Optimisation of dimensions and design for given head and discharge for maximum efficiency (i.e. with or without central shaft, uni-or-cross flow etc.).

(b) Fabrication Parameters:

Cost reduction by use of indigenous materials, silt quantum and its effect in low head-high volume situations and assembling techniques.

(c) Maintainance/Easy Repairability.

B. Generator:

(a) Optimal local fabrication to economise cost and

scarce foreign exchange.

(b) Reliability of performance and easy repairability.

C. Penstock :

Materials of construction, and optimal use of indigenous, (site-specific) materials.

D. Frequency Stabilization:

Drop in frequency (and voltage) can endanger dynamic loads while drop in load/consumption i.e. higher frequency and voltage, may threaten static loads.

R+D study is required to evolve economic solutions viz penstock-intake flexibility, coupled with bye-pass facility and consequent civil works or use of ballast to resotre balanace i.e. load control or flow control method and parameters of each.

The R+D options may include the feasibility of use of governors as well as probability of recycling ballast heat.

E. Day-Time Operations:

Use of motive/electric power by multi-belt shafts for small industrial activity closer to site.

Usually, two situations would seldom be identical, yet technology has to suit local constraints, local skill-levels and costs.

The activities must incorporate social scientists to give appropriate attention to the socio-economic factors in the indigenous cultural settings for motivation, acceptance, adoption, and operation/maintainance of this technology. We feel that R+D would be best carried out in the country of origin/need. However, a closer collaboration with the Centre

and through it with member countries of the region, would be very useful beginning. It would benefit all parties and help eliminate repetition.

3. List of actual needs for training in the field of SHG-MHG at national level.

The training needs would encompass the entire spectrum flowing from R+D as the technology and techniques to be adopted i.e. from appropriate-scale manufacture of components to installation, operation, maintainance and repairs of the station.

The Regional Centre may retain some broad centralised training programme while most of training would be in-country and the Centre could sponsor and coordinate intra-regional training programmes. Optimum results would ultimately emerge i.e. maximum benefit: cost ratio achieved, if all available power is exploited most productively. This will necessiate subsidiary R+D to evolve appropriate, site-specific technologies to use/recycle local resources in an integrated approach.

4. Suggestions on management and operation of SHG-MHG Regional Centre in Hangzhou.

Besides the general approach lines mentioned at P/2 of the Aide-Memoire and exchange of views about the concept, it may be helpful to look at the performance and progress viz-a-viz the programme of such other set-ups recently created in the UN Network particularly R.C.T.T. to arrive at a practicable profile.