The Provision of Access through the Expansion of Micro Hydro Mini-grids

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- **An introduction to the main issues**

basic hypothesis

micro hydro power schemes
involve a mature technology
that in certain circumstances
can provide "access" to electricity
and motive power
to relatively poor people
on a financially
and environmentally
sustainable basis.

- Why is it not being taken up by the private sector

  - The evidence that micro hydro is financially profitable is not yet in a form investors find credible

  - It is not yet clear what types of infrastructure and institutional support is necessary for growth and sustainability of the micro-hydro sub-sector

  - The value of electricity to poor people may well exceed their ability to pay for it.

- On-going research will try to shed light on these issues.

  - research is being carried out by
    Intermediate Technology
    under contract to the UK Department for International Development
    Part of the World Bank's programme to determine best practice in a number of areas of rural energy development.

    The project leader is Dr Smail Khennas (smailk@itdg.org.uk),
  - Research teams have been established in Nepal, Sri Lanka, Peru, Zimbabwe, and the UK.

- Need to distinguish between policy interventions
  Intended to increase sales of micro hydro
  vs
  Intended to increase the "access" of specific groups of people who are particularly resource-poor or live in remote areas

  Failure to make this clear appears frequently to result in disappointment and to ineffective policy advice.

- "public/private" initiatives.

  reformulating the more long standing arguments over the treatment of "subsidies".

- Micro hydro, like many other renewables, is characterised by
  - high up front capital costs, and low running costs, relative to the alternatives such as diesel generators.
  - economies of scale particularly in distribution and transmission,
  - primary demand is for electricity for lighting, but unlike other productive uses, tends not to generate an adequate increase in cash flow.
  - costs of end-use equipment is always significant, .

- An analytical framework

  - "micro" analysis of individual investments.
  - "macro" level inputs "system overhead costs"

  - existing "conventional" technologies, such as diesel generators, has massive systems already in place
    (often as "sunk costs").

  - A key issue in the current policy debate is the identification of these activities at the macro or sub-sector level and how their costs are to be covered, and by whom.

  - real costs and need to be paid.

- Analytical insight from
  idea of "financial intermediation"

- Consider three additional forms of intermediation,
  - technical intermediation,
  - social intermediation and
  - organisational intermediation.

"win win options" not being implemented to the extent predicted - energy to kick start them?

- *Organisational Intermediation* involves not only the initiation and implementation of the programme, but also the lobbying and policy change required to construct an "environment" in which the technology and the various players can thrive. This will involve putting in place the necessary infrastructure, and getting the incentives firing the right way to encourage owners, contractors, and financiers.

- *Social Intermediation* involved in the identification of owners and beneficiaries and the development of the capacities necessary to take on and run each individual investment project. Social intermediation plays a major part in taking on the transaction costs that communities would have to incur if they themselves were to source, select and contract suppliers of everything from money and to machines.

- *Technical Intermediation* starts up stream by undertaking the necessary R and D, the importation of the technology and know-how, "down" through to the selection and development of the capacities to supply the necessary goods and services (site selection, system design and technology acquisition, construction and installation of civil, electro-mechanical and electrical components, operation, maintenance, Trouble Shooting, overhaul and refurbishment).

- *Financial Intermediation* ranges from the "bundling" of projects together to make them attractive to finance agencies, dealing with the transaction costs of administering loans, assessment and assurance of the financial viability of schemes, assessment and assurance of the financial credibility of borrower, supply of wholesale finance (from aid agencies, governments, development banks), supply of retail finance (equity finance, loan finance), the management of guarantees, collateral ("financial conditioning") and the management of loan repayment.

- link with and between the numerous actors involved in micro hydro development.

- The viability of micro hydo is clearly context specific

    - location of a particular site (is there enough water and enough concentrated "demand") at the micro level of analysis,
    - specifics of the institutional arrangements at the macro level.
      The Enabling Environment and
      The Regulatory Environment
      The context many markets in which micro hydro is to be developed.

- The search is now on to identify and describe the "best practice" and innovative arrangements for dealing with each of them.

- **The case of Peru**
    - successful programmes
    - The main innovation would appear to be the experience of a revolving credit fund, financed by a soft loan from the Inter-American Development Bank.
    - revolving fund by the "intermediary" Intermediate Technology(IT), with resources provided by the Inter-American Development Bank.
    - soft loan of $400,000

- (1% service charge and repayment in 25 years in local currency)
  - a technical assistance grant of $120,000.
- Since its initiation in 1992
  - installation of 15 plant.
  - $465,718 worth of loans
  - Total investment of $1.7m.
  - Plant from 175 kW down to 3 kW
  - (average of 40 kW).
  - Av. Capital cost $2,874 per kW installed
  - Av Capital cost per installation of $115,333
  - Of the 15 loans, 5 were to individuals and 10 were to "municipalities"
  - Village organisations - Comités de Gestión - no legal status to accept loans.
  - Considerable social intermediation to form these pre-electrification committees or other ad hoc organisations to operate and maintain the plant.
  - Sponsors, Intermediate Technology, had to set up a "Credit Operator"

    to provide financial services such as financial assessment of each loan applicant, appraisal of each scheme, administration of the loans and their recovery

    Operated at arms length from technical and organisational intermediation.

    Very high loan repayment levels,
- Two problems quickly emerged.
  - First, there was little demand for micro hydro or credit
  - Second, rural communities (where households are said to have an annual income of $500) could not afford the full cost of the plant.

- For every $100 spent on a project:

  $27 is covered by a loan and spent largely on equipment

  $43 comes from grants and is spent on civil construction and distribution lines

  $13 grant to TA and ?promotion? of the demand

  $17 is the equity contribution from the owners and is supplied in part by contributions in kind such as labour.
- **The case of Sri Lanka**

  - Sri Lanka also represents a very positive experience with micro hydro.
- Four strands:
  - an effort to develop the technology and local capabilities through the rehabilitation of hydro on the Tea Estates;
  - a village hydro scheme with a strong emphasis on community development;
  - the nurturing of a group of village hydro specialists who act as "catalysts"; and,
  - grid connected systems.

- The programme has had considerable technological and institutional success
- Approximately 40 village hydro plant have been constructed (or are nearing

completion) in the 1990's.

- Importance of Electricity Consumer Societies (ECS)
- Extensive community development skills are deployed and various village factions identified in preliminary socio-economic surveys of each site.
- six "manufacturer/catalysts" to guide ESC at the implementing stage,
- Substantial variation has been experienced in the cost of installations
- variations in the standards
- the average of cost of the small plant is $2,500 per kW,
- and the cost of the larger plant is $1,500 per kW

- Typical plant (eg at Andaradeniya)
  - total capital cost of US$ 39,200,
  - installed capacity of 23 kW,
  - supplying electricity to 100 beneficiary households
  - ($392 per household)

- The most expensive plant in terms of installed capacity (at Weddagala) cost $14,400 for 5kW
  - ($2,880 per kW)
  - 25 households ($576 per household) and ten households were excluded.
  - People cannot afford :ECS to provide 30% of the capital cost
  - provided in "cash, kind and sweat equity", and would cover civil works and transmission.
  - consumers pay less than one rupee per watt, averaging 50 rupees per month ($11/year) for each household
  - full cost covering tariff which covered capital and operating costs 80 to 170 rupees per household per month ($17-$36/year).
  - Had to find extra money for distribution from the Provincial Councils adding delays to the project implementation (often over a year)
  - The costs of transmission are greatly affected by the standards used, and where the Ceylon Electricity Board (CEB) Standards were use the cost could rise substantially.
  - House wiring costs have risen dramatically over the years from 2-3000 Rupees in the early 1990's to 4-8,000 rupees in 1997 ($70-$140). CEB costs were as much as 11,000 rupees (nearly $200) per household.
  - end uses: primarily for lighting and cassette radios, (but surveys also show some ownership of TV, electric irons and heaters).
  - financial viability helped by cash generating end uses
- Village hydro in Sri Lanka is now moving into a more commercial phase
  - set up the catalyst/manufacturers as small businesses.
  - World Bank's Energy Service Delivery Project (WB-ESDP)

    softens the terms of commercial money by extending its payback period from between 2 and 5 years to ten years.

  - The Waddegala scheme
  - the Hatton National Bank loan with interest is at 20% over 5 years. Repayments were reported to be "satisfactory and on schedule".
  - Rotary Club of 200,000 Rupees ($3,500).
- **The lessons learned**

- huge progress has been made in developing and understanding the technology,

- many of the plant examined are not (yet?) financially sustainable
  - larger plant that can be sell surplus power to the grid are financially attractive
  - until there are reliable data on costs and performance of a large sample of micro hydro plant, risk averse funding institutions will remain unwilling to invest.
- the schemes in both countries described are making efforts to blend hard and soft money.
  - But

    greater pressure to undertake schemes with end-uses that generate a cash flow. complementary "down stream" investment in the funding packages.

    pressure to locate plant only in those areas that already have an ability to pay commercial rates of interest. (Problem of access)
- success involved very active "intermediation"
- "soft" grant money will be required for some time to come.
  - to increase access
  - to build technical capacities (market failure)
  - to fund the necessary intermediation and credit retailing.

- Experience also suggests that the use of soft money can both help the expansion of the sector and harm it.
  - The whole question of support to the sector (including subsidy, and tax policies) needs to be thought through
  - which are necessary conditions
  - define more clear what is best practice.

- "the devil is in the detail" and in the specifics of each context.

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