

# The impact of energy infrastructure projects on poverty

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## Introduction

What effect do ‘infrastructure projects’, such as micro-hydro installations, have on poverty? More particularly, what impact do they have on the communities, and on the environment in which they are installed? When, for example, a village has access to electrical or mechanical power, *how* does energy contribute to economic development at village level? Who are the beneficiaries – who is empowered by energy supply? And exactly what benefits does energy bring? Moreover, how can perceived benefits, and indeed potential negative outcomes, be assessed? There is now ample evidence that when traditional sources of energy have been augmented by modern energy systems, economic development does not always follow. The key need is to plan local energy infrastructure so that it has the maximum impact. What are the pre-conditions for it to be able to do so?

This article is based on two case studies of micro-hydro installations in Nepal and Kenya, carried out within an overall project managed by Intermediate Technology Consultants (ITC). Fieldwork for the case studies was carried out by ITDG staff in Kenya and Nepal. The project looked at the relationship between energy and poverty, using the ‘Sustainable Livelihoods Framework’ (see *BP46*, page 30). This framework is centred on people and their lives, and provides a checklist of important issues – how these are dynamically linked – and the influences and processes at work.

## The Kenyan project

Tungu-Kabiri project is located in Mbuiru village in the Eastern province of Kenya, around 200 km from Nairobi (see *BP 45* – Page 6). The Meru people, one of Kenya’s smaller communities, constitute most of the population. People from other communities have

### Projets d'infrastructure énergétique et leur impact sur la pauvreté: étude de cas de micro centrales hydro-électriques.

A partir d'une méthodologie définissant un cadre d'analyse pour des revenus durables, des projets au Kenya et au Népal ont été analysés afin d'établir leur impact sur la pauvreté. L'absence de marché est considérée comme une contrainte essentielle pour les communautés isolées. L'acquisition du capital physique (par exemple la micro centrale) peut ne pas conduire à une augmentation de revenu. Une évaluation devrait également prendre en considération les coûts-avantages, sociaux et environnementaux.

moved into in the area, however, resulting in an ethnic mix. Residents have coexisted for a long time and form an integrated, cohesive society. The vast majority of people, around 90%, are under 40 years of age.

With an average annual rainfall of between 600 and 900mm, the area is hot for most of the year, experiencing temperatures up to 33°C. It is hilly and soils exhibit poor water retention. The vegetation consists of low bushes and scattered trees that have survived cutting for firewood or making charcoal.

At the time of this study, the project was in its early stages. Though significant preparatory work had taken place with the community, the turbine had not been installed. The goal is enterprise creation for income generation via electrification of a commercial centre.

## The Nepal project

To reach Pinthali from Kathmandu is a two-hour drive east followed by thirty minutes steep uphill walk. Residents of Pinthali all belong to the Tamang ethnic group.

Implementation of the project began in 1997 through the Rural Energy Development Programme (REDP). This programme assists rural communities to establish local energy systems and develop productive end-uses that generate income. REDP take a community-based approach, identifying mobilization as a precondition for assistance. Thus the approach is more holistic and akin to the Sustainable Livelihoods approach.

The scheme has been running for some time, and provides domestic lighting and entertainment services.

## Gathering data

### Kenya

Both studies took their unit of reference as the household. The Kenyan study considered a household as ‘a person or group of persons, generally bound by kinship ties, who live together under a single roof, are answerable to the same household head and share a common source of food.’ A household is defined as poor if it cannot meet the basic needs of its members. The Kenyan study employed a range of formal and informal research methods:

- interviews with local opinion leaders, key informants and other stakeholders
- a questionnaire survey of selected households
- participant observation
- focus group discussions
- a wealth ranking exercise.



Figure 1 Micro-hydro scheme at Chuka, Mbuiru Village. Canal taking water from the river to the penstock and then the power house (photo: ITDG East Africa)

## Nepal

The fieldwork used the following research methods:

- a structured questionnaire to conduct a household survey
- two focus group discussions: the first about the MHP and livelihoods; the second – with women only – on gender issues and the MHP
- key informant interviews
- observation and photographs.

A representative sample of one third of households in Pinthali were selected for the household survey.

## Comparison of communities

Pinthali is the smaller and the more isolated from infrastructures – roads, health facilities, markets and administrative centres. Many health problems are a result of poor quality drinking water, and health facilities are inadequate in both cases.

A lack of irrigation restricts agricultural production. With regard to energy, both villages are dependent on a combination of biomass for cooking and kerosene for lighting (Table 1).

## Analysis of case studies

Table 2 compares what the communities wanted to achieve through the micro-hydro installation. It can be seen that many of their aspirations are similar

### Impacts in Tungu-Kabiri Project

Results so far indicate that the main benefit is an increase in *social capital*. (Social capital means an increase in linkages between people – membership of more formalized groups, relationships of trust, sharing and exchanges.) The formation of a Project Management Committee has boosted

community confidence, promoted mobilization and increased solidarity of purpose. Through the committee, finance has been raised from residents of Mbuiru to pay for necessary government permits to allow installation of the MHP. Women are, for the first time, taking a role in formal decision-making processes. Local government structures, meanwhile, are aware of the project and are responding with increased cooperation and support.

In Mbuiru, at the present time, the Project Management Committee cannot plan household connections for electricity from the MHP, because, under current Kenyan utility law, they are not allowed to sell electricity to a number of households. Ingeniously, the committee and project partners circumvented this law by obtaining a dispensation to supply their commercial centre as one large ‘house’. This is not

Table 1 Comparison of communities

Feature	Mbuiru	Pinthali
Local economy	Subsistence agriculture	Subsistence agriculture
Crops/staple foods	Maize, beans, vegetables	Potatoes, maize, rice, black gram
Livestock	Cattle, goats, sheep, pigs, chickens. Typically 2 large beasts/household	Buffalo (only 2.4% of households sell milk)
Cash crops	Tobacco	Garlic, dairy produce: milk & ghee
Constraints on agriculture	Irrigation, especially for tobacco & cotton growing. Soil erosion	Irrigation, inhibiting increased cash-crop garlic production. Soil erosion
Off-farm activities & income	Important: A range of activities & forms of employment contribute 72% of annual household income	Marginal: ‘Thanka’ painting & labour on the highway supplement farming income by up to 20%
Population	1,800	709
Typical educational attained	Primary level, basic literacy 90%	Primary level, basic literacy 73%
Household composition	Typically, husband, wife, 4 children	Average 6 people per household
Houses	300, ‘improved’ traditional – no thatch roofs	118, partially improved traditional, 36% thatched roofs
Drinking water quality	River water. Poor quality, seasonal disease risk	River water. Poor quality, seasonal disease risk
Direct road access	Poorly maintained roads impassable in rainy season	None (highway 30 minutes walk away)
Produce market	Kaanwa Market, 2 km away: food, tobacco, household goods	Traders come to village to buy garlic. Dairy produce sold at side of highway
Healthcare provision	2 health centres very poorly equipped within 2 km. Hospital with maternity facility 12 km	No village clinic
Administrative centre	Local administration at Kaanwa Market (2 km)	District HQ in Dhulikhel, 27 km away
Fuel use	100% of households use fuelwood for cooking. Kerosene lamps for light. (An estimated 90% of energy needs are purchased)	Firewood & agricultural residues as domestic fuel. Wood scarce, long collection times. Kerosene lamps for light
Electricity grid connection	None	None. Not expected within 50 years

Table 2 Comparison of community aspirations

Mbuiro	Pinthali
Higher income through opportunities to engage in enterprise	Increased economic activities and income, principally via irrigation for production of more cash-crop garlic
Increased well-being via better access to water for domestic & farming uses	Increased well-being from the provision of electricity for households
Enhanced food security via increased production & more affordable (grain) milling	Increased food security (undisputed top priority) via irrigation scheme
More sustainable natural resources via using electricity for productive activities	Decreased drudgery through spending less time sourcing kerosene and fuelwood, husking rice, milling and expelling oil
Increased social participation – people have already seen the advantage of organizing and working together	Better infrastructure, particularly road connection to markets, telecommunications and a village health centre

ideal in terms of technical efficiency – people will charge batteries and carry them home to provide lighting. It is hoped that, as a result of lobbying on behalf of the project and the commitment of the Ministry of Energy, Kenyan law will be changed.

### Impacts in the Pinthali Project

Overall, the acquisition of micro-hydro power has had a positive impact on livelihoods in Pinthali. It was not, however, the use of electrical or motive power that had the greatest effect. Additional irrigation water, a by-product of canal infrastructure to supply the turbine, promoted a significant increase in agricultural production. This boosted financial assets via increased sales of cash-crop garlic. From 649 kg per annum, community garlic sales have risen to 864 kg. The proportion of houses selling garlic has grown from 81% to over 90%.

Provision of electric light has permitted people to spend more time tending livestock. Reportedly as a direct consequence, sales of buffalo milk have risen from 800 to 1037 litres per household per annum. As with garlic production, the number of households able to produce a surplus for sale has grown from 2.4% to around 12%. A knock-on effect is that people increasingly use money rather than barter as their preferred form of trade. Combined with the availability of electric light, this has allowed village shops to develop, opening for longer hours and stocking a wider range of goods.

Electric lighting has also contributed to building human and social capital. Community and group meetings, as well as cultural events, can take place in the evenings. Hence they are better attended and more effective.

Both children and adults, meanwhile, are reported to be benefiting educationally from the opportunity to study and hold evening classes under electric light. In 2001, the MHP Group registered as a cooperative company in which households are shareholders. The process of building – or rebuilding – natural assets, meanwhile, has commenced with the establishment of a tree nursery and a replanting programme managed by the Forest Users Group.

Overall then, the community's well-being has increased and its vulnerability decreased as a result of using the micro-hydro power to develop other physical capital – the irrigation scheme – as well as financial, social, human and natural capital.

The area where the project has proved least effective is in identifying productive end-uses for power from the MHP. According to the case study the community only utilizes around 50% of the available power, mainly for light-

ing. The principal problem has been in identifying and accessing markets that would encourage productive activities to flourish. The local 'internal' market within the community remains relatively cash poor. Abiding by a tradition of subsistence, people are more inclined to make rather than purchase goods they need. Urban markets, meanwhile, are distant and difficult to access.

The need to identify viable productive end-uses for power produced from energy interventions, and thence to provide appropriate training and support, is a critical observation from the Pinthali project.

### What lessons can be learned?

One lesson from the Pinthali experience is that production must be market driven: there needs to be a proven – hopefully predictable and sustaining – demand for goods. Enterprise *is* risky and the successful entrepreneur will need good business instincts, based on a thorough understanding of the market. To give an example of some of the questions that should be asked:

- Which of these enterprises has the real potential to increase assets?
- What is the extent and nature of the market for the various products?
- Who are the competitors and who are the potential cooperators?
- What are the constraints on producing and selling proposed outputs?

A thorough understanding of technical and non-technical issues is required, implying close co-operation between professionals from a range of disciplines. There is a limit to the power available and thus to the number



Figure 2 Woman able to work at her sewing machine after dark – a positive impact on her financial assets (Caroline Penn ITDG)

and nature of enterprises. Other proposed activities also require further scrutiny. What, for example, are the implications of providing power to health centres that cannot afford essential drugs or the cold storage required?

Pinthali benefited more from the irrigation scheme than from the energy intervention. The irrigation scheme – though planned – was considered of lesser importance when the scheme was instigated. Energy supply projects can have innovation and spin-off effects that have more impact than the core intervention. In Nepal the proliferation of village-level micro-hydro schemes has contributed to the development of a manufacturing industry, and ‘virtually all turbines’ are now made nationally. When policy and decision makers consider energy interventions on any scale, therefore, the potential innovation effects should be taken into account.

Mbuiuru is planning to install irrigation and water supply schemes, and the community is in the process of seeking funds to develop them. Micro-hydropower, irrigation and drinking water supply can be assessed and compared in terms of their potential contribution to building community assets. It may be, for example, that a scheme to provide safe drinking water may have a more positive impact than supplying power. An analysis of ‘competing’ benefits may serve to make the best informed choice of resources.

## Conclusions

### *Markets and alternatives*

A lack of market opportunities is patently a stumbling block to building assets in both Pinthali and Mbuiuru, exposing what can be assumed to be a common problem for poor communities, particularly isolated rural communities. Three points stand out from the case studies:

- For geographically isolated rural communities, the starting point may be reversing a trend of decline. Markets have migrated further and further away – not just in terms of distance, but also in the nature of the demand.
- Generally, there is a surplus of what rural communities are able to

produce when and where they are able to produce it. Agricultural produce enters seasonal markets when there is a glut and demand is low. Meanwhile, those in need of food are typically those with the least ability to pay. Traditional craft production, similarly, tends to be what too many people turn to as a first option for earning off-farm income – the market is saturated.

- It is difficult to see what can be done at project level, in the short to medium term, by communities and their development partners, about the dearth of opportunities that result from macro-level political and economic constraints on markets.
- When, as part of a participatory process, people identify outcomes they hope to achieve, there is often a mismatch with the resources they have access to – including markets. There may be other outcomes that could be more readily achieved and which would have a greater positive impact on livelihoods – such as using the micro-hydro power to pump potable water, improving health and hence human capital, rather than to power woodwork shops in the pursuit of financial capital. Development professionals need to be able to guide communities in matching their assets with viable livelihood outcomes that have the maximum positive effect. To do this, professionals need to be informed about the constraints on people’s aspirations, particularly perhaps constraints on markets and building financial capital.

### *Achieving a positive impact*

- To have a positive impact, acquiring physical capital (in this case – micro-hydro), does not necessarily lead to building human, social or other physical capital; it certainly does not lead directly to building financial capital.
- The majority of energy supply projects will, almost by definition, be designed for a long operating lifetime. The micro-hydro schemes in Pinthali and Mbuiuru will have an impact on livelihoods that changes over time and is difficult

to predict. The fact that the Pinthali scheme is currently unable to fully utilize energy to generate income does not mean that will always be the case.

- Feasibility studies must include both the design of technically feasible interventions *and* an evaluation of the social, economic and environmental costs and benefits. A Sustainable Livelihoods Approach should be ideal for performing such studies.

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