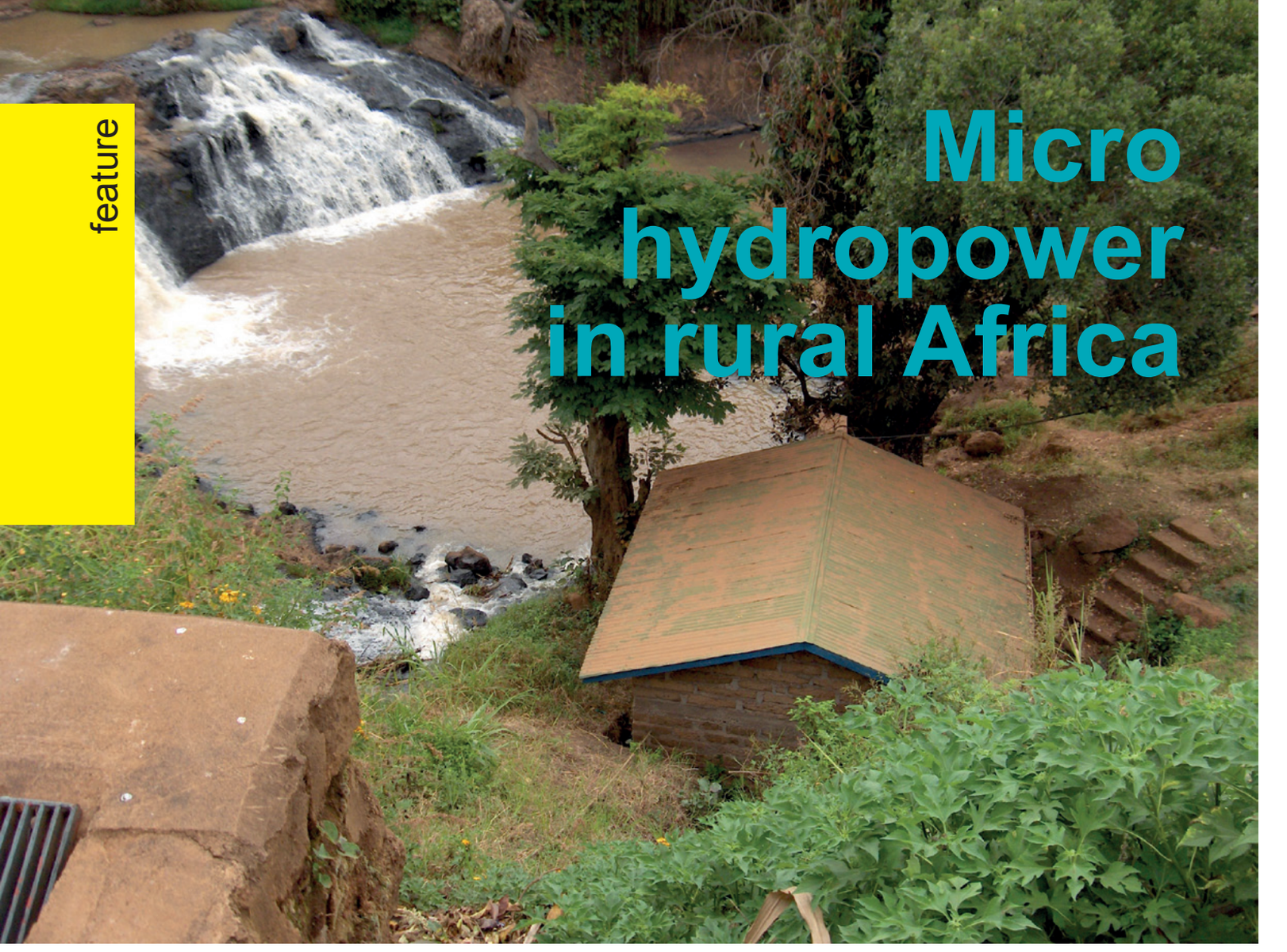
feature

Micro hydropower in rural Africa



Wim Jonker Klunne argues that local renewable energy production provides a better solution for rural Africa than the national grid model

Sustainable energy provision is regarded as a major challenge, especially in Africa with large proportions of (rural) populations lacking access to (basic) energy services.

On the continent over 500 million people do not have access to electricity. This translates to two thirds of the population, while in rural areas up to 92% of the population lives without electricity. Although the electrification rates do differ from country to country, rural areas in general lack access to adequate, affordable, and reliable energy services.

It has generally been agreed that providing access to energy is an absolute necessity in order to reach the Millennium Development Goals.

The traditional way of providing electricity to rural areas through the extension of the national electricity grid becomes prohibitively expensive due to geographical barriers (distance and terrain) and initial low demand for electricity. A viable alternative for grid extension is provided by renewable energy sources that use local resources.

Substantial numbers of projects and programmes have been implemented in Africa providing solar systems to rural populations. However, it has become clear that the costs of photo-voltaic systems are very high and that they do not provide households with the level of energy services to which they aspire.

Micro scale hydropower, often implemented through local isolated mini grids, is able to offer a higher level of energy services than solar PV. In the case of Kenya, research by Maher et al (2003) revealed that hydro stations in the pico range (in this case defined as less than 5 kW) are able to supply electricity to households at a fraction of the cost to the end-user compared with either solar PV or using car batteries charged at grid connected charging stations.

Microhydro in Africa

There is enormous exploitable hydropower potential on the African continent, but despite this massive potential for large and small scale hydropower, Africa has one of the lowest hydropower utilisation rates. While large-scale hydropower

development is becoming a challenge due to environmental and socio-economic concerns, and more recently its vulnerability to changing climates and hence water availability in the main water bodies, micro hydropower development continues to be an attractive resource especially in remote parts of Africa.

The fact that microhydro installations tend to use only part of the available water in rivers makes them less vulnerable to changes in water quantities due to climate change.

Microhydro is a proven technology that can adequately contribute to the electricity needs of African countries.

Micro scale hydropower has a long history in general, but also in Africa. For example the first

◀ Tungu-Kabiri community hydro project.

Tungu-Kabiri's 18 kW crossflow turbine ▼

system in South Africa was a 300 kW station on the slopes of Table Mountain, which was inaugurated in 1895 (Barta 2002). All over Africa church missions were particularly active in implementing small scale hydropower installations. In Tanzania, more than 16 small hydropower systems were installed by church missions in the 60's and 70's of last century that are still operating (Mtalo 2005), while in Zimbabwe for example large scale commercial farmers in the Eastern Highlands of the country installed hydro stations as early as the 1930's (Klunne 1993).

Many countries in Africa do have a rich history of small scale hydropower, but over time large numbers of these stations have

"in rural areas up to 92% of the population lives without electricity"

fallen into disrepair. Some because the national grid reached their location but others because of lack of maintenance or pure neglect.

Recently initiatives have seen the light in a number of countries in Africa to revive the hydropower sector, either through international development agencies or through private sector led initiatives. Particularly in Central Africa (Rwanda), East Africa (Kenya and Tanzania) as well as Southern Africa (Malawi, Mozambique and Zimbabwe) new initiatives are focusing on implementing small scale hydropower projects.

Barriers

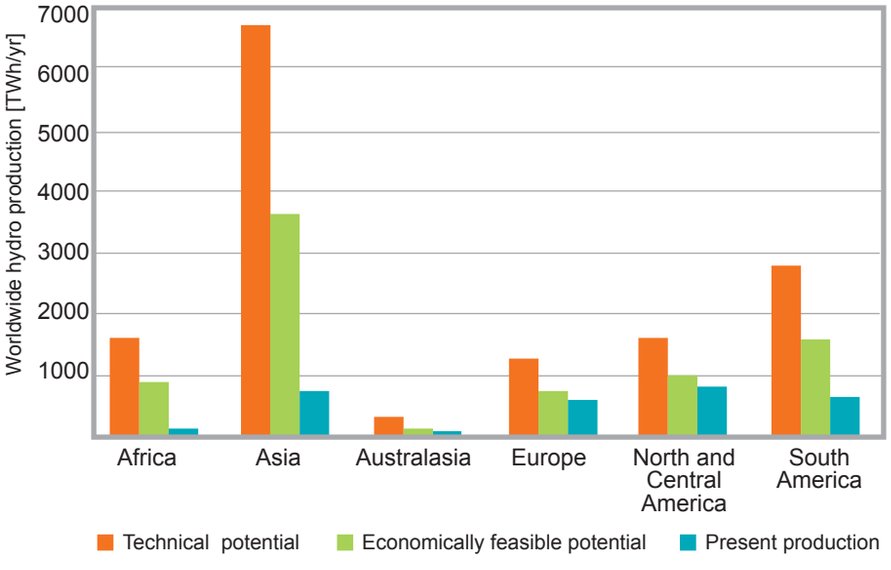
The challenges facing micro hydropower exploitation in general are many and most of them are part of the larger picture of general barriers for the uptake of renewable energy and independent power producers. These generic barriers can be summarised into the lack of clear-cut policies on renewable energy and associated requisite budgetary allocations to create an enabling environment for mobilising resources and encouraging private sector investment, and the absence of lost-cost, long-term financing models to provide renewables to customers at affordable prices while ensuring that the industry remains sustainable.

Current experience and way forward

Microhydro has the technical capability of providing electricity to rural areas of Africa that are currently not supplied with electricity. Several initiatives are currently ongoing on the continent that are aiming at installing a large number of microhydro schemes to serve rural populations. Although information is available on the technical aspects of these projects, little has been published on the implementation models used in these projects.

From the analysis of a number of the current initiatives it has been very clear that microhydro developments need to be embedded in a national program for capacity building and industrial development to foster a new industry to emerge. Particular attention needs to be given to governance issues related to hydro stations as experience from the described projects suggests that

Worldwide Technical Hydropower Potential versus Economically Feasible Potential and Present Situation 1998
(International Energy Agency 2003)



linkages with ongoing economic activities will ensure proper management of the system.

Very clearly the inclusion of entrepreneurs / private sector developers could benefit the sustainability of the systems, although this does in most cases also come with requirements from the financiers of these private developers which have shown in the case of Rwanda a tendency to favour developments that feed in to the national grid as this ensure a steady income stream for the enterprise.

Several African countries have establish renewable energy feed-in tariffs (Kenya, South Africa and Uganda) that do support

" ... linkages with ongoing economic activities will ensure proper management of the system."

the establishment of small scale hydropower linked to the electricity grid. For remote locations without access to the national grid rural electrification agencies and/or funds, like in Tanzania, do provide the needed legislative and financial incentives for the uptake of remote hydropower.

3 key obstacles to hydropower in Africa

• Lack of access to appropriate technologies in the mini, micro and pico hydro categories, which because of small heads and high volumes or very high heads and low volumes pose special technical challenges

• Lack of infrastructure for manufacturing, installation and operation.

Most countries in Africa do not have any facility to manufacture even the most rudimentary turbines or basic parts that might be critical for maintenance, for example, polyvinyl pipes.

• Lack of local capacity to design and develop small hydropower schemes for areas sometimes considered too remote.

Most African countries lack specialisation to undertake feasibility studies that would include detailed design and costing of the schemes.

To enhance the uptake of microhydro technology local stakeholders (private sector, financial sector, government entities, etc) need to be made aware of the opportunities for the technology and coordinated efforts need to be initiated to get this technology thriving again.

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photos by Wim Jonker Klunne

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Africa hydro

case study one: **Svinurayi**

Installed in the 1930s, the micro hydro-power system at the Svinurayi co-operative in Zimbabwe consists of a penstock and powerhouse delivering 220 Volts direct current and a grinding mill for milling maize.

The water intake is situated 176 metres above the powerhouse level, with water conveyed by means of a 650 metre long channel.

The turbine wheel, manufactures by Gilbert Gilkes & Gordon in the UK, dates back to 1933. Estimated power output is 10kW.

With a worn seventy eight year old turbine, the 22 members of the Svinurayi co-operative are struggling to make best use of energy generation. Potentially, hydro-power could be powering lighting in the co-operative's shop, school, beerhall and workshop, driving sunflower oil

expelling, sugar cane crushing, and providing a source of electricty for charging batteries and mobile phones.

With the national grid not reaching the Cashel valley, and no real prospect of its doing so in the foreseable future, hydro-power is the best opportunity for this rural community to have access to electricty and all the development opportunities that come with it.. Around 96% of Kenya's rural

case study two: **Tungu-Kabiri**

population still lack access to grid-based electricity.

A typical family in rural Kenya will spend a third of their income on kerosene for lighting and diesel for milling grain.

The Tungu-Kabiri community micro hydro-power project, funded by the United Nations Development Programme and developed by Practical Action East Africa and the Kenyan ministry of Energy, brought 200 households together to own and operate their own power station, supplying electricity to local businesses and households.

Once river flow records, going back 40 years, had been assessed and the river Tubgu, near Mbuiru, had been passed as suitable, work began on building the hydropower station.

To construct the scheme, villagers gave up their Thursdays every week for several months, digging, shifting stones, laying concrete, building the

▲ mobile phone charging service

Car Battery charging, to provide domestic lighting ▼

intake weir and canal and penstock.

The project took two years but now provides real benefit to all 200 households.

Electricty from the plant gives the community access to power to charge car batteries, used to power lighting in homes, and charge mobile phones.

This access to clean energy also alleviates the environmental problems associated with using kerosene, diesel and wood.

Access to power enables the villagers to develop and run small businesses which, in turn, provide money for education, clothes and food.

Small hydropower projects such as these typically cost between £1,200 and £4,000 per installed kilwatt hour, a fraction of the cost of conventional approaches and technologies. Furthermore because the energy produced is used locally there are not the transmission losses associated with national grids.

Since this pilot project was completed a further two other communities in the vicinity have installed small scale hydropower turbines.

http://practicalaction.org