SMALL HYDROPOWER DEVELOPMENT IN AFRICA

*By **Wim Jonker Klunne**, Renewable energy and climate change expert*

There is enormous exploitable hydropower potential on the African continent, but despite this, Africa has one of the lowest hydropower utilisation rates. Currently less than 7 % of the potential has been harnessed. Eastern, southern, central and parts of western Africa have many permanent rivers and streams providing excellent opportunities for hydropower development.

While large-scale hydropower development is becoming a challenge due to environmental and socio-economic concerns — and more recently its vulnerability to changing climates — small hydropower development continues to be an attractive resource, especially in remote parts of Africa. It is a proven technology that can be connected to the main grid, isolated grids or as a stand-alone option, or combined with irrigation systems. Small hydro can adequately contribute to the electricity needs of African countries.

Region	Installed SHP capacity	Percentage
Asia	32,642	68.0 %
Africa	228	0.5 %
South America	1,280	2.7 %
North & Central America	2,929	6.1 %
Europe	10,723	22.3 %
Australasie – Oceania	198	0.4 %
TOTAL	47,997	100 %

Installed SHP capacity by world region (source: The International Journal on hydropower and Dams, 2004 and US DOE, 2004)

Although there is no internationally agreed definition of "small" hydro, the upper limit is usually taken in line with the World Commission on Dams as 10 MW of installed capacity, although large countries as China and India tend to put the limit higher at 50 MW and 25 MW respectively. Within the range of small hydro, distinction can be made between mini hydro (below 1MW), micro hydro (below 300 kW) and pico hydro (below 10 kW), each with its own specific technical characteristics. Micro and pico hydro installations are typically used in developing countries for energy provision to isolated communities where the national electricity grid is not available, whereas mini hydro tends to be grid connected. Micro and pico hydro can also differ from mini hydro due to the extended possibility of using local materials and labour in the case of first two, while mini hydro typically involves more traditional engineering approaches and will usually need a heavy access road for delivery of materials and electro-mechanical equipment.

In general terms the environmental impacts of small hydro plants are minimal through the use of "run-of-the-river" schemes in which no dam or reservoir storage is involved.

BARRIERS TO LARGER UPTAKE OF SMALL HYDRO IN AFRICA

The challenges facing small hydropower exploitation 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.

Specifically for small hydro, large scale implementation is hindered by:

1) Lack of access to appropriate technologies in the mini, micro and pico hydro categories, which because small heads and high volumes or very high heads and low volumes pose special technical challenges
2) Lack of infrastructure for manufacturing, installation and operation. Most of the countries in Africa do not have any facility to manufacture even the most rudimentary turbines or parts that might be critical in maintenance of the schemes. An example is the availability of capacity to manufacture high-density polyvinyl pipes that can serve as good penstocks for the micro hydro schemes. Few countries have these products and as such, exploitation of otherwise simple sites has been hampered by this deficiency
3) Lack of local capacity to design and develop small hydropower schemes for areas sometimes considered too remote. Generally, most of the countries lack specialisation to undertake feasibility studies, detailed studies that would include detailed design and costing of the schemes to make a meaningful impact on utilisation of small hydro sites.

IMPLEMENTING SMALL HYDRO IN AFRICA

At the moment several initiatives are ongoing to help developing small hydropower in Africa. Both UNDP and UNEP are active in support programmes to remove barriers to the harnessing of the large small hydropotential, small hydro support centres are established or in the process of being established in a number of countries and a number of national rural electrification programs do include electricity generation by small hydro.

The United Nations Environment Programme (UNEP) is implementing a Global Environment Facility (GEF) funded project that looks at the possibilities of applying small hydro at tea estates to generate electricity in the Eastern Africa region. Starting from the premises that tea does need altitude and water to grow, which are requirements for hydropower as well, a collaboration of the East African Tea Trade Association

(EATTA), UNEP and the GEF is currently looking in setting up a facility to accelerate the uptake of hydropower.

First indications show huge interest by the tea estates due to the current unreliable power supply from the national electricity grids. The project aims to establish 6 small hydro power demonstration projects in at least three of the EATTA member countries, preferably with an attached rural electrification component, as well as to prepare additional pre-feasibility studies. Both studies and planned installations will serve as training grounds for the entire tea sector in the region. The project includes a special financing window to assist individual tea processing plants to move into "green power generation".

In West Africa the UN Development Programme (UNDP) is implementing a GEF project that will promote decentralised off-grid rural electrification in 10 countries in Africa with micro hydropower systems as a key element in creating viable rural economies. For each of the participating countries, the project intends to strengthen the institutional, regulatory and operational capacities of key agencies to provide decentralised microhydro-based electricity access to remote rural areas and it will deploy 36 hydroplants in rural areas. The lessons learned at national level will be shared amongst the 10 participating countries in order to effectively develop viable delivery models.

To create more capacity for small hydro development in Africa a number of initiatives to create knowledge and training centres are currently under way, with the inauguration of the UNIDO Regional Centre for Small Hydro Power for ECOWAS Region at Abuja, Nigeria on 22 May 2006 as a key achievement.

Country	Harnessed (MW)
Algeria	42.00
Morocco	30.00
Tunisia	15.00
Egypt	10.00
Uganda*	0.50
Mauritius	6.70
Kenya	6.28
Burundi	5.17
Somalia	4.60
Zambia	4.50
Tanzania	4.00
Lesotho	3.54
Mali	5.8
Ghana	10.00
Nigeria	33.00
Malawi	1.52
Botswana	1.00
Rwanda	1.00
South Africa	0.40
Swaziland	0.30
Mozambique	0.10

Small hydropower in Africa, selected countries. (Source: Karekezi and Kithyoma, 2005)
**** Other stations of total capacity 6.81MW are not operational***

Very encouraging is the fact that several countries have included small hydro in their rural electrification plans that are currently implemented with international assistance from bi- and multilateral donors. Tanzania and Ethiopia for example have included small hydro in their rural development plans, while in Madagascar the E7 foundation in collaboration with others is currently developing the Lokoho small hydroplant with minigrid that will be run as an IPP.

THE WAY FORWARD

Small hydro has proven itself as a major contributor to electrification in developing countries, with China as an example where small hydro has been developed in large parts of the country. The interest in small hydro on the African continent as emerged over the last couple of years, has resulted in a number of projects that will pave the way for large scale introduction of small hydro. The current interest by African Governments, international donors, development banks and the private sector in increasing energy access in Africa will facilitate the uptake of this robust, environmentally friendly form of energy. The challenge upon us now is to maintain the momentum created and ensure that the current interest will be translated into more small hydro plants installed.

For more information about hydropower in Africa, please visit the author's web site at http://hydro4africa.net.

CASE STUDY: THE TUNGU-KABIRI COMMUNITY HYDRO PROJECT IN KENYA

The Tungu-Kabiri community micro hydro power project in the rural area around Mount Kenya demonstrates how the use of micro hydropower can bring development to rural areas in Africa.

About 96% of the rural population in Kenya still lack access to grid-based electricity. A pilot project initiated by Practical Action (previously Intermediate Technology Development Group ITDG) in Kenya has shown the potential for decentralised micro hydro schemes to provide access to electricity. In 1998 ITDG in collaboration with the Kenyan Ministry Energy (MoE) and with funding from the UNDP, undertook a pilot project to illustrate the potential for decentralised micro hydro schemes to address the lack of electricity. After an initial feasibility study, the Tungu-Kabiti community 185 km north of Nairobi was chosen as the site for the pilot project.

About 200 members of this community came together and formed a commercial enterprise to own, operate and maintain a micro hydropower plant. Each individual bought a share in the company, with a maximum share value of about US$ 50. The members also contributed labour, dedicating every Tuesday for over a year to the construction work, which was overseen by the MoE and ITDG. Involving the community in all aspects of project development from the start was critical to reduce local technical barriers and it ensured that the community could effectively maintain and repair the micro hydropower system themselves.

The micro hydropower plant is owned and managed by the community, and this complete community ownership has been central to the project's success. The day-to-day operations of the plant are managed by a 10-member community power committee, and this committee also conducts consultations with the wider community about how the power generated from the system should be used. The electricity is currently used mainly for micro-enterprises, such as a welding unit, a battery-charging station and a beauty salon.

This project has shown that micro hydropower can effectively meet the energy needs of poor off-grid communities. It has demonstrated that communities are willing to invest time and money for improved energy services, and can organise themselves to build and operate a micro hydropower plant.