

POSITION PAPER: DAM DEVELOPMENT IN AFRICA

Based on the Dam Register of the ICOLD the historical growth of dam storage capacity is indicated in Figure 1. South America, the Middle East and Asia have experienced a steady increase in storage capacity over the last 30 years. In Europe, North and Central America, Australasia and Africa there has been little dam development in the last 20 years. Africa is however still developing and therefore needs more dams.

The annual overall costs and benefits of all dams according to ICOLD are:

- Some R320 billion of investments and R136 billion for operation, maintenance and upgrading, i.e. a total cost in the range of R456 billion/year.
- Some R1000 billion electric power supply (2500 TWH x R0,4) and R400 to R800 billion other benefits (especially food by irrigation for over 500 million people).

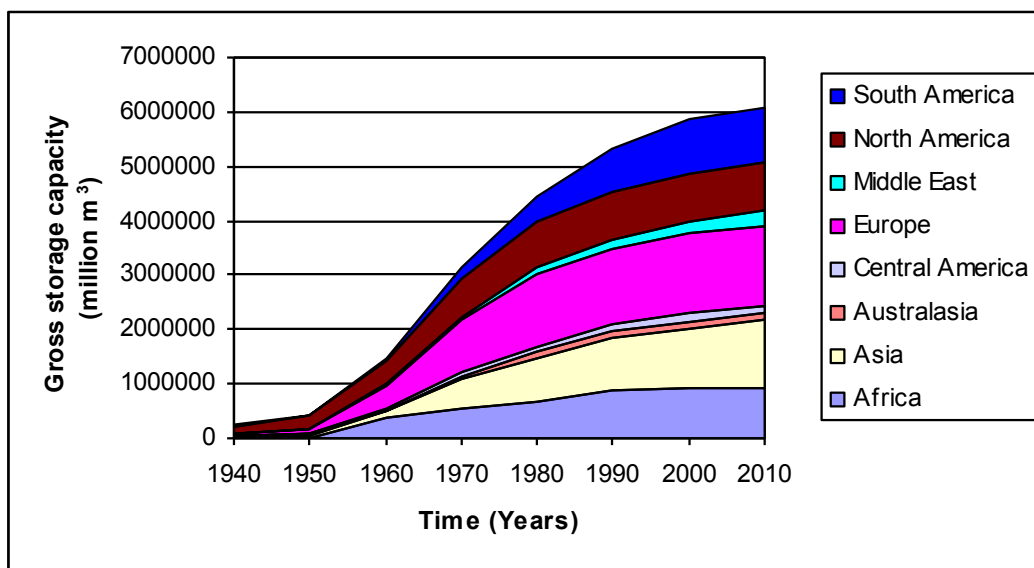


Figure 1 Historical growth in global reservoir storage capacity

Figure 2 shows the net reservoir storage capacity per region over time, considering the impacts of reservoir sedimentation. In developed regions such as Europe, North America and Australasia, a decrease in storage capacity since 1980 has been experienced (long before the WCD study). In the long term net growth in storage capacity has only been experienced in two regions: Asia and the Middle East. Since 1990 the storage capacity in Africa has decreased, but Africa still has the third largest storage capacity region in the world.

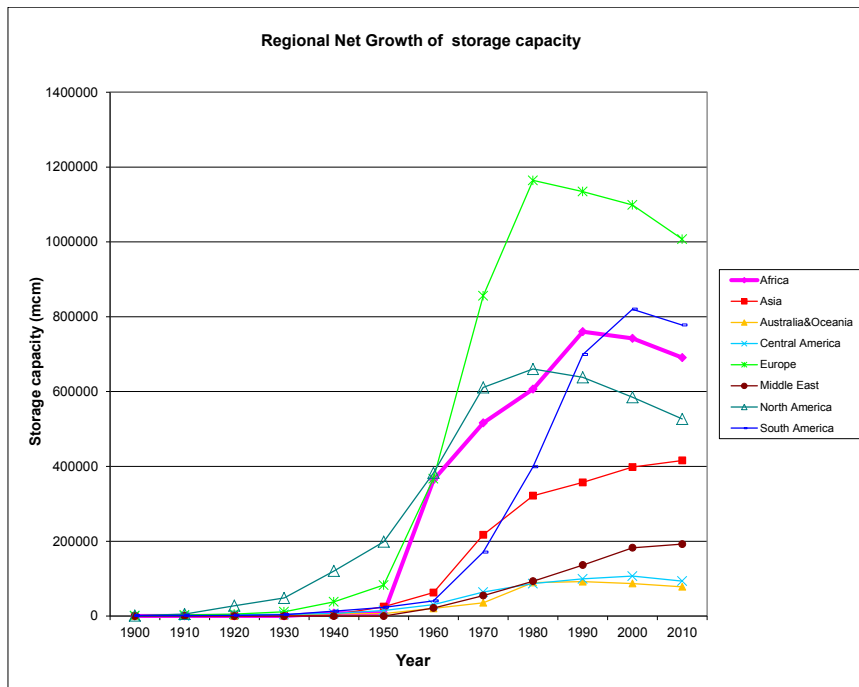


Figure 2 Net growth of dam storage capacity considering reservoir sedimentation

(note Europe includes Russia)

Africa is experiencing a period of bloom at ICOLD. Newly-elected President Adama Nombre is from Burkina Faso and Vice-President Gerrit Basson is from South Africa, and currently about half of ICOLD members represent the African continent.

This is no wonder. Africa is currently experiencing high economic growth rates despite the global recession. The International Monetary Fund projected GDP growth for sub-Saharan Africa for 2012 was 5.4%. Some of the countries with high economic growth rates in 2012 are Zambia (7.7%) and Mozambique (8.1%). This is coupled with a growing demand for water and associated infrastructure. A need for especially hydropower dams has been identified.

Africa lags behind dam development compared to the rest of the world. Internationally about 82 % of all dams are constructed for hydropower generation. In Africa 70 % of people live without electricity, but only 8 % of the hydro-electrical potential has been exploited. Figure 3 shows the historical trend in hydropower development. Currently hydropower only makes up 15 % of the total power supply in Africa.

These and other proposed water resource development schemes make the present an exciting time to be part of the field of dam engineering. Of course, these developments have to be undertaken sustainably. As engineers we have a responsibility to make sure any new dam's benefits are optimised with consideration and measures to limit the environmental and social impacts of the dam on the surrounding environment.

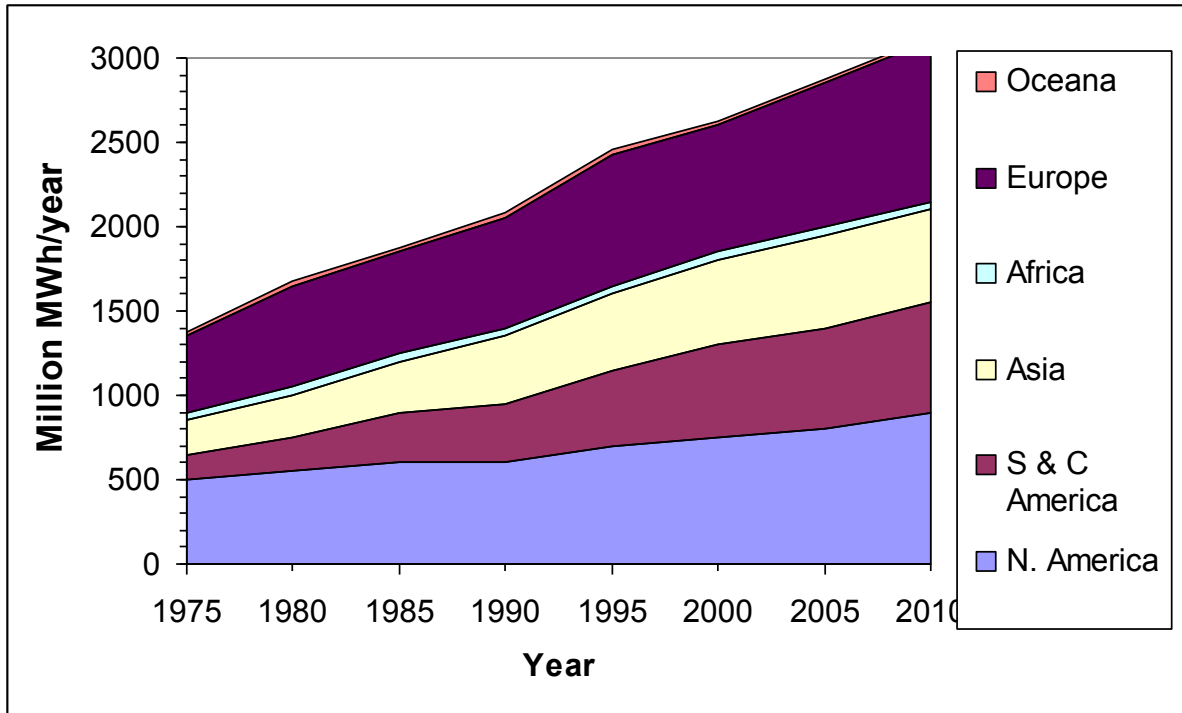


Figure 3 Historical hydropower development

The hydropower potential in the world as estimated by ICOLD is shown in Table 1. The African hydropower potential is estimated at 1100 TWh/year, which is comparable with that of North America.

Table 1 Hydropower potential in the world

Region	Potential TWh / y	Hydro-electricity produced	
		TWh / y	%
Europe	790	560	71%
Asia	4 000	950	24%
Africa	1 100	85	8%
North America	1 000	670	67%
South America	1 600	600	38%
Oceania	90	55	61%
World	8 580	2 920	34%

The actual current hydropower generated by countries in Africa is shown Figure 4. The African countries are compared with four non-African countries (developed and developing) (see right hand side of the graph). Not all African countries have opportunities for hydropower development due to the climate, and historical hydropower development was often based on historically cheaper local resources such as coal and gas, but these are not always environmentally acceptable or renewable.

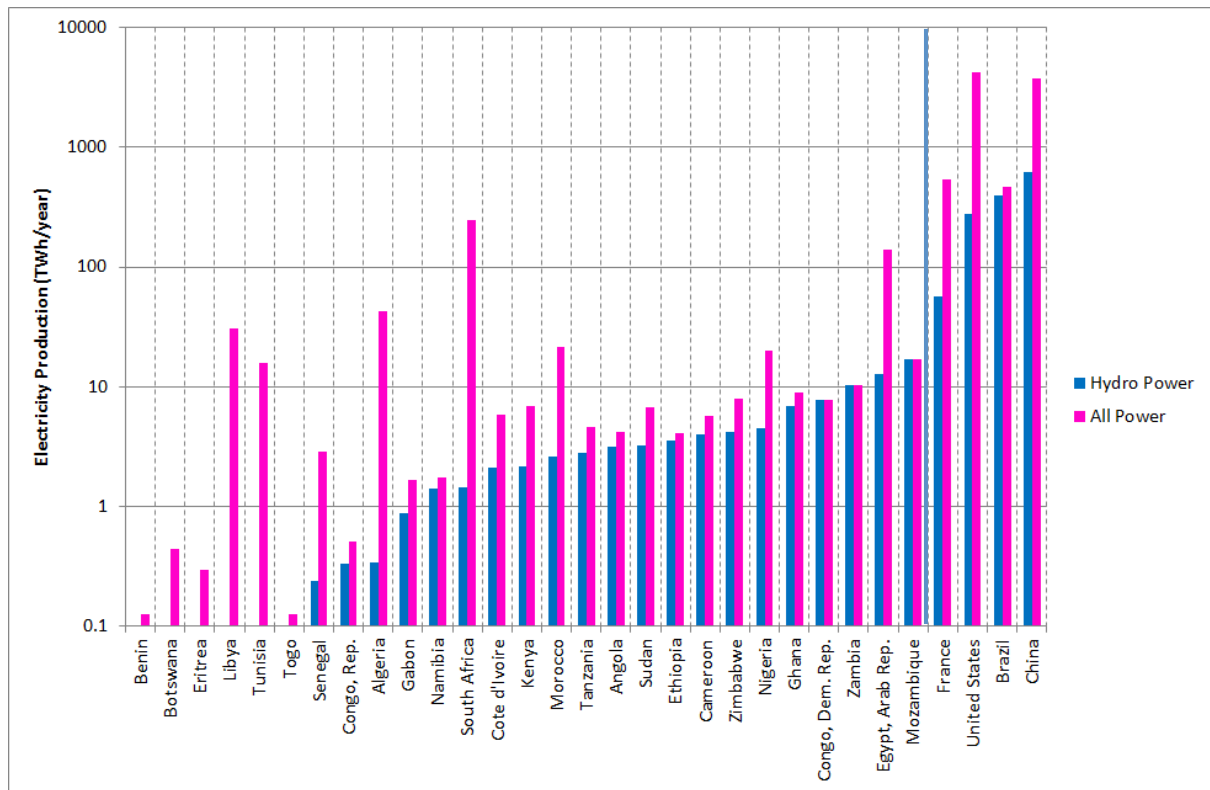


Figure 4 Hydropower versus total power generation (note vertical scale is a log scale)

Figure 5 shows current sources of electricity production in Africa. The diameter of the circles indicates the production in TWh/year, based on the legend in the figure. The relative contribution of hydropower to the total production is relatively high in many countries in Africa, except in the drier northern and southern African countries.

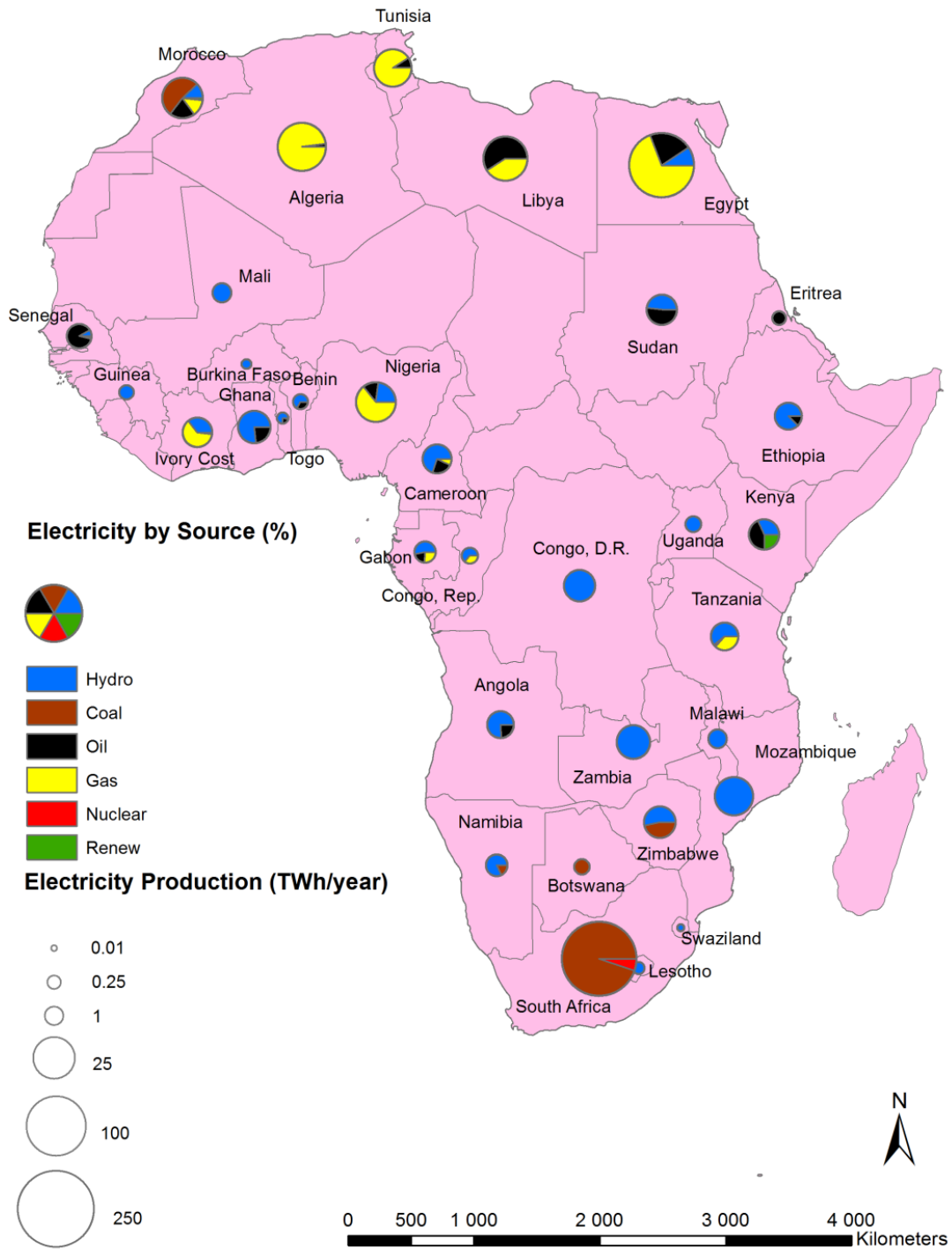


Figure 3 Current sources of electricity production in Africa

African dam engineers are playing no small part in water resource development projects on the continent, including in their own country and that of the country’s neighbours. They bring expert knowledge in, among others, dam design technology and construction, assessment of the impacts of infrastructure on downstream ecosystem and Reserve determination, environmental and social impact assessments, dam surveillance and safety, hydraulic design and modelling of spillways, to name but a few.

Despite these advancements, there is greater scope for involvement of African countries in ICOLD. Most countries on the continent have dams serving various needs, including hydropower, irrigation, flood mitigation and potable water supply. Many countries, however, are not ICOLD members due to lack of information or for financial reasons, for example.

At the same time, a need has been identified to update the ICOLD dam register for dams in Africa. ICOLD's World Register of Dams is recognised internationally as the best available database of dams in the world. Unfortunately data on Africa's large dams are often lacking and/or found to be inaccurate. Key staff in National Committees of African member countries will be identified to check the accuracy of the existing register data, and to update available information. For data from non-ICOLD member countries, a regional approach will be followed to obtain contact persons in these countries who would be willing to collaborate with ICOLD in providing the data.

ICOLD could play an important role in regional water resource development and planning in Africa. Due to political and social reasons, African countries have a poor track record of regional planning and sharing of the long-term benefits of water resources development. Apart from building technical expertise, ICOLD can play a role in regional planning and operation of dams and related schemes in Africa. Regional schemes such as the Grand Inga could produce 280 TWh/year, or new dams on the Lower Zambezi River, and with the high voltage network and interconnections now available in Africa, the larger regional hydropower dam schemes have become more feasible than ever.

This could be achieved by regional workshops, which could also tie in with the annual ICOLD Africa Regional Club symposium to be held in Africa. Regional clubs are formed by groups of national committees to facilitate interchange of knowledge and experience between countries with common interests and environments.

At such symposia, leading practice in regard to planning, funding, investigation, design, construction, operation, maintenance, safety review, environmental sustainability and social equity associated with dams are promoted. Exchange of information and experiences among African members on all aspects on dams will be encouraged. Regional planning could also benefit from independent reviews by experts from Africa in the field.

To have a list of experts there needs to be experts, and building capacity in African dam engineering. We need to encourage individuals, particularly younger people, with skills and interests in engineering, science and environmental matters associated with dams, to become active members of ICOLD and its regional organisations.

In 2012, ICOLD established a Young Engineers Forum for members under the age of 40, and it is hoped to build on this initiative in Africa. A good start is the fact that at the International Conference and Exhibition on Water Storage and Hydropower Development in Africa, co-sponsored by ICOLD, to be held in Ethiopia from 16 to 18 April this year, a session will be held specifically on the topic of capacity building. Prof Basson, ICOLD Vice President, invited presenters from Ethiopia, Morocco and Mozambique to present their country specific experience on capacity building of engineers in the dam engineering field.

Africa has some unique dam engineering expertise, and environmental and social considerations that differ in many respects from the rest of the world. RCC dam construction technology is state-of-the-art in Africa and is constantly optimized to obtain economical

solutions for many new dams now under construction. Labour intensive dam construction techniques, especially for smaller dams are also very important in Africa, and the design techniques have been scientifically researched. Unfortunately Africa is lagging behind in terms of dam maintenance and rehabilitation and this is an important issue to address to ensure dams are safe. Another related “problem” with older dams in Africa is that many of them are equipped with control gates. While gates have benefits in terms of flood control, they often add a risk of malfunctioning due to climatic and operational complexity and the dam safety risk is probably higher than in the many other parts of the world.

All dam development projects have detailed studies to assess the environmental and social impact assessments (ESIA). In terms of social impacts of dams, Africa has some of the highest displacement ratios in the world due to relatively large reservoir areas and the high population density. Upstream of a dam sedimentation could increase flood levels and limits the life of a dam, and retirement (decommissioning), even if it is in the next century, has to be planned and budgeted for. Downstream of dams there could be a reduction in flood peaks of small and medium floods, with increased base flows (for hydropower, or decrease in the semi-arid regions). This leads to changes in the sediment dynamics, water quality and ecology. ESIA studies often have mitigation measures such as the release of environmental floods and dam engineers have to work closely with ecologists to limit the impacts of future dams.

The large dam debate is still relevant, but Africa needs power for continued economic development. Hydropower dams can provide relatively cheap electricity, but should be developed with other renewable energy sources. To limit the environmental and social impacts of dams in Africa, regional hydropower schemes should be developed on large rivers, instead of large dams on small rivers in each country.

Under the initiative of ICOLD, several international organizations signed a World Declaration in 2008 to support “Dams and Hydropower for Africa Sustainable Development”. The declaration indicated that hydropower is “cheap” compared to other energy sources, and that hydropower generation is generally “clean”. The hydropower potential for Africa is vast and unexploited, and the need of the African population has now almost reached a state of emergency.

The time has truly come for Africa to show that large dams can be developed for the benefit of all.