# Hydroelectricity power project and policy for Sub Saharan Africa

Yusheng Gao *

Maple Glory Education, Xiamen, 361006, China

* Corresponding author: gaoyusheng@maplegloryedu.com

**Abstract.** As the development of renewable energy, more and more people realize that renewable energy is a good way to solve the global warming and decrease using chemical fuel but provide enough energy at the same time, especially for those countries which did not have enough resources to provide energy. This paper purpose is to help people in Sub-Saharan Africa have access to electricity using the hydroelectric power project. Although Sub-Saharan Africa has various resources, its industry is not developed, leading these resources cannot transfer energy. This paper analysis the advantages and disadvantages of hydroelectric power project for Sub-Saharan Africa, and find the way called chain to solve contracting problems. Research found that hydroelectric power project may have bad influence on environment, even worse in global warming. But can provide much electricity for countries which is more important during this time for Sub-Saharan Africa.

**Keywords:** Sub-Saharan Africa, Hydropower advantage and disadvantage, policy.

## 1. Introduction

Today, there are more and more people could use the electricity. However, in Sub Saharan Africa, most people in different countries still have no access to electricity. In most Sub-Saharan Africa countries, over 50% people have no access to electricity especially in central Africa more than 75% people without access to electricity as shown in fig.1. And most electricity is used in Industry, only a little for residential, which lead to people has not enough electricity, as shown in fig.2) [1]. So, helping people have access to electricity with law cost is every country in Sub Saharan Africa one of main purposes. In 2012, the Economic Community of West African States (ECOWAS) published one policy called ECOWAS renewable energy policy. The main purpose of this policy is improving the people quality of live and developing the economy. This policy is very useful. The electrification rate has grown from 33 percent in 2000 to 52 percent in 2016[2]. But there are over 175 million people still have no access to electricity, especially in villages about 85% [2]. The potential storage capacity of undiscovered oil and natural gas is very strong in Sub Saharan Africa [3]. But extraction for oil is extremely difficult and may increase the global temperature further. Therefore, finding some renewable energy for Sub Saharan Africa is necessary. There is a large amount of undeveloped renewable energy potential in African nations, estimated 350 GW of hydropower, 110 GW of wind, 15 GW of geothermal, and an astounding 1000 GW of solar power generation capacity on the continent [4]. This paper focus on the hydroelectricity project, analyzing the advantage and disadvantage of the large and small projects, also choosing the place to contract it and solve the fund problem.

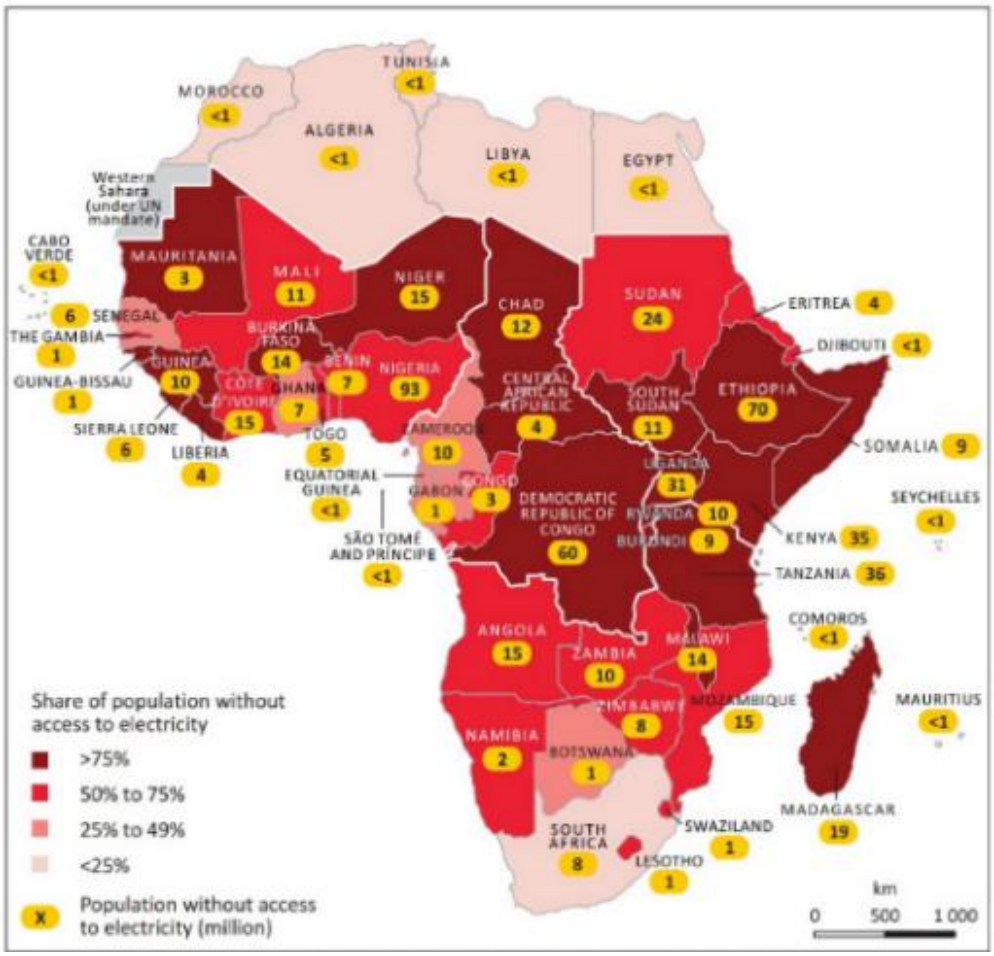


**Figure 1.** Number and share of people without access to electricity by country, 2012. [1]

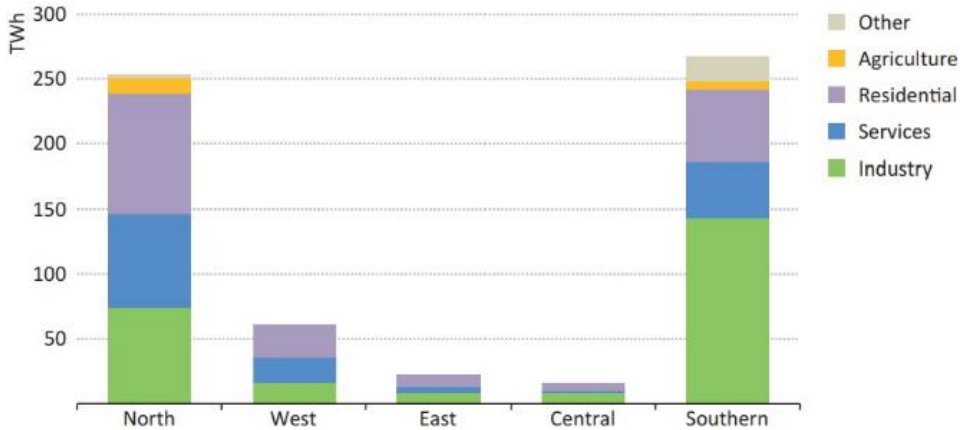


**Figure 2.** Electricity consumption in Africa by end-use sector and sub-region, 2012 [1]

## 2. The Hydropower Advantages and Disadvantages for Sub-Saharan Africa

The hydroelectricity project in this paper would be divided into two types: Large Hydropower and Small Hydropower according to contributing to making the contribution of power generation capacity and the main influence on water flows. Technically, a hydroelectric plant is categorized as large when it has a minimum capacity of 100 MW, medium when it has a capacity between 20 and 100 MW, and small when it has a capacity between 1 and 20 MW [4].

### 2.1. The large hydroelectric power advantages and disadvantages for Sub-Saharan Africa

There are some advantages for hydroelectric power for sub-Saharan Africa. First, Sub Saharan Africa have the potential to develop. According to the data from the International Energy Agency database, the hydropower share of the most central countries is 60%-100%, as shown in fig.3. Especially in the central Africa countries, for example, the hydropower share of Congo is up to 80%-100% which means that all country is depended on hydropower for energy providing [4]. Secondly, comparing other renewable energy project, the technique of hydroelectricity plant is more well-established, so the countries in Sub Saharan Africa do not need to invest a lot of money to experiment the principle of hydroelectricity. Thirdly, building the hydroelectricity power could also solve the water problem including the water for some area which need the water immediately. The hydropower not only provides the electricity, but also storage of water resources at the same time. Besides, hydroelectricity energy projects are conveniently dispatchable, not over than one hour could make hydropower schedule, even turning on and down frequently cannot affect the infrastructure service life. Finally, the cost for conservation is cheaper than other renewable energy, so Sub Saharan Africa countries do not need to spend lots of money in conserving the hydropower electricity project [5].

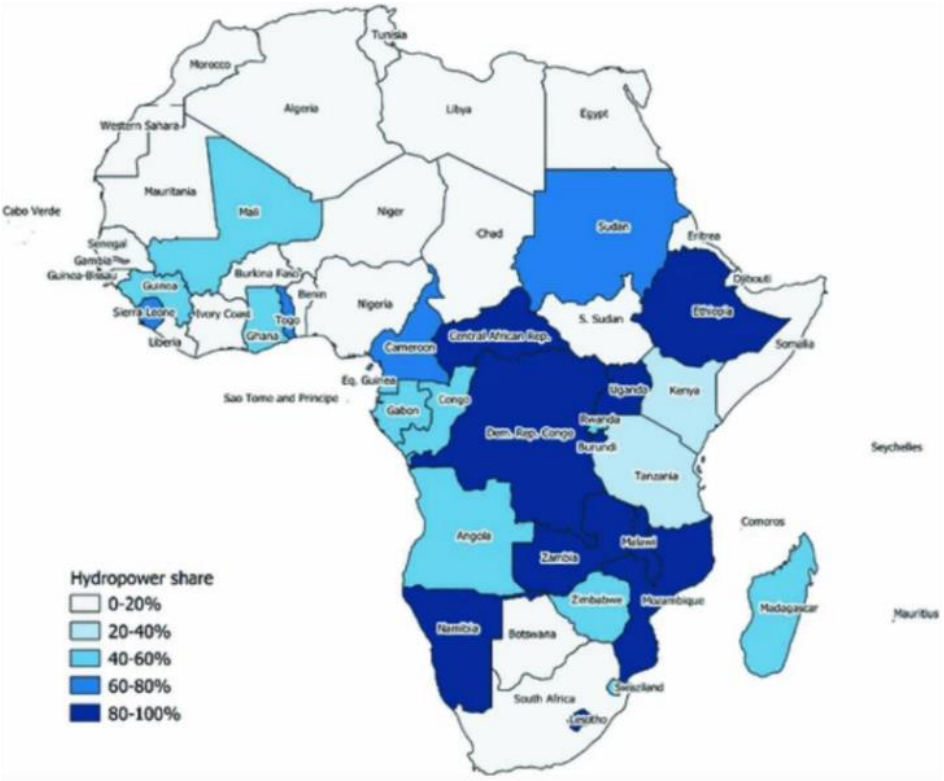


**Figure 3.** Country dependency on hydropower [1]

But the Large Hydropower still has some disadvantage. The first is that there is growing popular disagree to hydropower, especially considering the negative social and environmental effects of large and mega dams, both locally and across international borders. Large land areas may need to be flooded in order to build hydropower dams, which could result in the displacement of communities and a temporary reduction in the flow of water available for downstream uses like agriculture [4]. What's more, Africa is so draught that much water would be evaporated except to the rain forest. Which may lead to the waterpower offering and the water level may not be stabilize, and using some hydropower for some countries may not be a good choice. Third, the hydropower project makes some species cannot go back to upstream from lower reaches of a reiver which lead to them die out. For instance, the paddlefish are migratory group, they spent most of time in the lower reached of the Changjiang River. In March and April, they need go back to upstream to lay eggs. But Three Gorges Dam prevent them to back to the upstream, so they lose their spawning grounds. This is one of the reasons of paddlefish extinction. Finally, is the hard problem that most countries in Sub Saharan

African cannot afford the fund of making hydroelectricity project alone, which may lead to the project will be postpone such as Grand Inga. So, some countries may think about the Small Hydropower.

### 2.2. The small hydroelectric power advantages and disadvantages for Sub-Saharan Africa

Although the cost for conserving the hydroelectricity power project is cheaper than other renewable energy, the cost for contracting one hydropower is very expensive and it takes lots of time to build one hydropower. Many countries cannot afford this cost, so they will consider the small hydropower or borrow many from the others, but borrowing money will meet many problems. The Grand Inga project is an example. Because of funding problem, it still didn't finish building. Comparing the large hydropower, the small hydropower is cheaper to build and easy to design and contract, though it cannot provide as many energies as the large hydro power. What's more, the climate and rainfall variability are not stabilized in Sub Saharan Africa, so the small hydroelectricity power project is enough for most countries.

But it also has bad influence for the environment like Large Hydroelectricity power, such as producing much green gas. Because the organism on the land which is flooded by the river may cause itself broken down to methane and nitrous oxide [6]. What's more, in many studies, the natural flow regime in the diversion of river section has been changed by small hydroelectricity [7]. Nonetheless, the level of bad influence for environment by Hydroelectricity power is still less than some chemical energy like carbon dioxide which can exacerbate global warming if it is too much. And comparing to this small influence for the environment, providing enough electricity for the public is more necessary. If the government publish one policy about protecting the environment before solving the problem that people have no access to electricity, which may make the public disagree this policy and prevent to it.

## 3. The Solution for the Hydroelectricity Power Problem in Sub-Saharan Africa

Most countries in Sub Saharan Africa must face two problems that they cannot afford high cost in contracting the Hydropower if they want to build a Hydroelectricity energy project. And Hydroelectricity energy project cannot provide enough energy for some countries which may not have large potential in hydroelectricity. This paper provides a way called the Energy-Economic Chain. This Chain has two parts including working together with world and working together in Sub-Saharan Africa.

First, working together with world. Today more and more countries start using the renewable energy, but the renewable energy sometimes may not enough to provide energy for all need. Sub-Saharan Africa has very potential in Hydroelectricity, so they can publish a policy about making Hydropower with other countries or state like China or Europe. According to the International Energy Agency, projects with a Chinese company as the sole main contractor account for 30% of new capacity additions in sub-Saharan Africa. Of these projects, 56% are in the renewable energy sector, with hydropower accounting for the vast majority of them but increasingly also wind and solar energy [8]. The terrain of China is very complex, so it is hard to build the capital construction, but the Chinese engineers solve this problem which make China at the top of technique of capital construction. There many benefits for this policy. The Co-benefits is providing many jobs for the public to improve people living qualities. For China, China provides the technology, engineers, and funding to help to contract the Hydropower project. It can get two parts of benefits. First, China can get some mineral resources from the Sub-Saharan Africa like copper, aluminum which can alleviate the problem of insufficient domestic mineral resources. Secondly, putting in the geopolitical context, the United States proposes an Asia-Pacific strategy to limit the development of China. So, China has to do something to break through this strategy like publishing the policy called One Belt One Road. In One Belt One Road, China helps many countries to build the capital contraction and get some resources like oil in Middle East also make friends with them. For Sub Saharan Africa, they would have Hydroelectricity energy project to provide energy so the public can have access to electricity. What's more, one of the most

significant partners in the discussions and developments surrounding Africa's energy is the European Union (EU) and its institutions. Since the creation of the European Union Energy Initiative (EUEI) ten years ago, the EU and its member states have contributed over €12 billion to development cooperation aimed at facilitating access to energy in ACP (African, Caribbean, and Pacific) nations. The Africa-EU Energy Partnership (AEEP), which focuses on energy access, energy security, renewable energy, and energy efficiency, was adopted by the EU and important African energy stakeholders in 2007 under the EUEI framework. The ACP-EU Energy Facility, a crucial component of the EUEI, provided more than €180 million in funding for energy access projects in 36 African nations in 2005, and the second ACP-EU Energy Facility provided more than €200 million in 2009 (AEEP, 2012). And in most Europe countries, the area cannot contract a big energy project, so Sub-Saharan Africa can provide energy for them to get the funding for contracting the Hydropower [9].

The second step is countries in this area should work together after Sub Saharan Africa have some green energy projects. For example, Congo has higher waterpower so it also offers some electricity for surrounding countries which may not have enough electricity for the public, but they have harbors for trading like South Africa. And these countries can give some funding for Congo to conserve the Hydropower project or contract the new one. Besides, in order to solve the problem that some countries may have not enough energy through hydroelectricity energy project, Sub-Saharan Africa needs to have a variety of renewable energy especially solar energy. According to one study of potential for countries, the largest concentration for solar energy in Africa is South Africa whose up to 43275TWh/year, 42243TWh/year for solar PV [10].

## 4. Conclusion

This study set out to solve the Sub-Saharan Africa energy providing problem. To solve this problem, this paper analyzes the advantage and disadvantage of hydropower for Sub-Saharan. There are many advantages for hydroelectricity power energy for Sub-Saharan Africa. First, Sub Saharan Africa have the potential to develop. Second, the technique of hydroelectricity plant is more well-established. Thirdly, building the hydroelectric power project could also solve the water problem. Besides, hydroelectricity energy projects are conveniently dispatchable. Finally, the cost for conservation is cheaper than other renewable energy. But the disadvantage is obviously like causing the environment problem like global warming and destroy the zoology in Sub-Saharan Africa. And this paper tries to find one way to solve the funding problem called Energy-Economic Chain. This way means that Sub-Saharan Africa shares the energy or resources to get the funding and technology to contract the hydroelectricity energy project. Although contracting the hydroelectric energy project may cause many problems, the first problem that Sub-Saharan Africa countries need to solve is the energy problem, which is most important for these countries to develop the economic. But in the future, research needs to find better ways to solve the problem in contracting the hydroelectric energy project, especially how to decrease the methane generation and the destroy for environment.

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