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Impacts Assessment of Energy Development in Ethiopia

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Abstract - *Ethiopia is a nation endowed with huge amount of water, wind, solar and geothermal energy potentials. However, regardless of its enormous potentials the energy system is highly dependent on traditional fossil fuels and biomass and only about 32% of the nation's population has access to electricity. Approximately 34 % of its over 100 million inhabitants live below poverty line. Given this fact, the country has engaged itself in unprecedented multimillion dollar energy projects in recent years for the developments of energy. However, it has negative as well as positive impacts in the life of people around the plant site and people displaced for the plant installation. The entire impacts of some hydro power plants, wind, geothermal and biomass plant is assessed. In the construction of the EGRD project, more than 5000 people will be resettled from the reservoir and downstream area. Villages near the reservoir (home to over 7000 people) may also need to be relocated. Political tensions between Ethiopia and Egypt have continued yet. . It provides employment opportunity that increases the welfare of the nations at large and currently more than 5000 people are working in the dam construction. The project has been labeled as the "world's most controversial dam". There is also controversy regarding Kenya's Lake Turkana at which half million people depends on by the development of Gibe III hydro power plant. This is because the Omo River, on which Gibe-III dam is built, is its umbilical cord. 90% of the inflow to Lake Turkana depends on the river, which conveys fresh water and vital nutrients (such as nitrogen) that sustain the lake, and whose floods provide stimulus for fisheries breeding have led socio-political tension.*

In other hand the rubbish waste to energy Repi-Koshe biomass power plant impacts 5 million people around Koshe in Addis Ababa breath better air than before beside electric energy generation. The plant created work opportunity for 90 Ethiopians and 221 foreigners deployed during its construction have positive impacts.

Key words: *Energy, Impacts, Hydro Power Plant, Biomass Power Plant, Political Tension*

1. INTRODUCTION

Energy in the elementary definition, it is a capacity to do work. Energy supply is directly or indirectly strongly connected with a human well-being, prosperity and civilizations across the world. From simple vehicles to huge cargo locomotives, hand watch to super sophisticated computers, water heating and air conditioning, energy constitutes a critical part of our daily life. Britain coal finding for energy source accelerated textile industry of textiles production rate during initial industrial revolution. Energy production development which is increased supplying and utilization of energy for its service requirement is a fundamental component of enhanced social-political and economic development [1]. Besides our daily life benefits from energy, agriculture, manufacturing, transportation, construction, health and social services are also depend on the access of energy. Therefore, the economic and international social development determines the availability and use of suitable energy sources.

There is also a close interaction between an inadequate supply of energy and poverty. It is estimated that more than 1.3 billion people, approximately one in five globally, still lack access to electricity and almost all of them live in developing countries [2]. Meanwhile, about 2.6 billion people rely on solid fuels such as wood, coal, and charcoal for subsistence, which cause emphysema and other respiratory diseases and kill approximately 1.5 million people annually, therefore the access to electricity must be environmental and socially sustainable (World Bank, 2013).

Moreover, the population growth increase, industry and urbanization, and its increasing demands for more food, goods and services have put enormous challenges to the energy supplies and energy structure, which was dominated by fossil fuels nowadays. There will certainly be an abundance of health impacts by indoor and environmental pollution, lack of goods and services. Hence economic growth will be stunted and poverty will remain by continuous droughts and natural damage. Therefore, energy supplies must be sustainable and diverse including all energy sources rather depending on limited energy inputs to convenient economic development. As energy is the driver for development, sustainable energy is the stimulus for sustainable development. Therefore, energy development must be economically feasible, demand satisfying and suitable for the operation and environmentally friend.

However, in other side the development energy demonstrates a negative impacts creating natural imbalance depending on types of its primary energy inputs. The world energy balance performed by international energy association for the year 2015 indicates still more than 70% of energy source is from fossil fuels such as petroleum products, coal and natural gas as shown in figure-1. As the demand of energy increases, there is also continuous increase of environmental polluting gases such as CO_2, CFC, NO_X and like and rescue for global warming, and Ozen layer depletion leading to doomsday. Recent studies shows CO_2 emission rate increasing year to year 1.4%. Ethiopia indeed

frequently affected the westerns pollution impacts and that is why Ethiopia has developed its Climate Resilient Green Economy Strategy to transform it by 2025 from its present LDC status with agriculture as its main economic sector and annual per capita greenhouse gas emission of 1.8 tonnes to a lower middle income status with industry as its main economic sector and with zero net carbon emission [3].

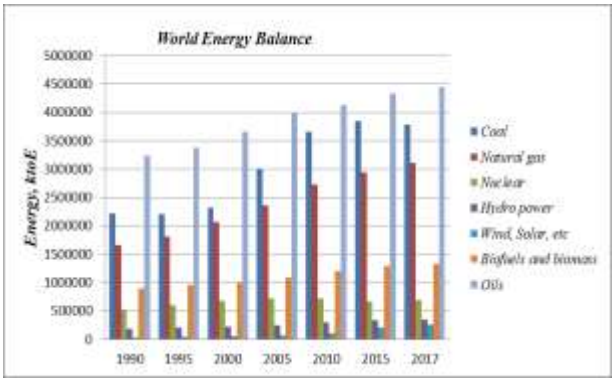

Fig-1: World primary energy shares

1.1 Background

Ethiopia has huge amount of renewable energy resources and has the potential to generate over 60,000 megawatts (MW) of electric power from hydroelectric, wind, solar and geothermal sources alone. As a result of Ethiopia's rapid GDP growth over the previous decade, demand of electricity has been steadily increasing. Despite Ethiopia's huge energy potential, the country is experiencing energy shortages as it struggles to serve a population of more than 100 million people and meet growing electricity demand which is forecast to grow by approximately 30% per year [4].

Table-1: Energy Resource Potential of Ethiopia

Resources	Units	Exploitable Reserve	Exploited, %
Hydropower	GW	45	<5%
Solar	kWh/m^2	4-6	<1%
Wind: Power	GW	100	<1%
Speed	m/s	>7	
Geothermal	GW	>10	<1%
Wood	Tones(million)	1120	50%
Agricultural wastes	Tones(million)	15-20	30%
Natural gas	m^3 (billion)	113	0%
Coal	Tones(million)	300	0%
Oil shell	Tones(million)	253	0%

The Government of Ethiopia has focused on the construction and expansion of various power generating projects to deliver reliable electricity. Approximately 90% of the installed generation capacity is from hydropower while the remaining 8% and 2% is from wind and thermal sources respectively. The hydro dominated systems have been severely affected by drought, and the Government of Ethiopia (GOE) is now diversifying the generation mix with other sources such as solar, wind and geothermal that will result in a more climate-resilient power system.

The Metahara solar independent power producer project is expected to generate 100 MW following approval of the implementation agreement by the Ethiopian government during the second half of 2018. Enel Power, an Italian company, will operate the project. The government of Ethiopia is also working with the private sector to implement the Corbetti and Tulu Moye geothermal projects with over 1,000 MW of combined generation capacity. Ratification of IAs by the House of Peoples Representatives is the last critical step to concluding these two 520 MW projects. On August 19, 2018, Africa's first waste to energy facility, with a generation capacity of 25 MW of electricity, was inaugurated in Addis Ababa. This facility has the capacity to consume 420,000 tons of trash per year.

The Grand Ethiopian Renaissance Dam (GERD), expected to be the largest dam in Africa and to generate 6,450 MW of electricity at full capacity, is reportedly 68.8% completed. The Government of Ethiopia has prioritized construction of the GERD, which is intended to serve as an engine for industrialization and economic development. Ethiopia exports electricity to Djibouti (up to 100 MW) and to Sudan (up to 100 MW) and has concluded power export deals with Kenya and South Sudan. Construction of an Ethio-Kenya-Tanzania transmission line is expected to be completed in 2019. Ethiopia has plans to export up to 400 MW of electricity to Kenya and 400 MW to Tanzania.

The Government of Ethiopia plans to construct an additional 9,000 kilometers of distribution lines and to complete, in the next few years, construction of 102 kilometers of 66 KV transmission line, 3,706 kilometers of 132 KV transmission line, 4,546 kilometers of 230 KV transmission line, 2,947 kilometers of 400 KV transmission line and 61 kilometers of 500 KV transmission line. The total transmission line length has reached 19,664 km. Only 30% of the country has access to electricity, of which only 60% of households are connected to the grid.

The country devised The Growth and Transformation Plan and with it came rapid expansions in various sectors of the economy. With the economy growing very fast on an average every year, the energy demand of the economy is rising and the country is exploring the different possibilities to meet this growing energy demand that comes as the result of such prompt growth in economy.

To mitigate environmental degradation and pollution problems that could result due to such rapid economic growth. The country laid down the strategy known as the Climate Resilient Green Economy Strategy, which is expected to guide the country into a sustainable development path in various sectors, principally in the energy sector.

The Climate Resilient Green Economy strategy is the response to the country's ambition to build net emission free economy by 2025, while bringing the positive impact of sustainable development needed in various sectors such as health, social justice, economic growth and natural resource conservation (Federal Democratic Republic of Ethiopia Climate Resilient Green Economy strategy, FDRE, CRGE 2011).

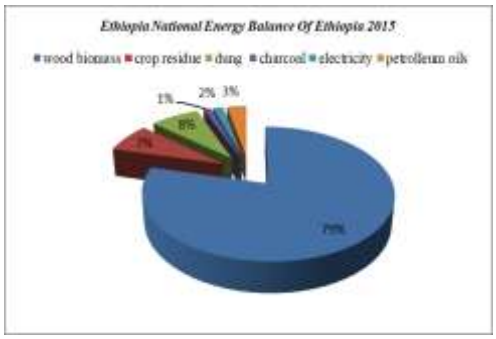

Fig-2: National Energy Balance of Ethiopia [5]

Ethiopia is one of the least developed countries in the world. Approximately 34 % of its over 110 million inhabitants live below poverty line [6]. The economy is one of the fastest growing country in the world, with an average growth of 10,8% since 2005 and demands approximate 2.5 times energy development for 1% annual average growth and have ambitious plans to achieve a climate resilient energy development till 2025 [7]. The existing power generation in Ethiopia and the projected energy requirements from the .year 1990 through 2040 indicate and prove that the power generation needs to be increased by 4 times by the year 2000, more than 14 times by 2020 and about 25 times by 2040. It was the first developing country which submitted its NDC (Nationally Determined Contribution) at the UNFCCC (United Nations Framework Convention on Climate Change) and therefore takes a leading role in climate policy of the most vulnerable countries to climate change.

This paper demonstrates the socio-political and economic impacts in the development energy sector in Ethiopia based on the real data and situations observed directly. This is mainly concerned with the process of electricity generation rather than the environmental and house hold pollution. Most of it is hydro-electric power generation, wind power, geothermal and solar power plant. Due to limited time and materials I concentrate in hydro-electric energy, wind, geothermal and biomass Rephi-Koshe power plant development since it accounts majority source.

1.2 Current Energy Situation of Ethiopia

Ethiopia has a final overall energy consumption of around 40,000 GWh, whereof 92 % are consumed by domestic appliances, 4 % by transport sector and 3 % by industry. Most of the energy supply thereby is covered by bioenergy, which in case of domestic use is usually stemming from unsustainable sources. The produced electricity of approximately 9000 GWh is mainly generated by hydro energy (88 %) followed by wind energy (4 %), whereof in total 11 % get exported. In contrast the major share of energy supply for transport is imported in forms of petroleum.

Ethiopia is endowed with renewable energy sources. These include first of all hydro, but also wind, geothermal, solar as well as biomass. Only a small portion of the potential is harnessed today.

Due to its fast economic growth the energy demand is increasing enormous. Therefore it is expected to rise by a rate of 10 -14 % per year till 2037. Today only 27 % of the population has access to electricity grid. This share is increasing due to an extension of the national grid on the one hand and an increasing number of Stand-alone-systems and Mini-grids on the other hand.

1.3 Objectives of the study

The main objective of the study is to conduct negative and positive impacts assessment of energy development in Ethiopia.

The specific objectives of the study is to assess the economic, social, socio-political, and cultural impacts on the life of the people in the energy development process by using hydro power energy source, wind power, geothermal power plant, and biomass power plant energy sources. It aims to show that the challenges of Ethiopia facing by the socio-political tension with neighbour countries and abroad in the developmental process of energy. Finally to recommend the suitable energy production methods and the way of reducing negative impacts and emphasize the positive impacts.

2. ENERGY DEVELOPMENT & ITS IMPACTS FROM DIFFERENT SOURCES

2.1 Hydropower

Although hydropower has no air quality impacts, construction and operation of hydropower dams can significantly affect natural river systems as well as fish and wildlife populations. Negative impact of dams are as follows: in flat basins large dams cause flooding of large tracts of land, destroying local animals and habitats; people have to be displaced causing change in life style and customs -about 40 to 80 million people have been displaced physically by dams worldwide; large amounts of plant life are submerged and decay anaerobically; the migratory pattern of river animals like salmon and trout are affected; dams restrict sediments that are responsible for the fertile lands downstream; salt water intrusion into the deltas means that the saline water cannot be used for irrigation; large dams are breeding grounds for mosquitoes and cause the spread of disease; dams serve as a heat sink, and the water is hotter than the normal river water - this warm water when released into the river downstream can affect animal life.

Ethiopia is land locked no oil source country and paving to reach lower middle income country using its thought white gold, water for its economic development. Ethiopia's highlands enjoy high rainfall that generates huge rivers, with much of this water flowing out into other countries. This includes almost70% into the Nile Basin and 14% to Kenya's Lake Turkana. According to the Ethiopian Electric Power Cooperation hydropower is the main source of power generating about 88 % of the electricity consumption in the country as indicated in section 1.2. The country has enormous additional potential for extensive hydropower development. The national water resources are estimated to have the potential to generate as much as 35-45 GW of power from economically feasible hydropower projects which is second huge potential of hydropower energy in Africa next to Democratic Republic of Congo (World Bank2006).

Table-2: Some hydropower plants of Ethiopia

Name of the Plant wer plant	Installed capacity in MW	Number of units	Type of dam	Location
Gilgel Gibe III	1870	10	Concrete gravity dam	SNNPRG
Beles	460	4	Natural dam (lake Tana)	State of Amhara
Gilgel Gibe II	420	4	Diversion dam	SNNPRG
Takeze	300	4	Concrete gravity dam	State of Tigrai
Gilgel Gibe I	184	3	Concrete gravity dam	State of Oromia
Melka Wakena	153	4	Concrete gravity dam	State of Oromia
Fincha	134	4	Gravel dam	State of Oromia
Amerti Neshi	95	2	Concrete gravity dam	State of Oromia
Tis Abay II	73	2	Natural dam (lake Tana)	State of Amhara

Most the newly build hydro power plants are solely financed by the Ethiopian government and share peoples after the construction of Gibe-I hydro power plant whom financial support got from world bank with long committed negotiations. Although Ethiopia is a poorest country in the world, it has strong stand to be out of poverty thus believed the development of energy can play great role rise up its GDP. In this transition Ethiopia faced so many challenges and so many impacts of energy development encountered which is the objective of this study.

Due to this fact several efforts have been undertaken to attack poverty in Ethiopia through sustainable economic development policies and strategies. One of the activities that have been done is the contraction of hydropower dam. During the last ten years the country managed to construct six hydropower dams (Including Gibe-III) that provide additional 3,331 Megawatt (MW). The constructions of these dams have increased the availability of energy supply by close to six fold. To meet the current annual 34 percent growth rate of energy demand in the country the Government of Ethiopia has started the new dam which is known as Ethiopian Grand Renaissance Dam (EGRD). This dam expected to produce 6000 MW; it will be the largest hydroelectric power plant in Africa when completed, as well as the 10th largest in the world. The main purpose of this brief article is to present the impacts of the EGRD on economic development in Ethiopia.

Ethiopian Grand Renaissance Dam (EGRD)

Ethiopian Grand Renaissance Dam construction started officially by declaring of former prime minister of Ethiopia Mr. Melese Zenawi along the Nile River in the western Benishangul-Gumuz region called Guba on the course to be completed in five years interval to generate designed 6,000 megawatt electricity. Although it is in the seventh year of full potential construction but less than 68 percent is completed design modification later made to generate 6450 megawatt electricity. The dam project completed the dam will hold up to 62-67 billion cubic meters of water after complete and has planned to fill water in the four years term interval without interrupting the water share of bottom countries.

A number of agency such as Oakland Institute, Anti-dam NGOs, Survival International, International Rivers, and the Friends of Lake Turkana, and with the support of Human Rights Watch are doing all possible efforts to stop the construction of hydropower dam in Ethiopia. I think these organizations will survive and mobilize dollar when Ethiopian suffer by poverty. But today all Ethiopian has recognized that poverty is their number one enemy [8].

Fig-3: Design Picture of Ethiopia Grand Renaissance Dam

Impacts of Ethiopian Grand Renaissance Dam

One of the factors that play the great and wide range role in the economic development of one state is the supplying adequate energy demand. The construction of Renaissance dam of Ethiopia is directly or indirectly will affect many

parts of the country economy at large. The first and the direct impact of Ethiopia Grand Renaissance Dam is to increase the energy supply from current 4 GW to 10 GW, which in other word it increases the Energy supply by 150 percent. This improves the quality and quantity of energy available in the country. According to various study a unit percent increase in energy supply increases economic growth by at least one percent. Therefore, when renaissances dam start operation the national economy increase by an additional 4 percent [8]. In other word the nation manages to produce an additional a billion USD National Products Output by energy selling. The total cost of the EGRD is about $ 4.7 billion which will be covered by Ethiopia Government and the public at large. It was impossible to get financial aid for the dam construction from any financial institutes as well as any country by negative pretend which become it as political issue. Egyptians frequently criticize as the dam reduces its water share and accused the dam water filling period to be prolonged and now it seems just cold wars. So many east Africa Nile issue discussions made but agreement has not attained yet and Ethiopia stand has been no force to stop the completion of the dam construction.

The availability of energy supply increase schooling of young peoples and health service facility in the country. It assists the application of modern technology flow in health and education sector that upturn health and education coverage and access through the country. The economic benefit of EGRD is two million Euros a day by selling electricity to neighboring countries as its plan. Such benefit of the dam in turn diversifies export earnings of the country and at the same time reduces the shortage of foreign currency reserve and advance energy links relation. It provides employment opportunity that increases the welfare of the nations at large and currently more than 5000 people are working in the dam construction. When the project completed it facilitate for the establishment of different types of enterprises that provide more employment opportunity in the future. In addition to providing employment opportunity it contributes for the structural change of the industrial sector in the country.

The local community before construction is greatly dependent on the fisheries and forest resources for their livelihoods (fishing, hunting, gathering fruits, honey, firewood, etc.). Displaced people were socially and economically impacted by displacing from their original fathers land. Since usually the indigenous people have strong linkage with their forefather land and water resources, and under the involuntary resettlement situation, it is stiffer for them to change to non-agriculture activities for livelihoods and compete in the job market due to their limited education backgrounds. In the construction of the EGRD project, more than 5000 people will be resettled from the reservoir and downstream area. Villages near the reservoir (home to over 7000 people) may also need to be relocated. This independent estimation of dam induced population displacement is much higher than the official figure of 800 people (International Rivers, 2012). Ensuring public trust and confidence requires that Ethiopian Government and the dam building companies need to sincerely fulfill all the promises of resettlement and compensation that they have made to the affected people. They also have to follow a clear and transparent plan for the implementation of the dam building project and its operation. Compliance with national or international guidelines and policies will keep coherence and facilitate in achieving sustainability of the dam project.

The socio-political impact arise in the development of EGRD is opposition from downstream neighboring countries specially Egypt, and Sudan.

Gibe-I-II-III hydropower

The source of the Gibe-Omo river, on which the Gibe-I-IV hydropower projects are being built ,flows from the southwestern highlands to southwards to Lake Turkana; a saline lake at the border between Ethiopia and Kenya. In recent years, a huge investment has been spent on the Gibe River in Gibe-Omo valley by the Ethiopian government cascaded projects, Gibe I-V. Gibe-I is the first hydropower plant to generate 183 megawatt electricity after fifty year 370 megawatt energy supply of a country completed 2004 and Gibe-II started to generate 420 megawatt electricity using 25 km long tunnel to turbine without dam. Gibe-II project has been out of service a few months after inauguration due to geological problems within the 25 km long tunnel. It has been blocked by muddy land slide within the tunnel and this unexpected impact takes time to resume services.

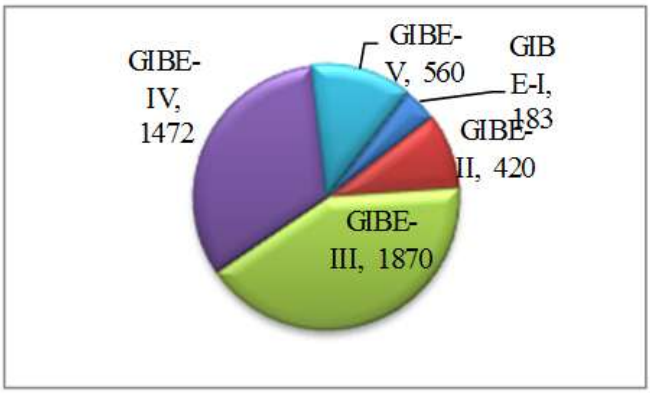

Fig-4: Gibe power plants energy share, MJ

Ethiopia's Gibe-III hydropower dam is now operational with the designed capacity, 1870 megawatt electricity even though sometimes power reductions due to water flow shortage. In this year the water level reduced 13m reduced from 892 m designed and constructed dam height more than 1000 megawatt reduction of electricity from its ten units. Gibe-IV hydropower project is under construction in this time for the designed capacity of 1,472 megawatt and also Gibe-V project plan for 560 megawatt energy to make Ethiopia energy hub of Africa [9]

Ethiopia faced so many economic environmental as well as political challenges through this Gibe-I-III hydroelectricity power development. During Gibe-I dam construction financial debit found from World Bank with some negotiations and have political impacts everyone thinking that the energy development the time as political show. Then after the energy development of the country has been turn to self-help investment and using of financial supporting contractors.

Fig-5: Gibe III hydroelectric power plant dam

Gibe III is the most recently commissioned project in the Gibe cascade has 243m height which is the tallest dam in Africa. Its power station's installed generating capacity of 1,870 MW is not so far short of the electricity generating capacity of the whole Kenya in 2015, 2,295 MW. The dam construction started in 2006 and was officially inaugurated in December 2016. The project cost is stated to be 1.47 billion Euros (USD$1.75 billion) with funding coming from the Government of Ethiopia and Exim bank of China.

However, rights groups have raised concerns over the impact that it is having on downstream communities and the environment. The Conversation Africa's Moina Spooner asked expert Sean Avery about the dam and the huge controversy that has surrounded this project. The project has been labeled as the "world's most controversial dam". At the start, the procurement of the dam contractor was determined to be non-transparent by the World Bank, and international donors shunned the dam. Construction also started without a license from Ethiopia's Environmental Protection Agency.

There have since been ongoing complaints about environmental and social impacts downstream, including villagisation and displacement of indigenous people. There is also controversy regarding Kenya's Lake Turkana. This is because the Omo River, on which Gibe-III dam is built, is its umbilical cord. 90% of the inflow to Lake Turkana depends on the river, which conveys fresh water and vital nutrients (such as nitrogen) that sustain the lake, and whose floods provide stimulus for fisheries breeding.

At least half a million people depend of the lake. Lake Turkana is also the world's largest desert lake and has three national parks that together form a World Heritage site. Due to these concerns, the Friends of Lake Turkana Trust challenged the project in Kenyan Courts, but the case stalled.

Secondly, Gibe III's river regulation has enabled irrigated plantation development. A potential of 450,000 hectares of agricultural development in the Omo-Gibe Basin has been mentioned. So far, 100,000 hectares from within the Omo and Mago National Parks and Tama Wildlife Reserve are being developed into sugar plantations and downstream, 50,000 hectares has been allocated to a foreign cotton plantation developer. There will be other schemes requiring water too [10].

Through abstracting irrigation water, these plantations will deplete the Omo river influx to Lake Turkana. The lake is already semi-saline, said to be on the salinity brink for some species, and depletion of inflows will increase the salinity levels. Also, chemical releases from plantation developments may adversely affect the lake.

Thirdly, the dams will cause a massive drop in Lake Turkana's water level. When the Gibe-III reservoir was filled in 2016, it caused the lake to fall two metres.

The Gibe IV dam, also called Koysha, under construction will be next in the Gibe cascade to be built, and this in turn will also deplete the lake by 0.9 metres during its filling, forecast for 2020.

Fincha Hydropower Dam

Currently, Fincha Hydroelectric power plant has an installed capacity of 128 MW and meets 27% of the national demand for power. The other important benefits of the increased Fincha reservoir through Amarti reservoir are the enhanced possibilities for irrigation and fishing and the creation of an important wetland; increased water availability and has reduced the risk of flooding in to downstream areas and the hydro reservoir supplies water to a sugar factory downstream, creating new economic activities and attracting various birds to the area [11].

Despite these and other socio-economic benefits for national economy, the Fincha hydroelectric power project has far reaching social, economic, cultural, environmental, and political side effects in the zone in general and for the people living in Fincha watershed in particular. As studies indicate, the first impact of the Fincha dam on the people in the watershed is related to the change of the land use in the area [12]. The land that is now submerged by the Fincha, Chomman and Amarti Lakes was previously used for arable crops and grazing, sustaining the lives of many farmers and their families. Studies also showed that the reservoir has inundated large areas of different land use types and evicted several people from their original places. Due to the construction of Fincha dam project in 1973, more than 3,115 households making an estimate 22,250 peoples were relocated and displaced against their will [13 14].

Before 1973, Fincha watershed was known for surplus crop production, vast expanses of pasture and great herds of livestock. It is one of the potential areas of the zone in terms of agricultural productivity and natural resources (Office of

Abay Chomman Woreda). Dechasa (2003) showed that the community in Fincha watershed is nowadays confronted with a decline in crop and livestock production and even recently with famine. As a result of decline in agricultural productivity and environmental degradation in watershed, deforestation, loss of wild animals and soil erosion are the immediate consequences of the dam [12]. Although Fincha project created new economic activities and provides Sugar Factor Industry in the zone, it greatly affected the market demand, structure, and supply of the zone and most importantly, social disturbances, cultural and economic deteriorations of the peoples in the Fincha watershed.

2.2 Wind Energy in Ethiopia

The EEPCo has been gathering data on wind power for more than a year and half at four sites, i.e. Mekelle, Adama, Gondar, and Afar, with support from GTZ, and is going to start data collection at another spot in the west of the country. As can be seen in figure 6, winds blow stronger during the dry season. Therefore, wind energy could be an ideal complement to hydropower.

Mekelle Wind Firm

A Chinese company has won the tender for a wind firm in Mekelle. The Chinese firm had tied money from a Chinese bank, which was almost 80% of the total cost. This is crucial for GoE/EEPCo who has to find finance for projects, which is not an easy task. Untied ODA is a trend in the world, but it should be reconsidered in the situation of new development partners such as China who are emerging with new methodology and logic.

Wind energy has potential and is one of the areas which the GoE/EEPCo prioritizes. Also, considering the complementary characteristics of wind power to hydropower, wind power is an area where Japan can contribute. The utilization of the Climate Change Mechanism Fund and Yen Loans (when the ban is lifted) can be mobilized and also private sector investment with IPP is highly possible.

2.3 Geothermal Energy in Ethiopia

Potential of Geothermal Energy According to EEPCo, geothermal energy development is second in priority to hydropower. Feasibility studies have been carried out since 1969 and the estimated total capacity of the geothermal energy of Ethiopia is about 700-1,000MW. However, the initial investment and safety issue for a geothermal energy plant is huge and also the risk is relatively high (the excavation of expensive wells frequently fails). Therefore, no big plant has been built for more than 10 years after the first pilot plant constructed at Alto-Langano.

Alto-Langano geothermal power plant is located 200 km south of capital Addis Ababa and started to operate since 1998. Two generation units supply 7.28MW in total, and about 3.5MW from each unit. There are two types of generator; one is a high-temperature vapor type that revolves the turbine directly (6,000 revolve/min) and another is a media (pentene) heated by middle-temperature vapor that revolves the turbine (1,500 revolve/min). The life-duration of a generator is normally 25-30 years with good maintenance but both the generators at the Alto-Langano pilot plant are now out of order. The reason is not clear but it is assumed that capacity building for maintenance should be strengthened because a geothermal energy plant requires skillful maintenance. A plan to build a third generation unit with 30MW has been suspended for a long time due to the difficulty of raising funds.

Fig-6: Alto-Langano Geothermal power Plant

The identified potential areas for geothermal energy plants are; lakeside areas, such as Alto-Langano (Corbetti and Abaya), South Afar area such as Tulu-Moye, Gedemsa, and Dofan, and last one is North Afar area including Tendaho and Dallol.

2.4 Biomass Energy (Rephi-Koshe) Power Plant

Ethiopian constructed 50MW Repi-Koshe biomass power plant from Repi-Koshe waste biomass in Addis Ababa which accumulated for half a century at the Repi Waste disposal of Koshe. It was the case of 114 people death around the area by land slide of the long time accumulated waste in 2017, prompting the government to declare three days of mourning.

Fig-7: Koshe waste Biomass accumulation

Repi-Koshe biomass power plant is the first Africa's waste to energy transformation plant placed. The plant was jointly run by the Cambridge Industries limited of England Company and C.N.E.E. Ltd of china. The plant consumes 1400 tone waste per day which is supplied by the city administration of Addis Ababa. Waste consumption rate is

roughly 80 per cent of the city's rubbish while supplying the city with 30 per cent of its household electricity needs. The plant stack is integration add by air pollution control mechanism to neutralize air pollutants from the plant and meeting European standards on air emissions. Therefore, rubbish waste to energy Repi-Koshe biomass power plant impacts 5 million people around Koshe in Addis Ababa breath better air than before beside electric energy generation. The plant created work opportunity for 90 Ethiopians and 221 foreigners deployed during its construction.

Fig-8: Repie-Koshe biomass power plant

3. RESULTS AND DISCUSSIONS

In the energy development based on energy development policy for the economic development as well its people wellbeing. The development of energy in the gibe-III power plant dam construction started in 2006 and was officially inaugurated in December 2016 by its total cost 1.47 billion by Ethiopian government with lion share because of opposition from donor institutions. There is also controversy regarding Kenya's Lake Turkana at which half million people life depends on. This is because the Omo River, on which Gibe-III dam is built, is its umbilical cord which 90% of the inflow to Lake Turkana depends on the river, which conveys fresh water and vital nutrients (such as nitrogen) that sustain the lake, and whose floods provide stimulus for fisheries breeding.

The availability of energy supply increase schooling of young peoples and health service facility in the country. It assists the application of modern technology flow in health and education sector that upturn health and education coverage and access through the country. The economic benefit of EGRD is two million Euros a day by selling electricity to neighboring countries as its plan. Such benefit of the dam in turn diversifies export earnings of the country and at the same time reduces the shortage of foreign currency reserve and advance energy links relation. It provides employment opportunity that increases the welfare of the nations at large and currently more than 5000 people are working in the dam construction.

Today, all Ethiopians being with the government have accepted and agreed strive that poverty is their number one enemy. Due to this fact the government several efforts have been commenced to attack poverty in Ethiopia through sustainable economic development policies and strategies. One of the activities that have been done is the contraction of hydropower dam for energy source that can be input for industries and advance life standards of the people. During the last fifteen years the country accomplished to construct hydropower dams, solar, wind, geothermal and biomass power plants.

However, Ethiopia is facing so many socio-political challenges from inside and outside of Ethiopia. From inside some opposition political party leaders eagerly wanting political authority and external propaganda that as the people displaced, destroyed and self-benefits. A number of agency such as Oakland Institute, Anti-dam NGOs, Survival International, International Rivers, and the Friends of Lake Turkana and with the support of Human Rights Watch are doing all possible efforts to stop the construction of hydropower dam in Ethiopia.

4. CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

The development of energy is mainly for the wellbeing of the nation and economic development of a country in large. The rural people using biomass for their heating, lighting and cooking energy demand usual face with chronic and respiratory disease due to its indoor pollution start using of clean energy by the development of energy. The existence of the manufacturing and service industries is first by the availability of energy sources to run their machines have goods and good public service is by the development of energy.

However, there is always positive and negative energy development impacts based on the selection of primary energy sources and types. These can case social economical and socio-political impacts on the peoples around the plant site and people resettle because of plant construction. The number of people resettled from the Benshangul-Gumuz region for the construction of EGRAD and its overall impact investment conducted. The first and the direct impact of Ethiopia Grand Renaissance Dam is to increase the energy supply from current 4GW to 10GW, which in other word it increases the Energy supply by 150 percent. The local community before construction is greatly dependent on the fisheries and forest resources for their livelihoods (fishing, hunting, gathering fruits, honey, firewood, etc.). Displaced were socially and economically impacted by displacing from their original land. In other hand Gibe I-III hydropower plants effects on the economic as well as socio-political issues discussed. The first and most impact Gibe III project has been labeled as the "world's most controversial dam". Fincha hydro power plant installed in 1973 to produce 128 MW electricity supplying 27% national electricity demand has also positive and negative impacts. In one hand the important benefits of the increased Finchaa reservoir through Amarti reservoir are the enhanced possibilities for irrigation and fishing and the creation of an important wetland; increased water availability and has reduced the

risk of flooding in to downstream areas and the hydro reservoir supplies water to a sugar factory downstream, creating new economic activities and attracting various birds to the area.

4.2 Recommendations

The feasibility assessment and detail impact assessment of power plant before its start periods and discussion until full agreement to be conducted in the energy development process. Giving money for displaced people is not sustaining their future life and it should be considered.

Anybody who interested further expand this work including all other energy supply power plants of Ethiopia that is now not included here due to data limitations can make it base.

Abbreviations

EEPCo -----Ethiopia electric power corporations

EGRD -----Ethiopian Grand Renaissance Dam

GERD -----Grand Ethiopian Renaissance Dam

GOE -------Government of Ethiopia

GWh -------Giga watt hour

KV ---------Kilo Volt

MW --------Mega Watt

NDC--------Nationally Determined Contribution

UNFCCC- United Nations Framework Convention on Climate Change

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BIOGRAPHIES

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