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Policy Options for Integrating Climate Change Adaptation into Hydropower Development in Kenya

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Abstract

As climate change continues impacting on various economic sectors all over the world, a lot of efforts are being put on adaptation actions. Energy is one of those sectors contributing more towards GHG emissions while renewable energy technologies have the potential of mitigating GHG emissions. Among all the renewable energy technologies being utilised, hydropower stands out to be the most stable and proven technology over time compared to geothermal, wind, solar, biogas and ocean waves among others. Despite hydropower being capable of mitigating the impacts of climate change while supporting some appropriate adaptation strategies, less emphasis has been put on how to integrate climate change adaptation into the hydropower development activities.

The objective of this study was to assess the existing climate change related policies to identify policy options that can support integration of climate change adaptation into hydropower development. Policy analysis framework methodology was adopted to evaluate the already existing climate change related policies to identify the policy options for integrating climate change adaptation in hydropower developments.

The results indicate there are several existing policies that are capable of supporting the integration of climate change adaptation in to the development of hydropower. This presents opportunities for supporting adaptation actions that are capable of addressing some of the impacts of climate change on the local community. The only existing gap is the formulation of the rules that can ensure that the appropriate actions are implemented on the ground.

Key words: Climate change, adaptation, policies, Hydropower development, Kenya.

I. INTRODUCTION

For many years human activities have resulted into continuous increase of greenhouse gases concentrations in the atmosphere. There are several greenhouse gases that occur naturally in the atmosphere such as carbon dioxide. The occurrence of these gases always keep the earth warm as they trap heat within the atmosphere. The major contributor to the atmospheric concentrations since the period of industrial revolution has been anthropogenic sources of CO_2. Some of the major sources that have been cited include the burning of fossil fuels for the production of electricity and also for transportation. The process is believed to have been intensified by other man made greenhouse gases such as Chlorofluorocarbons (CFCs). Increased concentration levels of these greenhouse gases are projected to cause substantial temperature rise in the next century. Due to the current rates of economic and population growth, the scientific consensus have projected a global mean temperature rise of approximately 3^{o}C indicated that the global mean temperature will rise by 3^{o}C by the close of the following century. Increase in global precipitation levels of approximately 15% is expected to accompany this temperature rise [23].

It is also projected that changes in the river flow characteristics specifically quantity and timing accompanied by increased water evaporation from the reservoirs have got higher likelihood of impacting on the hydropower production. This is inclusive of impacts on system operation, financial and other energy sectors [18].

Though hydropower has been identified as one of the projects that can contribute towards mitigation of Greenhouse gases (GHGs) emissions, less emphasis on climate change

issues has been considered during the planning, development and operational phases.

Hydropower being a renewable energy offers unique opportunity to support socio-economic developments locally in form of climate change adaptation strategies and actions. Therefore, it is important for the identification of these opportunities and harness them to form part of the activities for the integration of climate change adaptation into hydropower developments. It is expected that this will contribute majorly towards enhancing the local climate change resilience within the local communities where such projects are being implemented. These need to be supported by sound policies.

While it is well known that renewable energy technologies are capable of playing a major role in reduction of greenhouse gas emissions, less emphasis is usually put on the adaptation roles at the inception, implementation and operational phases. The major emphasis is usually placed on the hydroelectric power generation for economic benefits for the whole nation and not necessarily to benefit the local area within which the resource is located. A hydropower development scheme has the potential of providing major supporting role for the climate change adaptation actions locally.

For a long time, no considerations have been always put in place for integrating climate change adaptation into the implementation of hydropower development activities. This has made a major contribution in increasing local communities' susceptibility to impacts of climate change while improving social, economic and environmental conditions of the larger region. Currently there is a growing demand for renewable energy technologies all over the world. One of the key driving forces behind this growth is the climate change mitigation to address the root causes of greenhouse gas emissions. Apart from Greenhouse Gas (GHG) emissions reduction, renewable energy technologies also offer many other benefits including air quality as a result of low/no pollution and good health conditions compared to the use of fossils fuels [26].

The only benefit to the local community usually associated with hydropower development is corporate social responsibility (CSR) which does not guarantee climate change adaptation activities or programmes. This is also coupled with none existence of a clear implementation framework that can compel the hydropower development agencies to integrate climate change adaptation activities or programmes into the hydropower development plans.

Currently, climate change adaptation is being considered an essential element of sustainable development [26]. This adaptation can be in the form of anticipatory or reactive to the changing climate. Several renewable energy technologies are capable of supporting climate change adaptation efforts which is usually anticipatory in nature [22]. The hydroelectric power generation dams can also be utilized in the management of the impacts of extreme meteorological events such as droughts and floods. These events are projected to increase in the future based on the projected climate change scenarios [31].

Mainly the focus of this research is, therefore, to assess ways by which climate change adaptation can be integrated at conceptual, implementation and operational phases of hydropower developments. The objective of this study is to assess the existing policy options for integrating climate change adaptation in to hydropower developments.

The current drive for electricity generation expansion in Kenya is largely based on renewable energy. Among the renewable energy technologies, only hydropower is capable of providing both base load and peak load electricity supply for the growing peak demand. A well designed hydroelectric power plant is a strong driver for socioeconomic development as long as benefit sharing is adequately addressed [23].

II. LITERATURE REVIEW

Globally, climate change has got a lot of influence on precipitation and temperature. The two parameters determine availability of water resources for various competing uses including hydropower. Rainfall is considered the main river flow source for hydropower generation and other competing uses. In Kenya temperatures have been on increasing trends based on the long term observations. The minimum and maximum temperatures have risen generally by 0.7^{o}C to 2.0^{o}C and 0.2^{o}C to 1.3^{o}C respectively across the country [8].

The past changes in climate has recently caused a lot of impacts on human and natural systems globally. The evidence of impacts as a result of climate change is very strong. This evidence is most comprehensive within the natural systems. On the human systems, some of the impacts have been associated with climate change whose major or minor contribution can be distinguished from other influences [27].

Changing precipitation alters hydrological characteristics and this affects water resources in terms of the quantity and quantity. Hydropower will definitely be severely impacted on in future by these changes in climate due to the non-linearity nature of rainfall-runoff process. It has been observed that a reduction in rainfall by 10% can easily lead to a loss of hydropower generation by between 25% and 50%. At the same time a temperature rise by few degrees is also capable of substantially increasing evapotranspiration rates leading to severe impact on hydropower as well. Increases in year to year climate variability may well result in lower energy security in general [4].

Observation of rainfall trends in the past has given indications of a general decline of rainfall received in the main rainfall season of March to May also referred to as "Long

Rains" and a general increase during October to December in the region [8], [25]. The recent studies have shown that the "Short Rains" which normally occur during October to December season is now extending into what has been normally known to be hot and dry period of January to February season. As a result of these changes, drought is becoming more frequent and prolonged in the Long Rains Season.

There exist various publications for the studies on the impact of climate change on the river flows. These studies mostly used catchment hydrological models that are driven by climate change scenarios. These scenarios are based on the climate model simulations. Downscaling climate data that involves converting global climate model output into the corresponding climate data set in the catchments is always necessary before using any data in the catchment hydrological models. Finding the best methods for downscaling has currently been given high priority in research area whereby downscaling can be both temporal and spatial. [23].

Even though the climate change impact on the hydropower resource potential might sometimes be approximated as comparatively smaller on average at the global or continental scale, regional and local effects are more significantly possible. The factors that determine the hydropower resource potential include topography and hydrological characteristics such as the volume, variability of the flow and runoff seasonal distribution. In addition to depending on both the regional and local scales, an increase in the variability of climate without necessarily any variation in the mean runoff, is still capable of reducing the production of hydropower. This can only be avoided by increasing the reservoir capacity and modification of the operations to make them capable of accounting for the new hydrological conditions resulting from climate change.

Economic activities in any given area such as agriculture, forestry, fishing, mining, manufacturing among others are usually very sensitive to the climate change consequences. This can normally be attributed to their immediate dependence on the natural environment [20]. These economic activities dominate the Sondu Miriu River basin.

The impact of climate change on most of the economic sectors are projected to be relatively smaller compared to the impacts contributed by the other drivers. The changes in other factors will have major impacts especially on the demand and supply of economic services and goods that are most likely to be larger compared to impacts arising from climate change. These factors include age, population, household income, applied technology, relative prices both locally and globally, lifestyles, existing regulations, governance and other aspects of socioeconomic developments among others [20].

In responding to climate change mitigation and adaptation are the two main approaches. The Intergovernmental Panel on Climate Change (IPCC) defines mitigation as "an anthropogenic intervention to reduce the anthropogenic forcing of the climate system, which includes strategies to reduce greenhouse gas sources and emissions and enhancing greenhouse gas sinks" [19].

Adaptation is also defined by the IPCC as "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities" [19].

The mitigation actions are mostly known for tackling the issues that are most likely to cause climate change. These actions normally target the reduction of CO_2 emissions. The mitigation actions may be implemented at any scale. This may range from local to global scale. On the other hand, adaptation actions aim at tackling the consequences resulting from climate change mainly targeting at local and regional scales. This is due to the fact that the benefits associated with adaptation actions are felt either locally or regionally [24].

Because adaptation is part of climate-resilient pathways, integrating adaptation actions has been proposed as an aspirational goal. This has been proposed within the broader framework of sustainable development [33], [2] particularly when the existing policy consideration and financial commitments towards response to climate change have to focus on pursuing adaptation actions. In practice, however, adaptation actions normally have a tendency of involving various community interests, schedules and responsibilities for decision making [19], [33].

The framing of adaptation as it is currently has been moved to focus more on the wider socioeconomic drivers of vulnerability and people's ability that can help them in responding to the climate change impacts. This has changed from initial focus which was mainly on biophysical vulnerability. The socioeconomic drivers include issues to do with gender, health, age, social ethnicity and institutions put in place either locally, nationally, regionally or even internationally. The expression of adaptation goals is normally done in terms of the ability to increase resilience. This usually encourages the incorporation of broader development goals with multi-sectoral objectives and various scales of operation that are capable of capturing complex interactions involving human societies and environment within which they exist [28].

So long as there is existence of anticipated risks and experienced impacts due to climate change that need actions for ensuring safety and security of the population including their own assets as well as ecosystem and their services, adaptation needs will always arise. Adaptation needs can be described as the difference between what is most likely to happen due to climate change impact and what would be preferred to happen. For the National Adaptation Programmes of Action (NAPAs) "needs" have been looked at in the form of major vulnerabilities and adaptation activities which are of high priority. This may be referred to as a hazard based approach. This approach pays more attention to the drivers of

climate change impacts and actions with a target of moderating them. It is still most commonly used approach in many urban and regional programmes. The focus has recently changed to find ways of how the underlying causes of vulnerability can be addressed. These include various needs including information, capacity, financial, institutional and technology.

Currently, the availability of economic resources for combating climate change are limited. This has resulted into a major policy challenge. The challenge is how to determine the aspects that can constitute a balanced mix of adaptation and development policy socially, economically and environmentally [22].

A further aspirational goal is the integration of responses to impacts of climate change into the development processes. Recent research outcomes proposes that adaptation actions can be very effective provided they are planned and also integrated into the framework of other development programmes and interventions which must be within the wider framework of sustainability and resilience [34], [1].

Choices usually available for integrating adaptation will always vary depending on the prevailing circumstances within each and every country and where it is located [32], [3]. Adaptation may be considered to be of high priority for the countries that are highly vulnerable due to the immediate benefits obtainable as a result of reducing vulnerabilities on the basis of prevailing climate variability and extremes including the projected future climate changes.

One of the emerging strategies currently for integrating policies for climate change and development is designing of "win-win" and "triple-win" solutions or interventions. These solutions or interventions should seek the achievement of a balanced mix of adaptation actions that are within the sustainable development framework [29], [30]. It has also been suggested by Swart and Raes that whenever conducting evaluation of combined adaptation policy designs several factors need to be considered such as;

1. No trade-offs during the design of adaptation policies;
2. Identification of collaborations;
3. Enhancement of capacity to respond;
4. Development of linkages for national and international institutions;
5. Sustainable development policies to incorporate adaptation issues.

The existing enabling policy and legal framework that guides Kenya's response to climate change are outlined as follows:

(a) National overarching policy – The Constitution and Vision 2030.
(b) National climate change policies – These include the National Climate Change Response Strategy of 2010, the Climate Change Act of 2016, the Climate Change Framework Policy of 2017, the Kenya's National Climate Action Plan from 2013 to 2017, and the National Adaptation Plan from 2015 to 2030.
(c) National Supporting Regulations and Policies – These include the Green Economy Strategy and Implementation Plan (GESIP), the Climate Risk Management Framework, The environmental Management and Coordination Act (EMCA) and the National Climate Smart Agriculture Strategy.
(d) County framework– Climate Change Fund regulations.
(e) Regional framework– These are Africa Agenda 2063 and the East Africa Community Climate Change Policy, Strategy and Master plan.
(f) International framework– UNFCCC, Paris Agreement, Nationally Determined Contributions (NDC), link to Sustainable Development Goals (SDGs).
(g) The Climate Change Act has set out governance or institutional structures for guiding action. Good examples are the National Climate Change Directorate which is the lead agency, NCCAP, Climate Change Fund and role of counties among others.

A. *The Constitution of Kenya 2010*

The 2010 constitution provides the right to goods and services to every consumer. These goods and service should be of reasonable quality and necessary information provided to the consumers to enable them in obtaining full valuable benefits from these goods and services offered, protecting their health, safety and economic interests and also compensation for any loss or injury that may arise from any defect in the course of providing these goods and services. This is directly linked to the electricity services which requires the government to put measures in place that ensure that all citizens are being given access to reliable, efficient and clean energy systems and full knowledge of the sources of energy available [9].

B. *Vision 2030*

The Vision 2030 aims at transforming Kenya into an industrialized middle income economy country that provides life of high quality for all citizens in an environment that is clean and secure. 10% economic growth has been projected by the vision 2030 of which climate change will affect 3% of that growth. The implementation of Vision 2030 is done through medium term plans (MTPs). The NCCAP is already aligned with the MTPs [7].

Currently, the existing Kenya National Climate Change Plans include;

1. The National Climate Change Response Strategy,
2. The National Climate Action Plan which is a five

year plan,
3. The National Adaptation Plan,
4. The Green Economy Strategy and Implementation Plan.

C. Climate Change Act (2016)

This Act applies for the management, development, regulation and implementation of mechanisms that are capable of enhancing low carbon development and climate change resilience for sustainable developments in Kenya. The Act is applicable to all economic sectors by both the national and county governments in order to address the various specific objectives as listed here below [13];

a) Mainstreaming responses to climate change into decision making, development plans and implementation.
b) Improving the capacity to adapt and also building resilience to climate change impacts.
c) Formulating plans and programmes that are capable of improving the capacity to adapt and also resilience of both socioeconomic and environmental systems to climate change impacts.
d) Mainstreaming and reinforcing reduction of disaster risk that may be associated with climate change into public and private sector strategies and actions.
e) Intergenerational and gender equity mainstreaming in all responses to climate change.
f) Giving obligations and incentives that can enable the private sector to contribute and participate in achievement of various low carbon and climate resilient developments.
g) Promoting low carbon technologies, efficiency improvement and emission intensity reduction through uptake of technologies and facilitating approaches that are capable of supporting both low carbon and climate resilient developments.
h) Facilitating development of capacity especially to enable public participation in responding to climate change through consultations, representation and creation of awareness and information access.
i) Mobilizing and managing all the financial resources for climate change responses in a transparent way.
j) Putting in place mechanisms for ensuring facilitation of climate change research and development, training and capacity building.
k) Incorporating the principle of sustainable development into decision making process and planning for climate change response.
l) Considering climate change issues with an aim to incorporate them into exercising of powers and functions at all levels of governance and strengthening collaboration between the national and county governments in climate change governance.

D. Climate Change Framework Policy (2017)

This policy focuses mainly on the inter-linkages particularly the ones involving sustainable development and climate change. This is because the impacts of climate change are more adverse on key important socioeconomic sectors such as energy; environment, water and forestry; agriculture livestock and fisheries; trade; extractive industries; tourism; physical infrastructure; and health. Intervention measures are well elaborated in this policy that can contribute towards achieving low carbon and climate resilient developments [16].

The main purpose of this policy is for facilitating effective, coherent and coordinated response to challenges and opportunities resulting from climate change at the local, national and global levels. It has adopted an overarching mainstreaming approach to ensure that all the necessary climate change issues are incorporated into all development plans including budgeting and implementation schedules across all the sectors and levels of government. The main aim of this policy is therefore building resilience and enhancing adaptive capacity to deal with climate variability and change while at the same time promoting low carbon development pathway [16].

E. Climate Finance Policy

This policy provides for institutional, legal and reporting frameworks for access to and management of climate finance. This policy aims at enabling and supporting Kenya's national development goals related to climate change. This is done by enhancing climate funds mobilization. The mobilized funds contribute towards both low carbon and climate resilience development goals [17].

F. National Adaptation Plan (2015-2030)

The main aim of the National Adaptation Plan (NAP) is consolidation of the country's vision on climate change adaptation. The adaptation actions are to support the country's vision at macro-level relating to the socioeconomic sectors and also vulnerabilities at the county level for strengthening long term adaptive capacity and resilience. The current National Adaptation Plan has presented various climate change adaptation actions covering the period from 2015 to 2030 [14].

G. *National Energy Policies*

The energy sector in Kenya has been undergoing reforms. This has led to the reorganization of the whole sector to align it with the constitution and clearly separate and assign various roles within the sector. The sessional paper no. 4 on energy is the current policy in force in the energy sector [6]. This current policy is under review to come up with a more enhanced National Energy Policy.

H. National Energy Policy 2004

This policy is also referred as the sessional paper no. 4 on energy. This policy was established in May 2004 and was aimed at ensuring quality, adequate, affordable and cost effective supply of energy so that it is capable of meeting the needs for development while at the same time conserving and protecting the environment. The policy's specific objectives can be summarized as follows [6];

a) Provision of quality energy services to support sustainable development.
b) Utilization of the energy as a tool to accelerate economic empowerment and growth for the purpose of development in both the rural and urban areas.
c) Improving accessibility to energy services that are affordable.
d) Providing an enabling environment that is conducive for energy services provision.
e) Enhancing energy supply security.
f) Promoting indigenous renewable energy resources development.
g) Promoting conservation of energy and energy efficiency as well as ensuring prudent provision of environment, health and safety (EHS) services.

Key challenges identified in this policy include;

a) Energy infrastructure expansion and upgrades.
b) Energy efficiency and conservation promotion.
c) Environmental protection.
d) Financial resource mobilization to cater for operations and expansion of energy services due to consistent rise in demand.
e) Ensuring security of energy supply through diversification of energy sources and generation mix in a cost effective manner.
f) Providing universal access to electricity by all segments of the population.
g) Improving corporate accountability and governance in the energy sector.
h) Enhance regulatory, legal and institutional frameworks necessary for creating consumer and investor confidence in the energy sector.
i) Achieving and enhancing economic efficiency and competitiveness in energy production, supply and delivery.

I. Draft National Energy and Petroleum Policy

This policy aims at ensuring adequate, reliable, sustainable, affordable, secure and competitive supply of energy that is capable of meeting the needs of the nation and counties at the least cost possible while at the same time conserving and protecting the environment [12].

This policy's specific objectives are as follows;

a) Utilizing the energy as a tool for accelerating economic empowerment and development for the purpose of the county and national developments incorporating both rural and urban development needs.
b) Improvement of access to energy services that are reliable, affordable and competitive.
c) Providing a conducive environment that enables good quality energy services development.
d) Prioritizing and promoting indigenous primary and secondary renewable energy resources development.
e) Prioritizing and promoting developments of locally available technologies in the development and delivery of energy services.
f) Promoting conservation of energy and energy efficiency.
g) Ensuring that all issues of prudent environmental including climate change, social, health and safety are taken care of in all the developments in the energy sector.
h) Ensuring that the energy and petroleum sector plans are integrated, comprehensive and well informed for the purpose of effective developments.
i) Fostering cooperation internationally for both energy and petroleum investments, developments and trade.
j) Promoting the capacity building within the energy sector through appropriate and relevant research, trainings and development. This should also include promotion of local manufacturing of appliances, plants, equipment and even the required materials.
k) Supporting suitable system, standards, code of practice and clear specifications of equipment and processes in the energy sector.
l) Promoting energy generation diversification from energy sources to guarantee energy supply security.
m) Promoting energy products' equitable pricing and cost effectiveness.
n) Protecting the interests of investors, producers, suppliers, consumers and other stakeholders.
o) Providing attractive incentives in the energy sector for local and international investments.
p) Ensuring that investors and operators comply with local content requirements in the energy and petroleum sector.
q) Promoting and developing agencies that are owned by the government in the energy resources developments.
r) Promoting response strategies that are elaborate for the purpose of disasters management in the energy sector.
s) Encouraging the use of renewable energy resources in the production of electricity and construction of adequate power evacuation infrastructure.
t) Providing optimal distribution system and sharing of relevant responsibilities between the national and

county governments in the energy sector as well as fostering their cooperation with relevant public institutions.

J. National Environment Policy 2013

The overall objective as provide by this policy is the provision of good quality of life presently and in the future through the sustainable uses of environmental and natural resources and management [11].

This policy's specific objectives are as follows;

a) Providing an integrated approach framework for the purpose of planning and sustainable management of natural and environmental resources.
b) Strengthening of institutional and legal frameworks to support effective coordination, good governance and the environmental and management of natural resources.
c) Ensuring sustainable environment and natural resources management. This include both terrestrial and aquatic ecosystems for the national economic growth and improvement of livelihoods.
d) Promoting and supporting developments in research and capacity as well as the use of innovative environmental management tools inclusive of incentives, disincentives, indicators of sustainable development total economic valuation, environmental impacts assessments (EIAs) strategic environmental assessments (SEAs), environmental audits (EAs) and payment for environmental services (PES).
e) Promoting and enhancing cooperation, collaboration, partnerships synergy and participation in the conservation, protection and sustainable management of environment and natural resources.
f) Ensuring there is inclusion of cross-cutting and emerging issues such as poverty reduction, gender mainstreaming, disability, HIV/AIDS and other diseases in the environment and natural resources.
g) Promoting the coordination, domestication and maximization of the benefits granted from the strategic multilateral environmental agreements (MEAs).

In this policy, environmental stewardship is key to the achievement of the above objectives. The environmental stewardship here referees to precautionary approaches to the prevailing environmental challenges, promotion of greater environmental responsibilities and developments and diffusion of environmentally friendly and appropriate technologies. This implies taking responsibility for all the choices made. The responsibility for environmental quality is therefore required to be shared by all those who take actions that do affect the environment. Sustainable development dictates that businesses and industries should supply goods and services that are capable of meeting the needs of society and individuals, contributing to the quality of life improvements and ensuring efficient use and management of renewable and non-renewable resources at competitive prices.

On energy use, conservation and efficiency energy is recognized by the policy as an essential for socioeconomic development. To this effect, the Government of Kenya has made deliberate efforts in the provision of electric power to the remote areas within the country in order to spur socioeconomic developments and improve community livelihoods. Currently Kenya produces electric power from hydropower, wind, geothermal and petroleum. The demand for electric power is projected to increase substantially with time. In order to ensure a robust and efficient system that is secure and sufficient, there is need for the country's energy policy. The sector should focus on diversification of energy development for facilitating economic growth and industrial competitiveness.

For the purpose of energy use, efficiency and conservation the Government of Kenya has undertaken to carry out the following;

1. Development and promotion of a national strategy that integrates sustainable renewable energy generation and utilization.
2. Promotion of adaptation of the clean energy production concept in all energy production and consumption activities.
3. Development of policies that are comprehensive and guided by adequate research and the precautionary principle.

The policy recognizes that Kenya is susceptible to extreme climate related events especially droughts and floods that are capable of posing a serious risk to the socioeconomic development of the country. The country's current vulnerability to impacts of climate change is as a result of various factors. These factors include but not limited to livelihood dependency, limited adaptive capacity and high natural resources.

The warming of the climate system globally has been observed to be unequivocal and largely stimulated by the human activities through the release of greenhouse gases (GHGs) into the atmosphere. With the changing climate there is potential for damaging impacts on human livelihood and environment for Kenya as a country in the coming decades. The climate change impact has the potential of disrupting human development. Increased climate variability together with projected incremental changes that are associated with temperature, precipitation and sea level coupled with changes in frequency and severity of extreme climate events will have profound socioeconomic and ecological impacts.

According to the environment policy of 2013, climate change resilience and low carbon development are national priority with the potential of absorbing disturbances and

capacity building in order to adapt to additional stress and change. On minimizing carbon footprints and pursuing green economy path Kenya is capable of delivering the constitutional right to clean and healthy environment whereas at the same time minimizing the contribution to the overall climate change globally.

As measures are being put in place to address the existing climate variability to achieve the national development goals, they should not done at the expense of future climate change. The ability of today's generation to achieve livelihood centered sustainable development should not be compromised by the adaptation actions aimed at addressing the climate change impacts.

The Kenyan Government in this policy undertakes to perform the following;

1. Developing and implementation of a comprehensive national climate change policy.
2. Strengthening institutional capacities at the national and county levels for facilitation in supporting national climate change resilience and low carbon development through integration of climate change into implementation strategies.
3. Developing and implementation of strategies for awareness creation and raising and capacity development on the opportunities presented by the adaptation measures as stipulated in the national climate change action plan.
4. Enhancing and strengthening the response and early warning systems for climate and disaster risk reduction.
5. Building and strengthening capacity for research on the climate change and environmental related issues.
6. Putting in place climate financing mechanism aimed at supporting the country to explore new and emerging funds for climate change including innovative ways of funding climate change actions domestically by committing a percentage of GDP.
7. Establishing a national platform for carbon trading and a certificate system for renewable energy.
8. Involving and empowering the communities in adaptation to climate change.

K. *National Policy on Water Resources Management and Development*

This policy was formulated in 1999 and focused on provision of water for domestic use, agricultural production, livestock development and industrial production with an aim to realizing the following [5];

1. Improving the social wellbeing of the population.
2. Enhancing performance of both national and regional economies as well as promoting the national economic development.
3. Proper conservation of the ecosystem.

L. *Water Act 2016*

The main purpose of the water Act 2016 is to provide institutional and legal framework for the purpose of regulation, management and development of water resources and water and sewerage services in line with the constitution [15].

III. DATA AND METHODS

Several national existing policy documents touching on climate change and hydropower development were obtained from relevant institutions and websites.

Analysis of existing policies touching on the energy and climate change, both local and internationally, were carried to be able to identify policy options for supporting the development of hydropower and integration of climate change adaptation so as to reduce vulnerability of the local community living within Sondu Miriu basin. To achieve this, a policy analysis framework focusing on key elements were adopted looking at analytical descriptions of the existing policies. The essential elements for policy implementation that will be considered are as follows;

i. Goals and objectives,
ii. Forms of benefits and services delivered,
iii. Entitlement rules,
iv. Administrative or organizational structure for service delivery,
v. Financing method,
vi. Interaction among the foregoing elements.

The focus will be to propose policy options for integrating climate change adaptation and also the benefits to the local communities through improvement of their resilience to climate change impacts.

IV. RESULTS AND DISCUSSIONS

This chapter discuses policy options for climate change adaptation integration into hydropower developments. It looks at the existing policies and discuss how these policies can be utilized to facilitate and support the climate change adaptation integration into hydropower development. In particular, for the successful climate change adaptation integration into any development, enabling policy and legal framework are key.

There are several existing policies in Kenya that are capable of supporting integration of climate change adaptation. Various factors determine the effectiveness of any policy. They include;

i. Goals and objectives of the policy,
ii. Forms of benefits and services delivered to the citizens,
iii. Entitlement rules for all the stakeholders,
iv. Administrative or organizational structure for service delivery,

v. Financing method,
vi. Interactions among the foregoing elements,

The existing climate change related policies and regulations have been evaluated against these factors and the result presented in TABLE 1.

TABLE 1: POLICY AND REGULATIONS EVALUATION

Policy	**The goals and objectives of the policy**	**The forms and benefits and services delivered**	**The entitlement rules**	**The administrative/organizational structure for service delivery**	**The financing methodology**	**The interactions among the foregoing elements**
The Constitution of Kenya 2010	General access to reliable and efficient, clean energy systems and full knowledge of the sources of energy available	Full benefits for the citizens from goods and services	Right to goods and services of reasonable quality	All levels of government	National and county budgets	Overall supportive role
Vision 2030	transform Kenya into an industrialized middle income country	High quality of life to all citizens in a clean and secure environment	Improved living standards	Medium term plans (MTPs)	National budget	Supports the overall national developments
Climate Change Act (2016)	Enhancing low carbon development and climate change resilience for sustainable development	Low carbon developments and enhanced resilience at all levels	Coping with climate change impacts	National and County governments	National budget	Provides guidelines across all the development sectors
Climate Change Framework Policy (2017)	Linkages between climate change and sustainable national development	Reduced impacts on key socioeconomic sector developments	Sustainable development	National government	National budget	Provide linkages between sustainability and development activities
Climate Finance Policy	Support Kenya national development goals related to climate change through enhanced climate fund mobilization that contribute to low carbon and climate resilience development goals	Availability of funds for low carbon development and enhancing resilience	Enhanced resilience	National government	National budget and support from other financing institutions	Financial support to climate change activities
National Adaptation Plan (2015-2030)	Long term adaptive capacity and resilience	Enhanced resilience at local level	Enhanced resilience	National and County governments	National budget and support from other financing institutions	Provides actions for adaptation in all development sectors

Policy	The goals and objectives of the policy	The forms and benefits and services delivered	The entitlement rules	The administrative/organizational structure for service delivery	The financing methodology	The interactions among the foregoing elements
Sessional Paper no. 4 on Energy (National Energy Policy 2004)	Provision of quality, adequate, affordable and cost effective supply of energy	Access to cheap and clean energy	Universal access to electric energy	National government	National government	Provision of sustainable energy
Draft National Energy and Petroleum Policy	Provision of adequate, reliable, sustainable, affordable, secure and competitive supply of energy	Universal access to affordable energy services	Universal access to electric energy	National government	National budget and support from other financing institutions	Provision of sustainable energy
National Environment Policy 2013	Provision of good quality of life at present and in the future through sustainable use of environmental and natural resources and management	Clean and healthy environment for all	Clean environment	National and County governments	National budgets	Support to clean development activities
National Policy on Water Resources Management and Development	Provision of water for domestic use, agricultural production, livestock development and industrial production	Water access for all sectors of production.	Access to clean and portable water	National government	National and County budgets	Protection of water resources in all developments
Water Act 2016	Provision of legal and institutional framework for regulation, management and development of water resources	Equitable water access for all	Right to water resources	National and County governments	National and County budgets	Provides framework for managing water resources in all sectors

Policy decisions for climate change are complex involving many conflicting objectives and goals, several uncertainties, various alternatives and fragmented institutional infrastructures.

The constitution of Kenya 2010 recognizes the concept of sustainability on both the environment and natural resources.

It is evidence that there are several policies and laws that are capable of supporting integration of climate change adaptation into hydropower development in Kenya. The existing gap is the operationalization of these legal tools. In order to operationalize these policies and laws there is need to prepare rules and regulations which are specific to the climate change including integration of climate change adaptation in all sectoral developments.

V. CONCLUSIONS AND RECOMMENDATION

A. *Conclusions*

The climate has been changing. The climate change and hydropower development have impacts on the local communities. The impacts are on socioeconomic and environmental aspects of community livelihoods. The community has several options for socioeconomic activities in the basin which are all vulnerable to climate change. These activities are also influenced by the hydropower development in the area as the development changes the economic landscape in the area due to increased activities. Hydropower provides more benefits to the community both directly and indirectly which goes along in reducing the vulnerability of the community to impacts of climate change. In terms of policy there are several policies that can support climate change integration into hydropower development adequately right from national to local levels.

B. *Recommendations*

Both technological and management interventions will be required going forward to manage the anticipated changes in order to minimize any negative impact the climate change may have on the hydropower energy production in the existing hydropower plants and any future hydropower plants that may be planned.

Hydropower development benefits can be tailored to address community vulnerability to the impacts of climate change. This can be achieved through establishment of climate change programmes which are supported by the hydropower development projects for its long term sustainability. For this to be successful, climate change adaptation rules are needed to be put in place in order to realize adaptation objectives.

There is need to prepare rules and regulations specifically for integrating climate change adaptation into hydropower and other renewable energy development projects as well as other sector development programmes. This will enhance the integration of climate change adaptation into development programmes both locally and nationally.

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