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Challenges and Solutions in Sustainable Water Resources Management for Food Security and Climate Change Adaptation in Africa

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Abstract **– Climate change, population growth, increasing water demand, have had impacts on freshwater resources in many countries within the Intergovernmental Authority on Development (IGAD) region where increasing water demand outstrips available water resources. Many IGAD countries experience either water stress (less than 1,700 m3 per capita per annum) or water scarcity (less than 1,000 m3 per capita per annum) or both. Moreover, food insecurity and impacts of climate change remains endemic throughout much of Africa, with climatic factors such as rainfall variability being a major cause. In 2006, 25 African countries required food aid, largely due to recurring drought. Poverty and food insecurity are linked to low agricultural productivity aggravated by climate change and variability and water shortages. Essential activities including water resources management and agriculture are affected by recurrent climate change and variability. Variations in climatic patterns, which occur naturally from year to year and over longer periods of time can cause disasters such as droughts and floods and end up affecting millions of people. Such climatic patterns affect the availability of water which is required for agricultural activities. Warmer temperatures are likely to increase rainfall in some regions while in others there is decrease in rainfall. Changes in rainfall could severely reduce agricultural productivity and eventually have negative impact on food security. This paper has highlighted the need for sustainable water management, the required water vision and the way forward for countries in the IGAD region as key factors in the management of agricultural systems and climate change adaptation and hence the need to provide an opportunity for all stakeholders to discuss water and regional cooperation issues. Sustainable water development and management should be readily unleashed to stimulate and sustain agricultural growth and climate change adaptation and develop the necessary information systems for real time decision making.**

Keywords **– Challenges, Change Adaptation, Food Security, Integrated Water Resources Management, Water Management Vision, Solutions, Sustainable Water Development.**

I. INTRODUCTION

The availability and accessibility to water is a key determinant to food security in any country**.** In Africa many countries including those within the IGAD region, face a number of serious challenges, food security being one of them and that call for urgent remedial action if current trends towards endemic poverty and pervasive underdevelopment are to be turned around. The availability and distribution of water resources in the Horn of Africa region is uneven and irregular both in space and time. The situation is further exacerbated by periodic serious droughts that affect the region with serious and devastating human, economic and ecological consequences.

Water resources are an important trans-boundary issue in the region. With particular reference to the IGAD sub-region, approximately 60% of the surface, area is occupied by international basins. It is foreseen that by 2025, all countries in this sub-region would be water scarce. With climate change and increasing populations, management of water resources becomes a high priority in the region. In order to pre-empt future inter-state conflicts and political tensions, this calls for judicious consideration in the co-operative and equitable development and management of shared water resources, particularly between upstream and downstream countries. Even within individual countries, lack of information and mismanagement of available water resources has been observed as a source of intra-state conflicts and localized wars and conflicts.

There is urgent need to build capacities to manage water and land resources in order to meet the needs of the rapidly growing population. Among the major factors perpetuating poor management of water resources, is the lack of sufficient capacity in the countries to package correct and appropriate information in a form that is understandable by decision and policy makers. While the renewable water recharge within countries is constrained by continued land degradation and effects of climate change, the countries suffer due to weak water institutions, lack or scanty information, inadequate policies and poor water infrastructures. The region lacks either water management protocols or even a platform to discuss water resources issues.

The crucial role of water in accomplishing the needed food security goals is widely recognized in this paper . Hence there is need to have equitable and sustainable use of water for food security and climate change adaptation . In IGAD countries, where countries share the same river basin, there is need for shared vision and cooperation so that there is equitable and sustainable use and management of water resources for agricultural activities, poverty alleviation, socio economic development, regional cooperation and environmental quality management.

Sustainable socio economic development is a function of sustainable water management. Climate change and variability has a potential impact on the dynamics of vital ecosystems which when affected end up affecting the sustainable development and management of the water resources in them.

FAO recommends reducing hunger through climate smart agriculture . This is the type of agriculture that sustainably should increase productivity and resilience to environmental pressures while at the same time reduces green house gases emission or removes them from atmosphere and this should be tried by the IGAD countries in order to improve on food security within the region

The IGAD region stretches over an area of 5.2 million km^2 and a population of over 170 million comprising the countries of Djibouti, Eritrea, Ethiopia, Kenya, Somalia, Sudan and Uganda. The region has great variety of climates and landscapes including mountain glaciers, tropical rain forests, and grasslands as well as arid and semiarid areas among other features. The Region is prone to recurrent hazards such as droughts and floods making it one of the most vulnerable regions on the African continent to climate variability and change.

The dissemination of weather and climate information at the appropriate period can be a useful tool in sustainable water resources management which is a key factor in sustainable agricultural productivity and hence food security . Also climate change has a potential impact on the quantity and quality of water in any region including mountain ecosystems in Africa which are being degraded due to human encroachment, and hence all sectors of the economy including agriculture has to adapt to climate change and water scarcity. Countries in the IGAD should formulate strategies to enable them to move towards climate change adaptation within the IGAD region.
Essential activities including water resources management and agriculture are affected

by recurrent climate change and variability in the IGAD region. Variations in climatic patterns, which occur naturally from year to year and over longer periods of time has been causing disasters such as droughts and floods and end up affecting millions of people. Such climatic patterns affect the availability of water which is required for agricultural activities. The amount of water available for domestic use, agriculture, industry and generating hydroelectricity can be affected by small changes in one of the elements of climate, that is temperature. Warmer temperatures are likely to increase rainfall in some regions while in others there is decrease in rainfall. This will end up in having regional

disparities in the amount of rainfall, water and hence poor agricultural productivity. Changes in temperature, rainfall and soil moisture could severely reduce agricultural productivity of marginal lands and eventually have negative impact on food security and these are some of the issues which need to be addressed and real cooperation required.

As a result of climatic impact on water resources, this has a potential impact on many sectors of the economy and hence this necessitates the application of integrated water resources management in which all sectors including agriculture which require water are considered in a holistic manner. Coordination in climate change and water resources management is a key factor in the management of agricultural systems which are under stress and also there is need for responsible societal responses so as to manage in a sustainable manner the dynamics of such systems. Water resources should be readily unleashed to stimulate and sustain agricultural growth . Flood water should be harvested to enhance irrigation and hence food security especially in the arid and semi arid regions in Kenya and other arid and semi arid regions in IGAD countries with the objective of increasing agricultural productivity.

II. Water Resources Management Challenges Within IGAD Countries

The main challenges which are being experienced in Kenya and also other parts in Africa, IGAD countries included, are securing water for all people, securing water for food production, developing other job creating activities which require water, not protecting vital ecosystems, dealing with variability of water in time and space, managing agricultural risks which are climatic in nature or due to land mismanagement, creating popular awareness and understanding in order to mobilize effective support for sustainable water management and induce the changes in behaviour and action required to achieve this, forging the political will to act and ensuring collaboration across sectors of the economy and trans-boundaries .

The above problems can be mitigated by applying integrated water resources management. Climate change has major impact on the world's freshwater resources quality and water management. Increases in water temperature and changes in the timing and amount of runoff are likely to produce unfavorable changes in surface water quality, which will in turn affect human and ecosystem health. The threats posed by climate change will serve as an additional stressor to many already degraded water dependent systems, particularly those in developing countries and all sectors of the economy and more so in agriculture and hence a threat to food security.
In Kenya, for the county governments which are within the same river basin, there is need for the formulation of a shared water management vision by the respective counties so as to have counties where there is an equitable and sustainable use and management of water resources in agricultural activities, poverty alleviation, socio economic development, regional cooperation, and sustainable environmental quality management.

At the regional level, it calls for partnership and solidarity between countries in the IGAD that share a common water basin. To fully adapt to climate change and variability, it will require to the adherence to the following critical success factors in the water sector in IGAD countries with the objective of minimizing water use conflicts at inter country or intra country :

- Openness, transparency and accountability in decision-making processes;
- Ability to generate and receive water knowledge and information;

- Cooperation and team work by all countries in a river basin with the objective to achieve common, mutually beneficial objectives;
- Readiness to take tough decisions on the future direction and course of action in food security consistent with the aspirations in the shared Water Vision;
- Proper appreciation of "where we are", "where we want to be" and "how to get there";
- The adoption of financing and cost-recovery methods that are equitable and sustainable, while reflecting the concerns of the vulnerable poor especially in their food security.
- National political commitment and grassroots support at the local level .

Water is a precious natural resource, vital for life, development and the environment. It can be a matter of life and death, depending on how it occurs and how it is managed. When too much or too little, water can bring destruction, misery or death. Irrespective of how it occurs, if properly managed, it can be an instrument for economic survival and agricultural growth and hence food security. It can be an instrument for poverty alleviation, lifting people out of the degradation of having to live without access to safe water and sanitation, while at the same time bringing prosperity to all in a certain region or country.

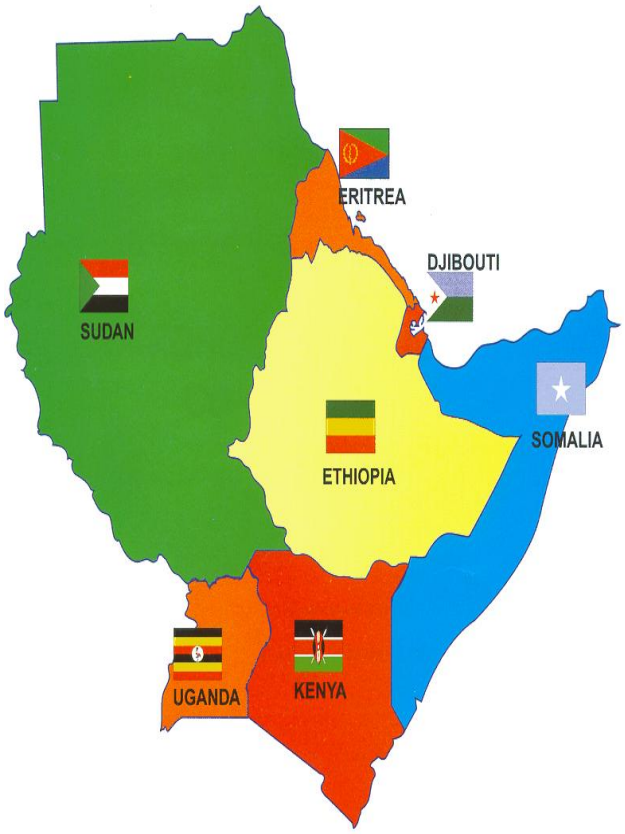

Fig.1. IGAD member countries

However, when inadequate in quantity and quality, it can rather serve as a limiting factor in poverty alleviation and economic recovery, resulting in poor health and low productivity, food insecurity, and constrained economic development. Thus what we get out of water depends largely upon what we put into it in terms of management and use and this calls for investment in water resources development and management. Hence everybody in Kenya should be concerned and be involved in the conservation and protection of water as a valuable but vulnerable natural asset. All should be involved in thinking about new ways of managing water by all countries in IGAD region (Figure 1) to improve its efficient, equitable and sustainable use, to the benefit of all and especially for food security.

It is apparent that water and socio-economic development are mutually dependent on each other. They can be nodes in a vicious cycle that puts societies in a downward spiral of poor economic development and poor access to safe and adequate water supply and sanitation.

Alternatively, they can be nodes in a virtuous cycle, reinforcing each other in an autocatalytic way, and leading to an upward spiral in which improved socio-economic development produces resources needed for improved development of agriculture that, in turn, buttress and stimulate real time food security.

In the midst of an apparently substantial supply of water at national level, there are sub regions within the IGAD countries that experience growing water scarcity. This situation is the result of a number of issues that face the IGAD region in the area of water resources. These issues fall into two broad categories: resource-side and demand-side issues. The resource side issues are concerned with the occurrence, distribution, protection and management of available water resources.

The demand-side issues regard the management of competing demands for available water resources. They are concerned with the extent to which such demands are satisfied in an equitable and sustainable way.

The many resource-side issues facing countries in the IGAD region are and not limited to the following:

- Multiplicity of trans-boundary water basins;
- High spatial and temporal variability of rainfall;
- Growing water scarcity;
- Inadequate institutional and financing arrangements;
- Inadequate data and human capacity;
- Inadequate development of water resources;
- Depletion of water resources through unsustainable negative human actions;

On the water demand side too, the same countries in the IGAD region faces the following number of issues.

- Lack of access to safe and adequate water supply and sanitation services;
- Lack of enough water for food and energy security;
- Inefficiency and wastage in water use especially in agricultural productivity.
- Threats to environmental sustainability in most of the river basins

In addition to the key issues identified above, there are a number of compounding issues that also have a significant impact on water resources in Kenya and other countries who are members of the IGAD . The most significant ones are:

i) Conflict within and between stakeholders especially in dry area parts of IGAD countries;
ii) Weak institutional arrangements and legal frameworks for the ownership, allocation
iii) and management of water resources especially for agricultural activities;
iv) Inadequate public awareness and stakeholder involvement in sustainable water management;
v) Inadequate research for water-resources development and management ;
vi) Weak socio-economic development and technology base;
vii) Low public capacity to finance required investments in the development and management of water resources, including protection and restoration of river catchments ;
viii) Inadequate private sector participation in financing for the water sector and also agricultural sector.

While the key and compounding issues pose numerous challenges for the water sector in many countries in Africa it is possible to identify 10 key challenges which need to be addressed to achieve sustainable water management for food security and climate change adaptation within the IGAD region and are as follows:

a) Ensuring that all have sustainable access to safe and adequate water supply and sanitation services to meet basic required needs;
b) Ensuring that water does not become the limiting factor in food and energy security especially in arid and semi arid regions in Africa.
c) Ensuring that water for sustaining food security life-supporting ecosystems is adequate in quantity and quality in both spatial and temporal dimensions;
d) Reforming water-resources institutions to establish water integrity and an enabling environment for sustainable management of national and trans-boundary water basins and for securing regional cooperation on water-quantity and water quality issues;
e) Securing and retaining skilled and motivated water professionals;
f) Developing effective systems and capacity for research and development in water and for the collection, assessment, and dissemination of data and information on water resources for agricultural productivity and climate change adaptation .
g) Developing effective and reliable strategies for coping with climate variability and change, growing water scarcity, and the disappearance of water bodies;
h) Reversing growing man-made water-quantity and quality problems, such as overexploitation of renewable and non-renewable water resources, and the pollution and degradation of watersheds and ecosystems;
i) Achieving sustainable financing for investments in water supply, sanitation, irrigation, hydropower and other uses, and for the development, protection and restoration of national and trans-boundary water resources for both food security and climate change adaptation;
j) Mobilizing political will, creating awareness and securing commitment among all countries in the IGAD region with regard to water issues, including appropriate community and stakeholder involvement in sustainable water management.

There is need for every country in the IGAD region to have a sound formulated Water Management Vision (WMV) by 2030 and the water management vision should include and not limited to the following :

a) There is sustainable access to a safe and adequate water supply and sanitation to meet the basic needs of all stakeholders.
b) Water inputs towards food security and climate change adaptation in all IGAD countries are readily available;
c) Water for sustaining ecosystems and biodiversity is adequate in quantity and quality so as to continue benefiting from ecosystems and their related services and functions .
d) Water-resources institutions have been reformed to create an enabling environment for effective and integrated water management of water in whole river basins;
e) Water basins serve as a basis for water cooperation and development, and are treated as natural assets for all stakeholders within;
f) There is an adequate number of motivated and highly skilled water professionals;
g) There is an effective and financially sustainable system for data collection, water resources assessment and information dissemination for quality decision making for river basins;
h) There are effective and sustainable strategies for addressing natural and man-made problems affecting water resources, including climate variability and adaptation;
i) Water is financed and priced to promote equity, efficiency, and sustainability and hence move towards good water governance and hence minize water related conflicts.
j) There is political will, public awareness and commitment among all water users for sustainable management of water resources, including the mainstreaming of gender issues and youth concerns and the use of participatory approaches.

III. IGAD Countries Water Vision

Many factors and climate change adaptation influence attainment of the water management vision in African countries and especially for agricultural activities. Among these factors are population and demographic trends, lifestyles and consumption patterns, structure and level of economic development, technology development and choice, water governance, policies and institutions.

The structuring of these factors is what will determine the attainability of the water management vision by IGAD countries. For example to achieve the water vision there is need for slower population growth, sustainable socioeconomic development, a new way of thinking about

sustainable water management and a new form of national and water cooperation and formulation of strategies for climate change and adaptation . It will call for a framework for action that is underpinned by partnership and solidarity between country governments that share river basins. In addition, it will call for cooperation between countries which also share river basins . It will require fundamental changes in policies, strategies and legal frameworks, as well as changes in institutional arrangements and best management practices. Above all, the water management vision in the countries in IGAD region will require adherence to the following critical factors for it to succeed:

- Openness and transparency in decision-making processes by national governments ;
- Ability to generate and receive knowledge and information;
- Cooperation and teamwork by countries sharing river basins to achieve common and mutually beneficial objectives;
- Readiness to take tough decisions on the future direction and course of action sustainable water resources management for food security and climate change adaptation consistent with the aspirations in the shared Water Vision by countries within the same river basin with the objective of minimizing water related conflicts;
- Proper appreciation at all times of "where the countries are", "where the countries want to be", and "how to get there".
- Integrated assessment of water resources within each country in the IGAD region.

IV. IGAD Countries Sustainable Water Management Vision Action Plan

The action plan should define the road map towards achieving the sustainable water management vision in every country. The framework for action should consist of actions under the following four broad categories:

- Strengthening good governance of water resources both surface water and ground water ;
- Improving water wisdom;
- Meeting urgent water needs such as for irrigation and hence food security ;
- Strengthening the financial base for the desired water future for food security and climate change adaptation.

The specific detailed requirements for each of the above four categories for the framework for the action plan is outlined for each of the broad category :-

The following four action plan should be included in the national water policies for each country within the IGAD region.

a) Strengthening good governance of water resources

- Adopting and implementing IWRM principles and policies by every country within the IGAD region ;
- Developing and implementing institutional reform and capacity-building at local, national and countries trans-boundary water-basin levels;
- Promoting transparency and stakeholder participation in sustainable water management ;
- Adopting the river basin as the unit for sustainable water resources management;
- Strengthening river-basin and aquifer management by implementing water catchment protection as a strategy;
- Creating an enabling environment for water cooperation between countries sharing river basins and also sharing benefits ;
- Mainstreaming gender in water management at the lowest appropriate level and creating institutional arrangements for full stakeholder participation;
- Liberalizing water markets while meeting basic needs of the poor who are vulnerable to climate change and environmental degradation which affect their food security and other basic needs for their wellbeing.

b) Improving water wisdom(Real-time Water knowledge)

- Raising awareness on intensification of irrigation water-management issues in the arid and semi arid zones.
- Establishing a sustainable system for data collection, management, and dissemination, including standardization and harmonization of data and information sharing for decision making ;
- Building institutional, technological and human capacity for effective irrigation water Management by introducing best management practices in irrigation schemes;
- Conducting research and development on integrated water-resources management issues;
- Facilitating access to knowledge and information centers and services such as the use of internet;
- Mainstreaming gender and youth concerns in all socio economic activities where water is involved.

c) Meeting urgent water needs

- Expanding safe water-supply and sanitation services to meet basic human needs;
- Ensuring an adequate supply of water for sustainable food security;
- Ensuring that environmental flows for ecosystems is adequate in quantity and quality with the objective of improving ecosystem services and functions;
- Ensuring an adequate supply of water for urban, agricultural, energy, and hydropower production, industry, tourism and transportation development;
- Managing climate variability and change, including drought, desertification, and floods;
- Conserving and restoring ecosystems biodiversity and related services and functions ;
- Protecting river catchments and controlling siltation of hydraulic structures such as irrigation canals and reservoirs and fish ponds;
- Meeting smallholder rural irrigation water needs and hence move towards food security ;

- Developing non-conventional resources such as desalination and re-use of water s o as to augment the current water quantity which has a trend of becoming scarce .

d) Strengthening the investment base for the desired water future

- Mainstreaming full cost recovery and service differentiation, while ensuring safety nets for the poor;
- Securing sustainable financing from national and international sources for tackling urgent agricultural water needs and strategies for climate change adaptation;
- Securing sustainable financing for institutional reform;
- Securing sustainable financing for information generation for irrigation water management;
- Promoting and facilitating private sector financing in the water sector;
- Establishing mechanisms for sustainable financing of water-resources management and this should be the obligation of all countries within the IGAD region.

V. Climate Change Adaptation and Mitigation Measures

Integrated water resources management is an intelligent strategy which need to be applied so as to be able to adapt to climat**e** change by countries in Africa and eventually have positive impact on sustainable economic development. Better water resources management is essential if communities in IGAD are to adapt successfully to climate induced changes in their water resources utilization for socio economic development. The strategies adopted has to use a combination of infrastructural and institutional measures. Water resources users to adapt to climate change require major changes in the way they use water in agriculture, industry and human settlements. Hence the best approach to manage the impact of climate change on water resources is that guided by the philosophy and principles of integrated water resources management (IWRM) which can be the basis of sustainable agricultural productivity for food security among other socio economic activities.

The IWRM if fully implemented at the national level in all river basins in IGAD countries, is expected to promote a holistic approach to water resources management and under IWRM there are multiple pathways to building resilience to water shortages which can end up having a positive impact on food security and sustainable water management. There is need to identify and to achieve tradeoffs between different water management objectives including agricultural, economic efficiency and social equity. The IWRM approach encourages the structured engagement of real-time stakeholders and sectors impacted upon by water into its management both to seek and promote “win-win” solutions but also to ensure that a better understanding of water constraints and challenges is developed and diffused into the society within a given river basin and if possible implemented by all stakeholders in the river basins.

To cope with climate change and be able to adapt to it, countries should have both infrastructural and institutional strategies and it is these strategies which can offer countries the best chance of coping successfully with climate variability and change and eventually improve on their socio economic development and more so on food security.

There is need for communities to build resilience to manage the impact of climate change on human activities and especially those affected by water shortages. Composite rainwater harvesting can enable the households and communities to manage variability of the water resources on which they depend on many economic activities. Large water infrastructures should be designed so as to operate under the expected climates of the 21st century and beyond and hence the need for climatic models which has long memory in the future for accurate prediction of the dynamics of the temperature profiles for the future.

Implementation of integrated water resources management if applied in river basins can offer a set of institutional and infrastructural tools to ensure that IWRM works effectively. To address potential water shortages in agricultural activities, much attention should be given to managing water demand than to increasing water supply which has cost implications and this can be done by introducing more efficient technologies such as drip irrigation as well as simply promoting a culture of conservation by the stake holders. An important element of water demand management is to encourage water users to use the water they have more efficiently in a continuous mode.

One way to manage the impact of climate’s variability on water resources is to capture and control river flows. Reservoirs can retain and store river flows in excess of user requirements and release them when low flows are not sufficient, this can also help maintain aquatic ecosystems. Peak flood flows can be stored and released later, avoiding flood damage by reducing maximum flows but there should be environmental flows all the time . These two functions are important and they can sustain human settlements and avert disasters caused by floods and droughts. Other important water infrastructure includes canals, tunnels and pipelines that serve not just to supply human demands directly but also, by creating linked systems with multiple sources, and the stakeholders will suffer less due to water shortages and hence offer enhanced water supply security but the infrastructure should be lined with impervious materials .

Adaptation to climate change in the agricultural sector so as to assist in local needs require the following actions : there is need to address local vulnerabilities, the need to involve stakeholders early and substantively and connect with local decision making processes. Kenya is a water scarce country, which essentially means that its annual per capita renewable water resources is less than the conventional universal minimum of 1000 cubic metres.

Climate change will aggravate the situation as it affects precipitation. Hence, certain climate change adaptation and mitigation measures in the water sector in Kenya and also other countries in Africa need to be implemented including and not limited to the following:

- Constructing inter-basin and intra-basin water transfers in IGAD countries to channel water from areas with excess water to areas with water deficit but this need high level consultation and cooperation to avoid conflicts and also negative environmental impacts,
- Investing in decentralized municipal water recycling facilities for both domestic and industrial use to reduce wastage,
- Enforcement and/or enactment of laws and regulations required for efficient water resources management within the river basins in IGAD countries,
- Increasing capture and retention of rainwater through the construction of waterways, strategic boreholes(dual purpose boreholes) and other water harvesting structures to ensure availability of water during dry seasons for agricultural activities and other economic activities.
- Developing and maintaining an appropriate stock of water infrastructure (dams, water pans, supply lines) to store water for irrigation purposes to enhance food security and climate change adaptation.
- Building capacity for water quality monitoring including training personnel to protect watersheds and monitor water quality as a strategy to increase water availability, accessibility and good governance .
- Having a strategic fund to purchase water purification chemicals for disinfection of community wells and shallow boreholes during floods and drought episodes when water quality is most threatened,
- Desilting rivers and dams to improve carrying capacity, water storage and water quality and reduce evaporation.
- Protecting and conserving water catchment areas, river banks, and water bodies from degradation and contamination eg by imposing a water levy to generate funds for investment in conservation of water catchment areas by stakeholders,
- Heightened awareness campaigns to underscore the importance of sustainable use of water resources, e.g, through the promotion of water harvesting techniques such as harvesting water from roof catchments at house hold level
- Developing artificial re-charging of groundwater for threatened aquifers especially in the arid and semi arid zones for the countries within the IGAD region.
- Protecting flood plains through construction of dykes and river dredging,
- Putting in place adequate hydrometric network to monitor river flows and flood warning telemetry systems,
- Introducing financial instruments such as subsidies to promote technologies that use water efficiently such as in drip irrigation in water scarce environments and hence have food security .

The above interventions must however, take into consideration the importance of integrated water resources management which has as its core the following key principles:

- Water is a finite resource : essential to life, human development and ecological functions it should therefore be managed in a holistic manner by linking the need for socioeconomic development and protection of the natural resource base,
- Water has an economic value : failure to recognize the economic value of water can lead to its unsustainable use and degradation of its natural base in many regions in country.
- Participatory approach : involving different water users including gender groups, socioeconomic groups, planners and policy makers in irrigation water management.
- Women play a central part: in the provisions, management and safeguarding of water

VI. The Way Forward for Water Vision by IGAD Countries

For the way forward, the priority actions that need to be taken by IGAD countries include: awareness-and consensus-building, creation of enabling environments for national and international cooperation, responding to immediate water problems, creating required frameworks for integrated water resources management, and capacity-building to cater for the agricultural sector. There is an immediate need to create awareness and consensus about the water management vision at all levels in IGAD countries, using messages that may be revised from time to time and from river basin to river basin to reflect local changing physical, socioeconomic and environmental conditions .

Some of the water management vision messages which need to be disseminated to all stakeholders and shared vision at the river basin level in IGAD countries are and not limited to the following:-

- Provide safe and adequate water and sanitation for all, urgently.
- Make equitable and sustainable use of water resources in Africa.
- Ensure sustainable development and management of water resources for all stakeholders.
- Use water resources wisely to promote agricultural development and hence food security.
- Develop water resources to stimulate socio-economic development.
- Treat water as a natural asset for all stakeholders in all countries in Africa .
- Share management of international water basins and aquifers to stimulate efficient mutual regional economic development and cooperation .
- Ensure adequate water for life-supporting ecosystems by allowing sustainable environmental flows .
- Manage watersheds and flood plains to safeguard lives, land and water resources and related ecosystem services.

- Price water so as to promote equity, efficiency and sustainability in every country in Africa.

Some eleven key strategic issues which should be introduced and formulated and implemented so as to have sustainable Water Management Vision by IGAD countries are and not limited to the following :-

1) Creating an enabling environment for countries water cooperation.

Management of shared waters by countries should be identified as a priority due to the multiplicity of inter-national waters both surface water and groundwater. To respond to this, early action should be taken to develop a framework and an enabling environment for cooperation in the development and management of shared river basins such as Lake Victoria Basin in Kenya . Action would be required at all levels, at the regional level, and at the national level.

2) Need for responding to immediate water problems within Countries in Africa

Reference should be made to the inter-dependency between water and economic development. It has been suggested that water-resources issues (such as climate variability and shared river basins) by Countries and inadequate access to water and sanitation services can contribute to poverty. Similarly, on the positive side, well-managed and adequate water resources can result to sustainable economic development. The challenge is how to prime the pump to launch the upward spiral in which water-resources development and economic development become mutually supportive. To this end, countries in Africa should appeal to their development partners for financial assistance to facilitate action in three key priority areas:

- Required institutional reforms ;
- Information generation and management systems ;
- Requirements for meeting urgent water needs for all sectors of the economy if possible.

Addressing the above three fundamental needs would contribute to improved vitality, longevity, and human productivity that can serve as the springboard for sustainable water management agricultural development in majority of countries in Africa with the objective of enhancing food security.

3) Creating frameworks for integrated water-resources management.

A prerequisite for successfully addressing the pressing sustainable water management challenges is to change from the fragmented approach to an integrated approach to water-resources management. A first step in this regard is the establishment of an enabling environment at levels that will include policies and institutional arrangements for water-resources management and allocation between competing demands within each country in Africa. This calls for an understanding of the Dublin-Rio principles(1992) by stakeholders at each country level . It also calls for a programme of gap analysis to determine the types of strategic assistance needed at the county level for implementing IWRM with an objective of enhancing food security in the Counties in Africa.

Moreover, it will need to call for an interpretation of the principle of water as an economic and social good. In this regard, it has been stressed that it might be helpful to separate the competing demands for water for economic development from the competing demands for water for supporting life and the environment. This would make it easier to treat water strictly as an economic good for competing demands for economic development. However, for its use to support life, such as water supply and sanitation for the poor or for food security, a case may be made for treating water as both an economic and a social good. The aim here is to so price water for these services that it can promote equity, efficiency, and sustainability. A lot of debate and public education and stakeholders participation is necessary to arrive at a consensus on these issues especially where water is needed for the enhancement of agricultural productivity.

4) Building capacity.

One of the major constraints in the development of water resources in many countries in Africa has been identified as inadequate human and institutional capacity for IWRM. Unfortunately, Kenya does not have an adequate number of highly motivated and highly skilled water professionals who can deal effectively with the complex issues of water scarcity, climate variability and joint management of international waters. It is fortunate that, under the Global Water Partnership, a program of capacity-building has been launched, starting in Southern Africa. Countries in Africa need to take the initiative to call for the use of the services of this new program for capacity-building at national levels . Countries in Africa should strive to build capacity in drip irrigation which will have two purposes one being enhancement of food security and water conservation in water scarce parts of IGAD countries.

5) Identification of water vision drivers.

Water **v**ision drivers(WVDs) (or water vision driving forces) are long-term factors that can influence the course of future water developments. They represent the conditions of the social and ecological system and the engines that move forward the development of water resources towards the desired water vision. By knowing the most important drivers, it is possible to gain an insight into the direction and speed of water resources management which should have the following components : water-resources development, abstraction and allocation, protection and pollution control. In view of their importance, a number of driving forces that might be relevant for the water management vision for many countries in Africa are but not limited to the following and in their order of priority they are: socio-economic, demographic, environmental, governance, and technological factors and international drivers and each of the drivers should in one way or the other relate with food security and sustainable water management in African countries.

6) Socio-economic factors.

The main socio-economic factor likely to constrain attainment of the water management vision is the

widespread poverty resulting mainly from slow economic growth and high levels of indebtedness in many countries in Africa . It is feared that this can inhibit investments in water resources development. There is a need to address this as a matter of urgency, especially through the expansion of access to safe and adequate water supply where irrigation is viable in Countries..

7) Demographic factors.

A key demographic constraint in Africa is rapid population growth and urbanization resulting in increasing demand on scarce water resources due to high demand for food both in urban and rural areas under conditions of limited managerial capacity. A related factor is the high prevalence of communicable diseases and premature death due to inadequate, unsafe and inequitable access to water supply and sanitation. There is need for countries in Africa to review the trade-offs between different policies in order to ensure that demographic factors do not limit socio-economic development or lead to increased water scarcity and high demand for food and hence more food security.

8) Environmental factors.

The major environmental factor is climate change and variability (spatial and temporal) leading to drought, desertification, floods and total crop failure. A second factor is environmental degradation from domestic, industrial and agricultural waste. A third factor is failure to allocate adequate water resources to sustain life-supporting ecosystems, both terrestrial and aquatic which if well managed can contribute to food security. Addressing these factors at the national level in every country in Africa is absolutely critical for Africa's sustainable social and economic development. If they are not addressed, the prognosis is dire.

9) Governance factors.

There are numerous governance factors in Africa which include: lack of accountability, transparency and poor governance which result to in ineffective management of water resources; inadequate cooperation and coordination in the management of national and international water basins; and inappropriate institutional arrangements resulting in poor management and low capacity in human resources. The governance factors also include: inadequate regulatory and legal frameworks at local, national, and regional levels; inadequate stakeholder involvement in water-resources management, particularly women and the youth. A lot of work remains to be done on water governance and hence the need for awareness and capacity building on water integrity.

10) Technology factors.

The key technological factor is the existence of critical gaps in data (ground and surface water information and knowledge in the water sector). Inadequate technological know-how is another factor. The Internet is a major instrument for overcoming some of the technological constraints; yet, high telephone charges may constitute a major constraint to access to the Internet. There is an urgent need for appropriate policies on Internet access in countries in Africa with whose accessibility can help researchers to use it to gather knowledge on aspects related to food security and especially with interchange of agricultural products amongst the Countries at the global scale.

11) International factors.

Water does not recognize borders. One factor is Africa's shared international river basins and aquifers, which can create interdependencies that can be threats or opportunities. A second factor is climate variability, which can create untenable risks in the absence of international and inter-regional cooperation, allowing diversified sources of water, food, power, etc. Regional institutions and Country agencies need to promote country cross-border economic cooperation and integration, replacing threats with opportunities and mutual benefits.

Also it is wise to note that, among the IGAD countries, there are factors of uncertainty which might have impact on sustainable water resources management and some of them are rapid population growth; unsustainable land use ; irrigated crop area; environmental flow requirements and water conservation.

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