

GUIDELINE FOR SUSTAINABLE MANAGEMENT OF WETLANDS IN IHEMI CLUSTER



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Executive Summary

The government of Tanzania is highly concerned with management of wetland hence it is fully committed to ensure that they are sustainably managed. In Tanzania, the wetlands are known to be nature's water store on land which supports a number of sectors including agriculture, livestock, forest and wildlife providing vital ecosystems support. In general, wetlands in the Ihemi Cluster face a number of challenges which some of them affects the ecosystem and livelihood of communities. Agriculture being the major economic activity conducted in Ihemi Cluster has modulated the wetland, hence a guideline for sustainable management of the wetlands needs to be developed and implemented. Therefore this guideline provides an approach for enhancing management of wetlands sustainably for the present and future generations in the Ihemi Cluster.

Definition of Terminologies

Guideline: *Aims to streamline particular processes according to a set routine or sound management practice.*

Indicator: *This is a quantitative or qualitative variable that provides a valid and reliable way to measure achievement, assess performance, or reflect changes connected to an intervention.*

Integrated management: *This is a combination of physical, technical, administrative, and legal practices relating to wetland in a manner designed to increase combined benefits or achieve a more equitable apportionment of benefits from both sources.*

Inventory: *A complete list of items such as property, goods in stock, or the contents of a wetland.*

Wetland Management: *Wetland management generally involves activities that can be conducted with, in, and around wetlands, both natural and man-made, to protect, restore, manipulate, or provide for their functions and values.*

Monitoring: *To observe, supervise, or keep under review; to measure or test at intervals, especially for the purpose of regulation or control, or to check or regulate the technical quality of something.*

Sustainable: *The development that meets the needs of the present without compromising the ability of the future generation to meet their own needs*

Wetland Rehabilitation: *To improve wetland functions, but not necessarily to pre-disturbance ecological character.*

Wetlands: *“Areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salty, including areas of marine water, the depth of which does not exceed six metres. In addition wetlands may incorporate riparian and coastal zones adjacent to wetlands, and islands or bodies of marine water deeper than six metres” (Ramsar, 1971).*

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1.0 INTRODUCTION

1.1 Background Information

In many developing countries including Tanzania, the economy and livelihood of people is dependent mainly on agricultural sector (URT, 2003). According to URT, (2014) agricultural sector has continued to be the center for economic growth in Tanzania, contributing up to 45% of the country's GDP and about 30% of the country's export earnings, while employing over 80% of the nation's workforce. Generally, agriculture in Tanzania is practiced by smallholder farmers. The majority of farmers depend upon rainfall in the production of food and cash crops. This kind of agriculture is severely constrained by drought, which drastically reduces crop yields. To overcome drought, farmers undertake irrigation farming to achieve food security and income generation at large. In the 1980s there had been a number of efforts in Tanzania to promote irrigation farming in order to increase food security. To some places Iringa Region inclusive, smallholder farmers opt to practice crop farming in wetlands where they can benefit from available water and moisture in both rain and dry season.

According to URT (2014) wetlands are known to be nature's water store on land. Almost 95% of all water on land providing vital ecosystems support services for humans, wildlife and livestock is stored in wetlands. Wetlands store the water and maintain perennial stream and river flows. Without wetlands, rivers and streams would drain all run-offs to the sea and dry up rapidly. Without wetlands there would be no water, no wildlife, no irrigation, no tourism, no power, no economy, thus no life. It is important to note that although wetlands make up less than 10% of land area, they are extremely valuable to the society. Wetlands can decrease flooding, remove pollutants from water, recharge groundwater, protect shorelines, provide habitat for wildlife and serve important recreational and cultural functions. Wetland farming or valley bottom farming in Iringa Region is commonly/locally known as 'Vinyungu'. *Vinyungu* farming is a traditional farming system in Iringa Region practiced by smallholder farmers usually in valley bottoms or flood plains. *Vinyungu* is a local term, which refers to farmlands or fields in valley bottoms or floodplains cultivated during the dry season utilising natural moisture or water diverted from rivers/streams or harvested from rain to produce food and cash crops. In doing so, farmers to a large extent cope with the problem of moisture stress commonly during dry the season. This type of farming is possible in Iringa because the groundwater table in most places is relatively high (Ravnborg, 1990; Lema, 1996). During dry season smallholder farmers make use of *vinyungu* to produce maize to supplement upland maize production as well as increasing household income through the sale of green maize (locally known as *gobo*) (Boesen and Ravnborg, 1993). This suggests that *vinyungu* irrigation system has potential for improving food security and income levels of farmers and thus contributes to poverty alleviation.

Vinyungu farming can therefore be considered to be a buffer to rain-fed agriculture. *Vinyungu* farming is practiced in wetlands and due to intensive cultivation they face a number of problems including over cultivation of land resource, intensive application of both chemical fertilizers and pesticides, intensive and unplanned use of water resource and conflicts particularly in land and water use/distribution. Currently *Vinyungu* farming is intensively

cultivated with substantial use of agriculture inputs and this threatens their sustainability and contributes heavily to reduction of surface water and poor recharging of ground water. Furthermore, *vinyungu* farming contributes to the surface and ground water pollution through application inorganic fertilizers and agrochemicals. Therefore, there is need to understand these impacts so as to develop appropriate management strategies to cope with the changing situation. This calls for a need to formulate sustainable management strategies that will sustain the productivity of *vinyungu* and overcoming threats emanating from *vinyungu* farming.

1.2 Definition of wetlands

Maltby (1986) defines wetland as "a collective term for ecosystems whose formation has been dominated by water and whose processes and characteristics are largely controlled by water". Cowardin *et al.* (1979) defined wetlands as "lands of transition between terrestrial and aquatic systems where the water table is usually at or near the surface of the land or the land is covered by shallow water". Smith (1980) described wetlands as "a halfway world between terrestrial and aquatic ecosystems and exhibit some of the characteristics of each". It is important to note that there are many definitions of wetlands found in literature, most of which were formulated out of perceptions. According to Mitsch and Gasselink (1993), the common distinguishing characteristics of wetlands include: presence of water, unique soil conditions that differ from adjacent uplands, and presence of vegetation adapted to the wet conditions (hydrophytes). Among the available wetland definition, the Ramsar Convention (1971) definition is widely accepted and it has been able to describe and capture the diversity and variety of wetlands. It tends to include characteristics that distinguish one wetland type from the other, indicating the differences in terms of character and origin.

The Ramsar Convention (1971) in Article 1, defines wetland as "areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salty, including areas of marine water the depth of which at low tide does not exceed six meters".

1.3 Importance of Wetlands

1.3.1 Ecosystem services provision

Wetlands provide a large array of ecosystem services defined as the benefits people derive from nature to urban and rural areas. They are among of the key productive natural resources which support community livelihood in most areas of the world including developing countries (Millennium Ecosystem Assessment, 2005). The information available emphasize that these resources provide useful and reliable environmental services and socio-economic benefits for human wellbeing. They are used for livestock keeping, fishing, hunting, harvesting medicinal plants and artisanal works. They supply families with basic needs such as water, construction material, and fuel. Ecologically, wetlands are instrumental in water storage filtration and supply, flood control, nutrients for agriculture, toxic retention and

import habitat for biodiversity both flora and fauna (Dugan, 1990). In addition to these local uses, wetlands play a critical role in mitigating the effects of climate change by management of greenhouse gases (especially carbon dioxide). Wetlands have been identified as significant storehouses (sinks) of carbon, which can help to reduce carbon in the atmosphere. Also, the system of interconnected wetlands plays a crucial role at a regional level by filtering pollutants and regulating water flows (Table 1).

Table 1: Ecosystems services provided by or derived from Wetlands

Provisioning services	
Food	Production of fish, wild game, fruits, and grains
Fresh Water	Storage and retention of water for domestic, industrial, and agricultural use
Fibre & Fuel	Production of logs, fuel wood, peat, fodder
Biochemical	Extraction of medicines and other materials from biota
Genetic Materials	Genes for resistance to plant pathogens, ornamental species, and so on
Regulating Services	
Climate regulation	Source of and sink for greenhouse gases; influence local and regional temperature, precipitation and other climatic processes
Water regulation (Hydrological flows)	Groundwater recharge/discharge
Water purification and waste treatment	Retention, recovery, and removal of excess nutrients and other pollutants
Erosion regulation	Retention of soils and sediments
Natural hazard regulation	Flood control, storms protection
Pollination	Habitat for pollinators
Cultural Services	
Spiritual and Inspirational	Source of inspiration; many religions attach spiritual and religious values to aspects of wetland ecosystems
Recreational	Opportunities for recreational activities
Aesthetic	Many people find beauty or aesthetic value in aspects of wetland ecosystems
Educational	opportunities for formal and informal education and training
Supporting services	
Soil formation	sediment retention and accumulation of organic matter
Nutrient cycling	Storage, recycling, processing, and acquisition of nutrients

1.3.2 Ecological benefits

Wetlands are the home of globally endangered species including birds such as the Shoebill (*Balaeniceps rex*) and Fox's weaver (*Ploceus spekeoides*), and fish species of the Cichlidae family. Many wetlands are an important stopover for large congregations of migratory water birds. Wetlands can act as a reservoir to store carbon dioxide, mitigating climate change impacts.

1.3.3 Biodiversity functions

The wetlands have a unique role in biodiversity terms, as they support not only the communities directly associated with them but also those from the aquatic and terrestrial habitats, too. This connectivity gives them a pivoted place in landscape mosaic. Abundant vegetation and shallow water provide diverse habitats for fish and wildlife. Aquatic plant life flourishes in the nutrient-rich environment, and energy converted by the plants is passed up the food chain to fish, waterfowl, and other wildlife and to human beings as well. Wetlands are ecologically important as nursery grounds for most of the fish species and they also provide shelter and protection to the young fish from predators.

1.3.4 Climatic functions

The enormous living and dead biomass of wetlands and their high productivity suggest an important function in the maintenance of “*greenhouse gas*” equilibria and contribution to the climatic change equation. Much interest is directed towards their role in the carbon balance in terms of Carbon-dioxide and Methane absorption/evolution. The contribution of the wetland to the water cycle is also very significant.

1.3.5 Hydrology

Wetlands function like natural tubs or sponges, storing water and slowly releasing it and in so doing, aquifers are recharged. This process slows the water's momentum and erosive potential, reduces flood heights, and allows for ground water recharge, which contributes to base-flow which maintains the rivers especially during the dry season. Although a small wetland might not store much water, a network of many small wetlands can store an enormous amount of water. The ability of wetlands to store floodwaters reduces the risk of costly property damage and loss of life, the benefits that have economic value to human being.

1.3.6 Water quality functions

After being slowed by a wetland, water moves around plants, allowing the suspended sediment to drop out and settle to the wetland floor (bed). Nutrients from fertilizer application, manure, leaking septic tanks, and municipal sewage that are dissolved in the water are often absorbed by plant roots and micro-organisms in the soil. Other pollutants stick to soil particles. In many cases, this filtration process removes much of the water's nutrient and pollutant load by the time it leaves a wetland. Some types of wetlands are so good at this filtration function that environmental managers construct similar artificial wetlands to treat storm water and wastewater.

1.3.7 Other uses of wetlands

The wetland resources have for a long time been associated with a number of uses to riparian communities. These include, among others:

- i. Source of fish,
- ii. Wetlands support agricultural activity and crops that are sustaining a large population in the basin. Crops grown include yams, sugar cane, bananas, potatoes, maize and vegetables such as beans, tomatoes and cabbages.
- iii. Wetlands are traditional grazing areas and sustain livestock populations especially during drought.
- iv. Crafts production, particularly using papyrus and other wetland reeds. These wetland crafts products are of economic value and thus help to sustain and supplement the meagre incomes of some of the communities,
- v. Source of traditional medicinal herbs,
- vi. Wetlands are also a source of water for domestic use especially for communities not adequately supplied with piped water.

1.4 Aim of the Guideline

This guideline has been designed to make a contribution to sustainable utilization and management of wetlands in Ihemi Cluster within the SAGCOT. It contains information to help stakeholders protect the functions of wetlands in agricultural production systems including crops, livestock, fisheries and agroforestry within the context of sustainable water resource management. The Guideline contributes towards the needs and interests of various stakeholders who can participate in sustainable management of wetland ecosystems for livelihood and economic development.

1.5 Scope of the Guideline

The guideline is prepared to lead on sustainable management of Ihemi Cluster wetlands and it covers procedures for: identification of wetlands; wetland integrated management plans; activities to be carried out and in the wetlands; identification of challenges and opportunities in the wetlands; and assessment of the inventory and state of natural resources provided by wetlands as well as procedures for carrying out comprehensive assessments. The guideline also covers procedures for: wetland resources use; monitoring activities; surveys; researches; rehabilitation as a management response; management issues in Ihemi Cluster wetlands; urgency and conservation priority; establishment of an effective and efficient institutional and legal framework for integrated management and wise use of wetlands; communication, education and public awareness among stakeholders; and promotion of partnership and cooperation.

1.6 Rationale of the Guideline

Ihemi cluster is characterized by different land uses including agriculture, forestry, urbanization and industrialization. There is growing demand for land to increase agricultural production through investments, tree planting and clearing of natural forest for different uses

such as agriculture, urbanization and the draining of natural wetlands – valley bottoms for agriculture popularly locally known as “*vinyungu*” farming. There are a number of problems faced by *Vinyungu* farming commonly practiced in wetlands including over cultivation of land resource, intensive application of agrochemicals (both chemical fertilizers and pesticides), intensive and unplanned use of water resource and conflicts particularly in land and water use/distribution. Land and water degradation is also a serious problem in wetland farming due to poor management of these resources.

The sustainable wetlands management situation is supposed to have effectively formulated and implemented management plan which can promote wetlands conservation in a considerable areas as far as their possible wise use in their territory. In this case, a guideline needs to be in place in order to manage resources sustainably and its development has to consider human needs and contributions. Therefore, this guideline provides for sustainable management of wetlands/valley bottoms that contribute to: i) improve livelihoods in line with the ability to maintain ecosystem functions; ii) Facilitate and provide a framework for sustainable management of wetlands; and iii) Maintain essential ecological and hydrological functions which ultimately provide its products, functions and attributes.

1.7 Target Users and Use of the Guideline

The users of this guideline include local communities, policy makers, extension agents, private sectors, civil society organizations, research and training institutions and media. The guideline provides some examples of wetland management based on observations in communities whose livelihoods depend on wetlands goods and services. For policymakers interested in ensuring that wetlands are used for agriculture and for other ecosystem services in a sustainable manner, the guideline shows the complexity of putting in place functional institutional arrangements that ensure sustainable wetland utilization and hence the importance of considering the linkages and interactions of the different governance arrangements in a wetland. The extension agents and CSOs are guided on the best wetland management approaches to be applied while private sectors and media can take opportunity to promote best management practices and technologies. The guideline also provides framework for researchers who are keen to ensure that utilization and management of wetlands is based on the best available information.

1.8 Method for Preparing the Guideline

This guideline has been developed based on the comprehensive literature review based on the publications, proceedings, policy documents, case studies particularly in Ihemi Cluster and consultations with some of the key stakeholders.

2.0 POLICIES AND REGULATORY FRAMEWORK

In order to achieve sustainable management of wetlands, environmental goals, objectives and actions have to be mainstreamed in various development activities including projects, programs and other natural resource use interventions. Recognizing such need, some Tanzanian laws, policies, strategies and plans have incorporated some directives regarding wetlands utilization and management issues.

2.1 Policies

2.1.1 National Agriculture Policy, 2013

The policy promotes integrated, sustainable use and management of natural resources such as land, soil, water sources and vegetation in order to conserve the environment. Irrigation is considered to be essential for increased productivity and production as it mitigates vagaries of weather, which are becoming more frequent and intensive because of global climate change. The policy states clearly that efforts to develop an effective irrigation system in the country are constrained by inadequate private sector capacity and funding for irrigation development; inadequate sector co-ordination and lack of holistic integrated planning in water resource utilization; weak irrigators' organizations to undertake overall irrigation water management and infrastructure maintenance; and low production and productivity in constructed irrigation schemes. Although the policy does not say specifically on sustainable management of wetlands it insists on strengthening effective management of irrigation schemes and full participation in Integrated Water Resources Management (IWRM) as well as promotion of enhanced water productivity will have a direct role to play in management of wetlands.

2.1.2 National Water Policy, 2002

The National Water Policy reflects the shift in approach towards comprehensiveness, subsidiary and economics. The policy states that a holistic water (river) basin approach, integrating multi-sector and multi-objective planning and management, should be taken in order to ensure sustainability and protection of the resource. It advocates decentralised decision-making and a participatory planning approach; that the use of water should reflect its scarcity, as should its price, thus recognising water as an economic good; it further promotes cost sharing and other incentives for enhancing efficiency in the use of water. The policy also emphasises the ecological aspects of water management and the need to ensure water allocation to maintain ecosystem health. With these basic shifts in approach and the attempt to coordinate and harmonise the sectoral policies, it is in line with the guidance from the Convention on Wetlands and the vision of the National Wetlands Working Group (NWWG).

2.1.3 The National Environmental Policy, 1997

The Environmental Policy focuses on directing the overall sectoral and cross-sectoral environmental management activities in various government departments. The policy makes specific reference to the need to improve the management and conservation of wetlands and

identifies the problems related to wetland management as land degradation, lack of accessible water of adequate quality and deterioration of aquatic resources.

2.1.4 Wildlife Policy, 2007

Wildlife Policy addresses issues related to protection, conservation management and sustainable utilization of wildlife and wetlands resources. In this policy the issues to do with wetlands management and conservation are being addressed under four objectives, whereby in each objective there are various issues and their policy statements. Comparatively, the Wildlife Policy has been the most successful in providing for and addressing the wetlands issues in relation to conservation and a management for sustainable development.

2.1.5 Land Policy, 1997

The overall aim of a National Land Policy is to promote and ensure a secure land tenure system, to encourage the optimal use of land resources, and to facilitate broad-based social and economic development without upsetting or endangering the ecological balance of the environment. Protection of land resources from degradation for sustainable development is among the specific objectives. In this policy wetlands are considered as wastelands and are thought as being not useful for social economic development. However, the policy Statement directs wetlands to be properly studied for proper land uses initiatives hence to be allocated to appropriate users.

2.1.6 Forest Policy, 1998

The Forest policy emphasizes ecosystem conservation and management that ensures ecosystem stability through conservation of forest biodiversity, water catchments and soil fertility. However, the policy stresses that; new reserves for biodiversity conservation will be established in areas of high biodiversity value. Also biodiversity conservation and management to be included in the management plans for all protected forests. Involvement of local communities and other stakeholders in conservation and management will be encouraged through joint management agreements. The Policy set out general guidelines for managing forest resources, aimed at ensuring a sustainable supply of forest products and services, and generally acknowledges the need for cross-sectoral regulation.

2.1.7 Fisheries Policy, 2005

The overall goal of the National Fisheries Policy is to promote conservation, development and sustainable management of fisheries resources for present and future generations. The Policy promotes sustainable exploitation, utilization and marketing of fisheries resources to provide food, income, employment, foreign exchange earnings, and effective protection of the aquatic environment to sustain development. The policy provides for aquatic ecosystem productivity and biological diversity protection through prevention of habitat destruction, pollution, and over exploitation. Sound utilization of water is also promoted in generating income and meeting dietary needs. The policy specifies protection of fragile aquatic ecosystems and collaboration with the water sector in developing a water quality monitoring

system. Procedures and guidelines are established for aquaculture development including: utilization of small water bodies, dams, and reservoirs for aquaculture activities; and environmental assessment and monitoring to prevent water source pollution.

2.1.8 Livestock Policy, 2006

Over 70 percent of livestock populations are kept in semi-arid areas in northern, central and western parts of Tanzania. These areas experience severe water shortage during the dry season, forcing livestock farmers and their livestock to migrate to other areas with wetlands in particular. This movement often results into overgrazing, degradation of environment particularly destruction and pollution of water sources due to limited watering points. The issues here are that water for livestock in the pastoral and agro-pastoral areas is constrained by inadequate water harvesting expertise, wetland management as well as uneven distribution of water sources and distribution.

2.2 Strategies

2.2.1 Wetlands strategy

The Tanzanian wetland conservation and management programme was developed in 1990s. Many wetlands are conserved in the game reserves, national parks, and the controlled areas, while others have no conservation status. Wetlands need to be conserved because of their fragility, endemic nature, historical importance, functions, products and attributes.

2.2.2 National Water Sector Development Strategy

For the purpose of managing wetlands sustainably the National Water Sector Development Strategy recommends the preparation of national inventories on the condition and extent of wetlands, floodplains and riparian ecosystems, as a basis for ensuring their long term protection. In addition, it is recommended that steps should be taken to identify and legally establish reserve areas for water sources to ensure resources conservation and protection.

2.3 Legislative Acts

In order to achieve sustainable management of wetlands, in addition to policies, Tanzanian government has enacted laws which have incorporated some directives regarding wetlands utilization and management issues.

2.3.1 The Environmental Management Act, 2004

The Act states declaration on protection and management of protected river, river bank, lake or lakeshore, shorelines protected wetlands. Also it states that, sector Ministries under whose jurisdiction any area of wetland falls, shall be responsible for the management of wetlands falling under their respective jurisdiction.

2.3.2 Wildlife Conservation Act, 2009

One of the objectives of this Act and to which all persons exercising powers, applying or interpreting this Act is to protect and conserve and administer areas with great biological diversity. This includes wetlands which are representative of the major wildlife habitats. The Act also gives special conservation status to endemic, rare or endangered wildlife species and aims at enabling Tanzania to effectively contribute and benefit from international efforts and measures to protect and enhance global bio-diversity.

2.3.3 Water Resources Management Act, 2009

Among other things, Part IV of this act addresses the issues of protection of water resources against all sources of damage. It classifies water resources and elaborates on water resource quality objectives. In order to achieve the objective of protecting water resources, the Act goes further by prohibiting human activities near water sources and in areas that are declared to be protected zones. The Act contains a list of areas that can be declared protected zones of which swamps, reservoirs, wetlands and other water carrying aquifers are specifically mentioned

3.0 SUSTAINABLE MANAGEMENT OF WETLANDS IN IHEMI CLUSTER

It is currently common for various people who secure their livelihoods through agriculture, fishing, and livestock as well as services including water services, tourism, an extraction of medicinal, making goods, traditional believes aesthetics as well as regulating the environment are largely supported by wetland resources (URT, 2006; Mwanukuzi, 2011).

3.1 Opportunities, Challenges and Solutions to Wetlands Management in Ihemi Cluster

3.1.1 Opportunities

In Ihemi cluster where the land is characterized by varied landforms and relatively high water table, valley bottom farming systems of “*vinyungu*” have been reported to supplement food and income generated from rain-fed farming. *Vinyungu* farming is a traditional farming system practised by smallholder farmers usually in valley bottoms or flood plains. Ideally, these areas are characteristically moist areas for a long period of the year, allowing the cultivation of multiple annual crops.

Opportunities that are ready for scaling-up in the Southern Agriculture Growth Corridor of Tanzania include agriculture, land management, and value chain practices and investments that are economically viable (for one or more categories of investor), socially and environmentally beneficial, and suitable for large-scale implementation in the Corridor. The best bet opportunities include: sustainable crop and livestock intensification; investments in forests, water, and bioenergy and; value addition and value chains.

3.1.2 Challenges

Findings from various studies (Kashaigili *et al.*, 2016; Majule and Mwalyosi, 2005) have observed that wetland health is affected by poor agricultural practices which cause a number of negative changes to wetland environments. *Negative impacts* include:

- changes in water regime,
- reduced flood frequency, duration and volume,
- increased permanent inundation,
- changes to water quality,
- reduced groundwater recharge,
- the loss and decline of riparian and wetland vegetation,
- the loss of habitat and other,
- biodiversity values and the introduction of exotic animal and plant species.

Most of the wetlands/*vinyungu* areas in Ihemi Cluster exist as shallow subsurface water, thus drainage of them has been a common practice, converting to agriculture or urban development, but this has detrimental effects as it can result in decreased recharge to

groundwater and increased flooding in the developed area. Generally, if wetlands are drained, biological impacts may be substantial because wetlands are some of the most biologically productive ecosystems on Earth. For instance, most of the wetlands (*vinyungu*) are water sources for the most rivers in the cluster. Their conversion to agriculture has impacted on the water resources by causing some rivers to dry out or becoming seasonal.

The sustainability of water supply in the Ihemi cluster is jeopardized by the human actions. Equally important is a realization that farming in the Ihemi cluster not only occurs in the valley bottoms (*vinyungu*) but also in the dry land and notably in the high rainfall forested steep slopes area. Farming in steep slopes results into erosions thus generating a lot of sediments that discharges into the wetlands/valley bottoms and rivers. Owing to this, most of the rivers in particular the Little Ruaha River which is the main river flowing in the Ihemi cluster has silted up and its channel capacity has been reduced substantially (Kashaigili *et al.*, 2016).

Irrigation practices in most areas are still traditional and inefficient coupled with very low productivity. Even where the irrigation schemes have been improved, the on-farm water management is inappropriately practised. Along with this is the improper use of agricultural inputs including use of fertilizers and pesticides. It is important to note that irrigation waters that return to either groundwater or surface waters can contain salts, pesticides, or have elevated levels of nutrients such as nitrate and phosphorous. These contaminants in turn can cause harm to plant and animal life that depend on the returned water. Another challenge is limited extension services on Good Agronomic Practices (Kashaigili *et al.*, 2016).



Plate 1: Maize and Tomatoes cultivation in the Vinyungu within Ihemi Cluster (Majule and Mwalyosi, 2005)

On the other hand, inappropriate grazing regimes and stocking rates are degrading many wetlands in the country. So far, livestock have unrestricted access to wetlands (and riparian zones) thus increasing the risk of spreading or introducing weeds and contribute to poor water quality by degrading bank stability. Many wetlands are being converted to grasslands and

other landforms through the high stocking rates by a majority of the pastoral communities. Farmers-livestock conflicts are now very common in the country especially in areas around soil and biodiversity rich areas of the country as well as in the areas with highest population and development increasing areas.



Plate 2: Livestock grazing in Ihemi Cluster wetland



Plate 3: Land degradation challenge in Ihemi Cluster (Majule and Mwalyosi, 2005)

3.1.3 Overcoming the challenges – what needs to be done?

The following needs to be done to overcome challenges;

Sectoral management

Wetlands are often viewed by each user as a single-product system, precluding other uses and values, which eventually put them under great threat. Given this, it is therefore important to understand that wetlands are multifunctional and their management should be integrated and coordinated. Thus planning at sectoral level should be harmonized.

Strict Enforcement of Established Policies

Wetland management needs effective legislation, which takes into account the diverse nature of wetlands and should be supported by effective enforcement and resources. The legislation must take into account the needs of wetlands and the requirement of all the sectors that use them. As the population increases, and thus more demands are made on resources, wetlands maybe further destroyed in the name of development. Despite of having good environment related policies the main weakness and challenges have remained on the *enforcement* of these policies. Putting in place policies which are not enforced have resulted into environmental and wetland degradation.

Minimization of Phosphate fertilizer

The amount of available P in soils was very high in most fields in most of areas and Iringa inclusive (>20 mgP/kg soil). This suggests that P may not be a limiting factor in the productivity of *vinyungu*. Excessive application of phosphate fertilizer contributes to high soil acidity that affects crop production. It may be a problem in the upland areas where soils are likely to be different. Therefore, application of phosphate fertilizers in *vinyungu* should therefore be minimized. The obvious problem is how to improve soil pH and organic matter content so as to increase the buffer capacity of soils.

Soil Test to be conducted

Fertilizer application in Iringa Region is practiced without technical recommendation on the type of fertilizer to be applied. Soil test will inform on what nutrients available in a particular area as well as its deficiencies. There is need to conduct research on fertilizer rates since the current recommendation does not take care of soils under *vinyungu* which seems to be very rich in phosphorus. The only problem seems to exist with P availability is fixation by calcium originating from irrigation water with very high pH. Field observation indicated that there is a formation of salt crust in irrigation canals particularly at Ilula mwaya. Under such circumstance, available phosphorus tends to react with calcium compounds to form whitish precipitates of calcium phosphate (Majule, 1991; Rowell, 1993). When this happens, farmers tends to apply excessive phosphorus in order to saturate the active fixing sites in soils as a result more cost is incurred. Research of sulphur application rates may be a solution since the powder tends to lower the pH of the soil. There is a need to follow closely proper use of artificial pesticides, fertilizers and herbicides in order to minimize their environmental impact

on soils.

Organic Farming

There is need to control the use and application of industrial fertilizers and pesticides in associated with *vinyungu* farming practices. As much as possible and wherever possible, efforts should be made to introduce and encourage the application of organic fertilizers and pesticides. Organic farming should be encouraged for improving soil fertility and the use of traditional pesticides and organic residues be encouraged for sustainable *vinyungu* productivity.

Capacity building on Hydrology Knowledge

Due to an increased demand of water for irrigation in *vinyungu*, there is a need to understand the hydrology of water in *vinyungu* so that to have a sustainable utilization of water resource. Communities are the ones make use of wetlands and are the ones misuse them unknowingly. There must be a deliberate measure on educating communities where wetlands are in terms of their importance and negative impacts when diminishing. Through capacity building, community members will take charge in wetland conservation for present and future generation.

3.2 Key Issues for the Sustainable Management of Wetlands

Developing an understanding by the local community and external stakeholders of the wetland ecology and the socio-economic situation process is crucial. The issues to be considered for sustainable management of Ihemi wetland include the following:

3.2.1 Identification of Ihemi Cluster Wetlands

Key wetlands are those wetlands which deliver a high level of goods and services (Kotze, 2004; URT, 2003). Wetlands are also considered key if they are threatened by degradation which is likely to lead to significant environmental impacts, aside from any goods and services that they may be currently delivering.

Identification of key wetlands in Ihemi Cluster is based on the knowledge of direct regional and local government responsible staffs that are familiar with the different Districts Councils and villages in Ihemi cluster; identifying key wetlands based on a systematic desktop-based description of all known wetlands using interpretation of remotely sensed images, examination of relevant databases and consultation with individuals having good local knowledge; and identifying key wetlands based on a systematic rapid assessment of all wetlands in the Ihemi cluster.

3.2.2 Improve Wetlands Resource Use

On agricultural production, promotion of investments that will lead to sustainable agricultural production while ensuring sustainable wetland management should be conducted. This should be conducted in line with the development of smallholder farming practices and associated

activities such as mixed farming, improve home gardens such as *Chagga* home gardens. There is a number sustainable agriculture innovation practices which when they are implemented community livelihood will be improved. For example use of appropriate maize and rice varieties, more resistance crop and vegetable varieties to drought, diseases and pests.

As far as water is concerned, water harvesting practices such as ridges, box and *majaluba* conserve water for both crops and livestock. When sustainable agriculture is adopted, average crop yields for smallholders will increase. This will in turn increase farmers' income and improve their overall livelihoods. Small-scale farmers have to be helped to invest in well managed farming systems. Large-scale farmers and partners (e.g. NGOs and LGAs) should facilitate the processes of improving water management for enhancing production through training and practical demonstration of practicals in the field in collaboration with stakeholders. In this case, farmers will be encouraged easily to invest in agriculture since this will practically be observed in terms of benefits if adopted these practices will also reduce fossil fuels dependency and energy requirements and mitigate climate change through reduced emissions and enhanced soil carbon sequestration. Appropriate agronomic practices in wetland, vegetation conservation, tree planting, improve green farming (agriculture) if implemented will bring multiple benefits to the community including an increase in crop production, more nutritious diet and improve health to the communities.

For sustainable wetland management, the following needs to be implemented:

- Discourage farming in wetlands/valley bottoms by providing alternative irrigation farming in non-wetland areas;
- Conduct re-assessment of land uses in the Ihemi cluster in consideration of villages land demands and provide village land titles;
- Establish partnerships between investors and villagers; invest in new technologies and agro-mechanization for improved agricultural productivity and efficiency of water use;
- Promote medium size and large-scale commercial farming through attraction and engagement of both local and foreign investors.

In general, experience shows that, local populations around large-scale farms have access to new farming technologies, better farming practices, and some provide services and jobs.

3.2.3 Integrated management plans for wetlands

Under this, two key aspects need to be considered and these are:

3.2.3.1 Promotion of equity of land access and land use

This is a participatory process which recognizes the rights of all the stakeholders, including fisher folks, pastoralists, landless farmers, rural women or ethnic groups within the context of the local cultures and traditions. Access and use of wetlands are considered in the broader context of sustainable natural resource use and are compatible with their fragility.

3.2.3.2 Negotiated decision-making

Decisions on use and management of wetlands should be taken by stakeholders within the broader framework of government land and water use and environmental related policies which also take into consideration international agreements. In Ihemi Cluster wetlands, representatives of various sectors need to work together and apply policy issues through discussion and planning.

3.2.4 Monitoring and Evaluation

Consistent, thorough and timely wetland monitoring and assessment activities are a critical tool for stakeholders to better manage and protect their wetland resources. This allows them establish a baseline in wetlands extent, condition and function; detect change and; characterize trends over time. The monitoring M&E plan will track progress at all levels of the guideline implementation focusing mainly on:

- a) Impact level - changes in people's livelihood and the wetlands environment
- b) Effect level – behaviour and institutional change, and changes in region and district planning systems
- c) Output level - results of sustainable wetland management interventions
- d) Activity level - completion of wetland management interventions

Participatory monitoring approaches to be considered which recognizes and capitalizes on community, households and all stakeholders engaged in the sustainable management of wetlands. In other situations, external evaluators or assessors could be used. Some examples of key monitoring indicators in both levels are being provided in Table 2.

Table 2: Monitoring indicators in Ihemi Cluster wetland

Changes	Key indicator components to consider at level 1	Key indicator components to consider at level 3
Change in hydrological integrity (water level)	Man-made structure	<ul style="list-style-type: none"> • Inflows and outflows • Evapotranspiration • Historical information on hydrological regimes • Climate conditions
	Water table depth	
	Plant invasion	
Change in physico-chemical parameters	Fire damage	<ul style="list-style-type: none"> • Intensity of fire and damage • Type of materials eroded and concentration •
	Degree sedimentation/erosion	
Change in ecosystem intactness	Loss in area of original wetland	<ul style="list-style-type: none"> • Shape and size • Corridors and links for all constituent species
	Connectivity barrier	
Change in browsing, padation and harvesting regimes	Damage of domestic/feral animals	<ul style="list-style-type: none"> • Size and visibility • Historical information • Frequency, extent and intensity
	Introduced predator impacts of biota	
Change in species composition and cover	Introduced plant canopy cover	<ul style="list-style-type: none"> • Type of alien species • Historical information • Frequency, extent intensity
	Introduced plant understory cover	

Wetland Resource Assessment is vital for assessing:

- a) The condition of the wetland environment and its ecosystem services.
- b) Listing of its current use pressures and future resource use needs of a growing human population.
- c) To identify the best areas for management intervention by providing information to be able to prioritize planning of mitigation responses.

3.2.5 Research

The role of research should be to conduct participatory research on wetlands resources and support innovations that facilitate sustainable management of wetlands by local communities. New and emerging wetlands research partnerships should identify technological advances on wetlands utilization. A major thrust will be on promoting improved land management and sustainable crop-livestock and fisheries intensification, in order to bolster farmers' adaptive capacity through participatory action research and support the national vision of achieving

food security.

3.2.6 Communication, education and public awareness

Effective negotiation and decision making on wetland use in Ihemi Cluster cannot take place without a knowledge base that is accessible and usable for all stakeholders. The two essential components of the knowledge base are information and education to make the information accessible. Awareness rising is an important stage for effective dissemination of knowledge and technologies and to be successful, it needs to use all appropriate communication channels such as radio, television, print media, leaflets, brochures, oral communication, and traditional communication. Awareness raising targets different socio groups such as government authorities, central and local administrative authorities, religious, traditional leaders, opinion leaders, NGOs, civil society, donors and media in Ihemi. In this case, there are policies and strategies that need to be translated and implemented in the Cluster. A number of agriculture research have been conducted in the area but the findings have not yet been communicated properly to stakeholders.

3.2.7 Partnerships

A collaborative public–private–partnership is encouraged and emphasized for sustainable management of wetlands in the Ihemi cluster. Stakeholders present in Ihemi Cluster, Table 2 each plays its different role but a partnership is highly encouraged if a sustainable management has to be achieved. For example a participatory research to be conducted for an agriculture scientist to assess the impact of improved maize or rice seeds to adapt to climate change particularly drought needs to involve an extension, media, stockiest and water sector. A partnership between investors and communities is also needed because this will meet both investors and community needs taking into account wetland ecosystem management. On the other hand, this will enable other challenges to be done with other stakeholders to improve adaptation.

3.3 Key Stakeholders Roles

Stakeholders include individual, group or organization that has interest, share or concern in a given wetland (Table 3). Any decision/action on wetland can affect or be affected by stakeholder. Sustainable utilization: Sustainable utilization is defined as “human use of a wetland so that it may yield the greatest continuous benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations”.

Table 3: Stakeholder roles in Sustainable Management of wetlands in Ihemi Cluster

Stakeholder	Roles
Communities	To understand and implement various activities which are important for their livelihood and also to share the information concerning the sustainable management of wetlands
Policy makers	Formulate policies and guideline for the wetlands managements, and provide knowledge to stakeholders
Extension agents	To create awareness and sensitize on the use of this guideline and promote sustainable wetland management approaches and practices
Private sectors	Private sector can play an important role in identifying opportunities, maximizing profit, and managing risks in wetlands. Private sector to be empowered to invest in wetland management activities
Development Partners	To facilitate capacity building to increase knowledge and skills on sustainable wetland management approaches and practices
CSOs (NGOs, FBOs &CBOs)	To facilitate capacity building to increase knowledge and skills on sustainable wetland management approaches and practices
Researchers	Researchers/Institutions can help in bringing together different stakeholders using Learning and Practice Alliance (LPA) approach which engages key stakeholders including policy makers, practitioners and farmers to join and work together in addressing existing problems and identify potential solutions in wetland management.
Training institutions	To facilitate capacity building to increase knowledge and skills on sustainable wetland management approaches and practices
Media	Dissemination of information through various channels and should engage in soliciting information from researchers including undertaking field visit to various locations in Ihemi cluster wetlands

3.4 Approaches and Sustainable Management Practices

Integrated and participatory approaches to sustainable wetland management could be effective and operational if they take into account the needs and aspirations of the present and potential users of the wetlands in Ihemi cluster and if they are based on the existing local, traditional agro-ecosystems that have enabled the mostly resource-poor small farmers to meet their subsistence needs for centuries without adverse environmental consequences such as water pollution, declining soil fertility, soil erosion and others.

3.4.1 Agricultural

The majority of communities in Ihemi cluster engage in agricultural production for their livelihood and income. In general, they rely mainly on natural resources that are available in the cluster particularly water and fertile soils. Smallholder farmers can triple their yields if intensify crop production (produce more crops per unit area) is to be attained but they need the right education, right seeds, storage facilities and competitive markets. There is a need to follow closely proper use of artificial pesticides, fertilizers and herbicides in order to minimize their environmental impacts on soils.

In addition, use of traditional pesticides and organic residues for sustainable *vinyungu* productivity need to be encouraged. On the other hand, bylaws which prevent people to cultivate very close from water sources needs to be strengthened and adopted.

3.4.2 Livestock

In the wetland, inappropriate grazing regimes and stocking rates are degrading the wetland and polluting water resource. What needs to be done is to maintain the carrying capacity of livestock in Ihemi and also improving livestock breed. There is a need to strengthen livestock veterinary services to control diseases which normally cause loss to livestock keepers.

3.4.3 Integrated fishery management

Fish are of fundamental importance to the social and economic well being of the inhabitants of communities living in coastal, lake shore and other areas along rivers as well as near wetlands. The wetlands support subsistence and livelihood to thousands of people through fishing, collecting edible plants, agriculture, water transport, irrigation and fisheries, besides rich biodiversity in Ihemi. Wetlands are directly or indirectly linked to rivers in the Cluster and of these; wetlands are associated with floodplains of rivers (floodplain wetlands) and are a common feature of the landscape. They also form a major inland fisheries resource in the Ihemi Clusters in Iringa Region.

Fisheries of these wetlands are under open access regimes and fishing is an essential part of the livelihood strategies for hundreds of people associated with these ecosystems. In Ihemi Cluster, there is a growing demand for fish against the background of a resource that is declining due to climate change. In addressing this challenge, there is a growing interest to develop the fishery industry in Ihemi Cluster by introducing small dams to raise fish. As a result, the future appears to be for better regulation of conventional capture fisheries but also to pursue methods for production enhancement that are better adapted to the changing environment.

A sustainable integration plan envisages developing agriculture and aquaculture in one portion, leaving the other portion for capture and culture based fisheries in Ihemi Cluster include for example, a dike can separate the two segments of the wetland while the water flow to agriculture and aquaculture areas in each segment can be regulated through canals. The central marshy portion can be left intact for harbouring the birds that frequent the area. However, the long-term effects of this type of development, on the hydrodynamics and natural biological productivity are not adequately assessed in Ihemi Cluster, therefore this need to be studied. In this context, species management is a very important tool in wetland fishery management. This can be achieved through various options of species enhancement and management.



Plate 4: Integrated fish farming in wetlands

The overall goal for sustainable fish management is to produce sustainable biological, social, and economic benefits from renewable aquatic resources. For integrated management of fisheries:

- a) a cooperative between a local state and resource users is needed
- b) share management responsibilities is crucial
- c) A range of players in decision making process is needed
- d) Active involvement in fisheries management is crucial

Among the tools to manage fish includes;

- a) Fisheries management instruments
- b) Monitoring, Control and Surveillance (MCS)
- c) Closed areas, Closed seasons
- d) Collaborative Fisheries Management Areas (CFMA)

3.4.4 Water resource

The following four key practices need to be implemented:

- a) Discourage farming in wetlands/valley bottoms particularly *vinyungu* by providing and support alternative irrigation farming in drier non-wetland areas.
- b) Establish partnerships between investors and villagers through their water user associations.
- c) Invest in new technologies and agro-mechanization for improved agricultural productivity and efficiency of water use.
- d) Promote medium size and large-scale commercial farming through attraction and engagement of both local and foreign investors which have demonstrated that local populations around large-scale farms have access to new farming technologies, better farming practices, and some provide services and jobs.

3.4.5 Sustainable land management

Sustainable agricultural growth requires that sustainable land practices are adopted by farmers. In Eastern and Southern Africa, sustained gains to agricultural productivity are threatened by land degradation, especially land erosion and loss of fertility (Kimaru and Jama, 2005; Majule and Mwalyosi, 2005). This guideline recommend the following conservation practices to be used by small or large scale farmers in order to increase productivity and conserve soils and water resources.

The types of conservation practices suggested to be used includes bunds, ridges of different types and terracing. Agroforestry practice is recommended in wetlands to maintain soil fertility and conserve water which is virtually needed for crop production and livestock.

In general, the guideline should be able to achieve the following:

- a) Productive crops and animals achieved
- b) Conservation of soil and water
- c) High levels of soil fertility
- d) Low levels of soil and water pollutants
- e) Low levels of crop pests and animal diseases
- f) Viable production systems
- g) Food requirements
- h) Economic and social needs satisfied
- i) Awareness by farmers

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APPENDIX: 1 Wetland evaluation form which could be adopted in Ihemi Cluster

Summary of wetland values significance and expected impact	yes	Likely	possibly	No	Unknown	Critical	Critical only	National	Regional	Local	Negligible	High	Moderate	Low
1. Life support values														
Hydrological values														
Biogeochemical values														
Habit values														
Ecological Values														
2. Social/cultural values														
Aesthetic values														
Recreational values														
Education and public awareness														
Public status values														
Cultural attribute values														
3. Production values														
Agricultural values														
Renewable values														
Non renewable values														
Tourism and recreational values														
Urban values														
Total														