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DISCUSSION PAPER ON MAINSTERAMING OF ENVIRONMENTAL FLOWS INTO INTEGRATED WATER RESOURCES MANAGEMENT.

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Discussion paper: Mainstreaming of Environmental Flows into Integrated Water Resources Management

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Introduction

Water is essential to all kinds of human development and livelihood support systems including ecosystems management, sustaining both aquatic and terrestrial ecosystems. However, water resources are now under pressure due to increased competing demands and global warming, which have led to complex water management challenges. In recent decades it has been widely recognised that the impact of human society on the environment is beginning to threaten the basic foundation upon which humans depend for food, shelter and well-being. Rising demands for water and other natural resources as a result of increased population, compounded by the inappropriate use and poor management of land and water resources have increased negative effects on economic growth, on social welfare and on the world's systems such as coastal and marine environment. Poor management of river basins has resulted into degradation of water catchments consequently affecting river flows in both quantity and quality with devastating impacts on the downstream including the coastal and marine ecosystems which suffer from increased inflow of nutrients carried by rivers to the seas and sediment deposits on the sea bottom, and variation of flow regimes. The drivers for the change, namely deforestation, overgrazing, and extensive land based rural activities in the upstream catchment areas play a significant role on the coastal and marine ecology by altering flow regimes and sediment deposition. Notably, most governments are currently striving to promote effective management of water and catchments in order to meet anticipated requirements in the near and distant futures. Traditionally, the focus has been on providing enough water for human needs, with little attention to the environment. However it has been recently recognised that provision of water for the environment is one component of an intersectoral water allocation process in which the right to the use of water is distributed amongst various users. Therefore, Environmental Flow Assessments (EFAs) has in the recent years gained attention and scientifically accepted method for determining the quantity, quality, and timing of flows needed to sustain ecosystems and ecosystem services (King *et al*., 2008). In this case provision for

environmental flows is currently becoming a central issue in the debate of integrated water resources management in river basins.

Plans for the further development of water resources are being formulated in the framework of Integrated Water Resources Management (IWRM), which seeks to develop and manage water in a manner that maximizes economic and social benefits for multiple water users without degrading ecosystems (GWP, 2000). In essence, IWRM *is a process that promotes the coordinated development and management of water, land and related resources in order to maximise the resultant economic and social welfare in an equitable manner, without compromising the sustainability of vital ecosystems*. It is considered a basic principle in sustainable development and in the search for ways to reconcile multiple and competing water uses with environmental protection.

To that effect, most of African national water laws formulated in the past 20 yrs have adopted IWRM as the guiding framework, and these principles are well reflected in the framework for action for African Water Vision 2025 which calls for allocation of sufficient water for environmental sustainability across all nations on the continent by 2015. For example, the government of Tanzania National Water Policy (2002) and Water Resources Management Act No. 11 of 2009, provide for environmental flows, and require conducting EFAs to inform water allocation decisions by water managers aiming at protection of a reserve flow to meet the basic needs of people and protect aquatic ecosystems. Further, the Environmental Policy (1997) and Environmental Management Act (2004), calls for protection of reserve flows in all aquatic ecosystems, and has formulated regulations and guidelines to enable the operationalization.

Understanding Environmental Flows and its contribution to IWRM

Environmental flow (EF) is the water that is left in river ecosystem, or released into it, for the specific purpose of managing the condition of that ecosystem. According to Dyson *et al*., (2003); Tharme and King, (1998), EF is regarded as the water regime provided within a river, wetland or coastal zone to maintain ecosystems and their benefits. The Brisbane Declaration, (2007) is mostly used and describes environmental flows as "*the quantity, timing, and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems.*" Different names such as instream flow, environment water requirement, minimum flow requirements, ecological flow, ecological reserve, environmental reserve and riparian flow have been used in the literature. The failure to maintain such flows has led to a decline in the health of many of the world's water dependent ecosystems, largely as a result of increasing pressure from water and catchment developments.

The concept of environmental flows is adaptive and essential to the wider IWRM approach. It is closely linked to the concept of ecosystem services. In real terms, an

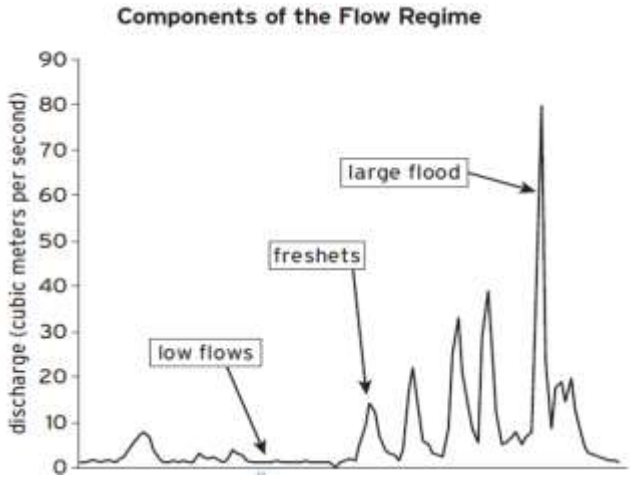
environmental flow expresses the quantity, quality and timing of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems. A useful way of understanding environmental flows is thinking of 'ecological water demand' in just the same way as there is agricultural or industrial water demand. Environmental flows are effectively a balance between water resources development and the need to protect freshwater-dependent ecosystems. When thinking about environmental flows it is important to consider all aspects of the river and drainage system. The basin must be viewed from its headwater to the estuarine and coastal environments.

Environmental flows improve water management by ensuring a sustainable water supply meets the needs of people, agriculture, energy, industry and the environment within the limits of availability. The application of environmental flows supports the health of aquatic ecosystems and the well-being of people who depend on them. By providing a system for equitable allocation of water, based on available supply, the application of environmental flows can support development and poverty alleviation. Environmental flow assessments provide the tools and the data necessary to help support decision-making processes which focus on poverty reduction contributing to wider national development activities. The beneficiaries of environmental flow protection are numerous, arguably extending to the whole of society. Environmental flow requirements should be viewed not as a use or allocation of water, but as a necessary and desirable outcome of sustainable water management.

Water management planners and other natural resource planners use EFAs to make informed decisions about water management that protect the environment and sustain social and economic development. An important measure for mitigating the potential negative impacts to river ecology caused by changes in the natural river flow is the planned releases of environmental flows downstream from dams, or limits on the amount of water that can be abstracted from a channel.

Assessment of environmental flows

The actual estimation of environmental flows is complicated by the lack of both understanding and quantitative data on relationships between river flows and the multiple components of river ecology. However, the major criteria for determining environmental flows should include the maintenance of flow variability (See Figure 1), which affects the structural and functional diversity of rivers and their floodplains, and which in turn influences the diversity of aquatic species.



Different ecosystem functions are maintained by different components of the flow regime.

- *low flows* - maintain the connectivity of pools and provide for longitudinal movement along the river;
- *small flood* - more frequent floods (known as freshets) can trigger spawning in some species and may remove detritus; and
- *larger flood* - more infrequent floods can water floodplains and provide lateral movement of sediment and nutrients to and from the floodplain.

Figure 1: River flow regime and its variability

Methodologies of carrying out EFAs can be classified as: hydrology-based, hydraulic rating, habitat simulation, and holistic. The hydrological methods rely on data, usually in the form of historical flow records, for making environmental flow recommendations (King *et al*., 2000). Hydraulic methods usually consider river width and wetted perimeter, and are an advance over purely hydrology based ones as they incorporate ecological information on the in-stream, physical habitat of the biota. Habitat methods assess environmental flow requirements on the basis of detailed analyses of the suitability of in-stream physical habitat under different flow discharges using integrated hydrological, hydraulic and biological response data (Jowett, 1992). Holistic methods assume that the requirements of the complete ecosystem are integrated and considered (including the river channel, source areas, riparian zone, floodplain, etc.). The basis for most approaches in the latter method is a systematic construction of a modified flow regime on a month by month and element by element basis which defines features of the flow regime to achieve ecological, geomorphological, water quality, social or other objectives of the modified system. Advanced holistic methods consistently utilize several of the tools found in hydrologic, hydraulic and habitat rating methods (King *et al.*, 2000; 2008). These various methods are used to characterize a river flow regime and its variability aiming at integrated water resources management.

Environmental Flows for sustainable rivers flows management in the WIO Region

Environmental flow is a core component of Integrated Water Resources Management. It improves water management by ensuring a sustainable water supply to meet the needs of people, agriculture, energy, industry and the environment. The loss of natural flow regimes disrupts the productivity of freshwater and estuarine fisheries and of flood-recession agriculture. Communities downstream face increasing conflict over water access and lose the resilience needed to cope with water scarcity and climate change.

Environmental flows provide tools to coordinate upstream-downstream water allocations in order to maintain healthy ecosystems and vital services.

The mainstreaming of environmental flow into IWRM is now a reality to some of the WIO Region countries as provided in their policies and legislations. In this case South Africa and Tanzania have been in the forefront within the WIO Region. In particular, Tanzania has recently implemented environmental flows in preparations of integrated water resources management and development plans (IWRMDP) for its hydrological basins using varied approaches, varying from simple hydrology-based look-up tables to complex holistic methods. The lessons from EFA for IWRMDP, culminated into developing harmonized guidelines (URT, 2016) to aid the Environment Water Requirement (EWR) assessment. The guidelines have been developed from experiences gained during undertaking of environmental water assessments in five basins namely, the Wami-Ruvu (Wami and Ruvu Rivers), Rufiji (upper Great Ruaha and Kilombero River Catchments), Lake Victoria (Mara River), Pangani, and Lake Rukwa (Katuma and Songwe Rivers). The guidelines provide guides for carrying out EWA for different types of water bodies in Tanzania and these guidelines provide a set of rules related to how the EWA process shall be done and how well the process shall be.

Some lessons for successful EFA implementation

Adoption and implementation requires that environmental flows are incorporated into water policies and national legislation. These must include mechanisms for negotiated consensus on flow allocation among all stakeholders. And, realizing the full benefit requires coordination of stakeholders at the different levels including the grassroots level. It requires paradigm shift from traditional systems based on command and control to an incentive-based system with major drivers on maintaining environmental flows, stakeholders' participation and use of modern and emerging technologies in water and catchment management.

Implementing environmental flows requires adaptive management, based on a 'learning by doing' approach. Flexibility is required to effectively negotiate the objectives and outcomes of environmental flows. Effective implementation of environmental flows can help to achieve the wise use of catchments and natural resources and contribute to all SDGs, particularly SDG 6, 14 and 15.

Finally, **"The success or failure to mainstream environmental flows in water management will depend on whether it has a place in national legislation (***IUCN, Managing Water Allocation and Trade-Offs***)"**.

Recommendations

Technical recommendations: *There is need to compile a status report on experiences in the application of E-Flows across the WIO region to promote shared learning*

Policy recommendations: *1. Contracting parties to consider incorporating E-Flows in IWRM legislation and regulations*

2. There is need to develop a regional E-Flows Assessment Guideline to harmonize approaches and application of this tool in IWRM

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