Challenges Associated with Incomplete Assessment of Stream Ecosystem Health and Land use Interaction Studies in East and Southern Africa – A Review

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ABSTRACT

The review aimed at identifying the gaps left out in the studies on how landuse influences ecosystem health of adjacent rivers in East and Southern Africa. These gaps left have affected both interpretation of results and rendered the studies incomplete. The gaps of interest here were three including; sampling procedure, relationship between river size and land use size as well as limited full ecosystem health components consideration. In our discussion, we have highlighted what the researchers should have done to seal the gaps and complete the ecosystem health assessment. The works reviewed in this paper include 22 peer reviewed papers in various journals, 3 technical ecological reports and 6 academic theses. The time frame of the works reviewed range between 2001 – 2019. It was concluded that a standard protocol be set for all researchers about the elements that must constitute a complete ecological health study such that if an element is left out, the study is not recognized as a complete ecological study. Sampling procedure should follow the before, in and after a stressor or landuse.

Introduction

Biomonitoring of river ecosystem health is important for sustainability of fresh water resources throughout the world. This is because increase in human population continues exerting pressure on land adjacent to rivers leading to degradation and loss of aquatic biodiversity as has been revealed by many studies (Van Butsel *et al*., 2017, Raburu *etal.*, 2002, Ratemo *et al*.,2018).Most studies in east and southern African regions have tried to evaluate the effect of landuse on ecosystem health by considering various components of ecosystem health each one choosing what he wants to consider from limno-chemical, macroinvertebrate, fish, nutrients and habitat quality (Raburu *et al*., 2002, Ratemo et al,2018, Kasangaki *et al.,* 2007,2008, Shivoga *et al*., 2001,2007). Considering the aims of researchers in each of the above cases, very few or no researcher has assessed at greater depth a complete ecosystem health. Whoever uses any of the above indicators leaves it incomplete but hurries to make conclusions based on their findings.

Hardly do you find any researcher who has arranged his sampling procedure in the order of 'before, in and after' each landuse of consideration to cater for ecological edge effects as opposed to core data. Ecological edge data helps to draw conclusions on whether the effect found in the landuse is actually generated from that landuse and not to have come from landuses before the one under study (Vallejo 2018). This means that studies about the influence of landuse on ecological health of a river should target a landuse identified such as urban, agriculture or forest, study the ecological

health conditions of the river before it enters the landuse, as it is inside the land use and as it leaves the landuse such that the difference between before and after compared to inside gives a pattern of effect of a particular landuse on health of river ecosystem.

In the set of the literature reviewed in this paper, some researchers did not even consider landuses (matshakeni, 2016, Ollis, 2005) while those who considered landuses did not indicate the size of the landuse and the size of the rivers affected by these landuses (wolmarans *et al*.,,2014 *et al*., Shivoga *et al*.,2007). It is important to compare landuse size (can be obtained using G.I.S technology) with the size of the river (as can be indicated by river order, discharge or indicators of discharge like width, depth and velocity) (Shivoga, *et al*., 2001). This is because anthropogenic effects on river ecosystem health are not an abrupt phenomenon, it is a collection of contributions from different river orders and different landuses affect ecosystem health of different river sizes or orders differently. For example, if the same magnitude of a landuse on a 5th order river is exerted on a 1st order river, this first order can become an effluent while if the effects of a 1st order is exerted on a 5th order, the impact may not be felt. So the size of the river and the size or magnitude of the landuse matter a lot as far as ecological health is concerned.

This paper reviewed literature on research carried out in east and southern African regions about effect of land use on ecosystem health of rivers pointing out gaps that have not been filled mainly on three aspects that matter for a complete

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