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Systematic review of drivers of riverbank cultivation, human livelihoods and conservation in Southern Africa

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ABSTRACT
Riverbank cultivation is an activity that has existed for decades in developing countries. Despite the threats it poses to riverine ecosystems against associated human livelihood benefits, the effectiveness of conservation strategies has been put to the test in different countries. Therefore, a continual understanding of the spatial and temporal dynamics of the nexus between drivers of streambank cultivation and human livelihood is key to formulating conservation strategies that promote sustainable development. The study's main objective was to investigate the link between the drivers of riverbank cultivation, sustainable livelihoods and conservation strategies through a systematic review of literature for southern Africa, using a pre-determined criterion from 2010 to 2020. A total of 43 scientific publications were analyzed. The study used the theory of change, which is informed by the Environmental Kutznet Curve (EKC) Theory of environmental degradation, to analyse the nexus between the three variables. Direct drivers include; access to land use, environmental degradation, decline related to climate change/frequent drought, and unmatched demand for arable land. The indirect drivers include; unsustainable livelihoods, population pressures and lack of knowledge all work together to influence riverbank cultivation. The study concludes that protection of riverbanks can be achieved by implementing sustainable natural resource management, by strengthening existing policies.

Key words: Access to land, environmental degradation, population pressures, southern Africa, sustainable livelihoods

RÉSUMÉ
La culture riveraine est une activité pratiquée depuis des décennies dans les pays en développement. Malgré les menaces qu'elle représente pour les écosystèmes riverains et les avantages qu'elle apporte aux moyens de subsistance humains, l'efficacité des stratégies de conservation a été mise à l'épreuve dans différents pays. Par conséquent, une compréhension continue de la dynamique spatiale et temporelle du lien entre les facteurs déterminants de la culture des berges et les moyens de subsistance humains est essentielle pour formuler des stratégies de conservation favorisant un développement durable. L'objectif principal de cette étude était d'examiner le lien entre les facteurs déterminants de la culture riveraine, les moyens de subsistance durables et les

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stratégies de conservation, à travers une revue systématique de la littérature pour l'Afrique australe, en utilisant un critère prédéterminé de 2010 à 2020. Au total, 43 publications scientifiques ont été analysées. L'étude s'est appuyée sur la théorie du changement, informée par la Théorie de la Courbe Environnementale de Kutznet (EKC) de la dégradation environnementale, pour analyser le lien entre les trois variables. Les facteurs déterminants directs incluent l'accès à l'usage des terres, la dégradation environnementale, le déclin lié au changement climatique/sécheresse fréquente, et la demande non satisfaite de terres arables. Les facteurs déterminants indirects incluent les moyens de subsistance non durables, les pressions démographiques et le manque de connaissances, qui influencent ensemble la culture riveraine. L'étude conclut que la protection des berges peut être réalisée en mettant en œuvre une gestion durable des ressources naturelles et en renforçant les politiques existantes.

Mots-clés : Accès aux terres, dégradation environnementale, pressions démographiques, Afrique australe, moyens de subsistance durables.

INTRODUCTION

Riverbank cultivation has grown over time (Apudo *et al*., 2016) with its drivers rooted in several factors including sustaining livelihoods, and land use efficiency. In their natural state, rivers and their surrounding landscapes have become a reliable source of livelihoods providing a wide range of socio-economic benefits to humans. Yet, they are at risk of degradation (Kanianska, 2016). However, in areas where water is limited and soils are not suitable for cultivation, subsistence farmers take advantage of riverbanks ability to retain moisture all-year-round, and thus provide an opportunity for good crop production. Rapid human population growth, urbanization, unemployment, lack of political will, and climate variability are some of the key drivers accelerating riverbank cultivation in arid and semi-arid areas of Southern Africa. Shifting rainfall patterns have increased incidents of droughts thus, worsening the situation, further underscoring cultivation of riverbanks for agricultural activities. Furthermore, rapidly failing economies of sub-Saharan Africa (SSA) have seen many vulnerable groups increasingly turning to informal sector for food security and household income (Simatele *et al*., 2012). Riverbank cultivation is one such informal activity that has grown over time (Apudo *et al*., 2016). The informal sector in this context is small-scale subsistence farming/gardening along riverbanks. However, the drivers behind riverbank cultivation, their impacts on livelihoods, and the resulting implications for conservation have received limited attention in the literature.

Riverbank cultivation refers to activities traditionally practiced within a specific radius of the river basin (minimum 6 meters from the edge of small rivers and 30 meters from the edge of larger rivers) (Charles, 2010). The activity includes, but is not limited to crop production, aquaculture, grazing and livestock raising. A variety of leafy vegetables and cash crops such as maize are mostly grown to generate income (Lee-Smith, 2010; Zezza and Tasciotti, 2010; Stewart *et al*., 2013; Voleníková, 2016) and provide food security. Various studies conducted in the region including Kenya (Jayne *et al*., 2014; Omondi, 2018), Rwanda (Nabahungu and Visser, 2011), Ghana (Ayerakwa, 2017; Omondi, 2018), Zambia (Smart, 2014), Cameron (Ngome and Foeken, 2012) show riverbank encroachments as human livelihoods strategy. In another study, Jayne *et al*. (2014) showed that riverbank cultivation is essential for communities as subsistence activity providing alternatives for dealing with declining yields in

their upland fields or increasing food demand (Scoones, 2007; Onyago, 2010; Arku *et al*., 2012; Chipatu, 2017).

Research work on the connection between social activities with the varied effects on river ecosystem structure and functions of riparian zones has been well documented (Grimm *et al*., 2008; Musa, 2019). Tracking the historical human ecological interaction, Coleman and Huh (2003) indicate that the Ganges (Ganga) River that runs through northern India is sacred to Hinduism, and supports more than four hundred million people in the Ganges River Basin. The river basin sustains fishing, animal husbandry, irrigation agriculture, tourism, river-based trade, transport, and bathing and is worshiped in the Hindu religion as the Mother Ganga whose Bay of Bengal forms the Ganges River Delta, the largest river delta in the world (Coleman and Huh, 2003; Kumar, 2017) contributing significantly to the livelihood, food and nutritional security of about one-third of Indian and two-thirds of the Bangladesh population (Kumar, 2017). Furthermore, the trend of relying on major catchments for diverse and competing needs and activities has been seen in Africa's region. For instance, the Nile is the world's longest river sustaining millions of people's livelihoods across ten countries in Africa. Its basin provides fresh water not only for domestic and industrial use, but also irrigated agriculture, hydropower dams and vast fisheries resource of the lakes of Central Africa (Awulachew *et al*., 2013). In Egypt and Sudan, agriculture is a major livelihood strategy of the Nile Basin, sustaining tens of millions of people and providing employment for 35 per cent of the labour force while Nile Basin fisheries provide mainly freshwater lakes, rivers and marsh sources (Karimi *et al*., 2013).

The trade-offs between conservation and human livelihoods seemingly appear more as an opposition to win-win solutions (McShane and Wells, 2004; Sunderland *et al*., 2007). Over the past decades, conservation strategies emphasized win-win solutions rather than conflict between conservation and development (Brown, 2002). In order to make conservation a priority, this calls for objectivity by value services ecosystems to provide human livelihoods in economic terms since the two are tightly linked. Globally, there is growing evidence indicating that there are many challenges to achieving both objectives simultaneously (McShane *et al*., 2011). For instance, the major challenge affecting implementation of soil and water management practices has been lack of their coordination on the ground (Amede *et al*., 2014).

At regional level, riverbank cultivation remains a challenge to conservation efforts in southern Africa (Cundill, 2010) due to poor soils quality, changes in climatic patterns, and frequent droughts. Conservation of river ecosystem has direct if not immediate effects benefitting human livelihoods requiring commitment from all stakeholders. In order for future generations to appreciate this sustainable effort, riverine areas should be listed as ecosystems of international significance. Fisher *et al*. (2005) suggested that conservation helps balance equitable and ecologically sustainable solutions for rural and poor communities that depend on natural resources for livelihoods. As such, the full protection of riverine areas can only be achieved through implementation of management strategies at national or regional levels (Mulei and Onkware, 2018). Zambia and Malawi are a case in point where the irrigation policy allows farmers to farm along river banks while the environmental policy discourages riverbank cultivation to curb siltation that eventually results in drying up of rivers. This comes from a background of on the direct linkages between biodiversity conservation and development which are based the assumption that local people benefit directly from biodiversity and this provides an inherent incentive to stop external threats to the biodiversity (Salafsky and Wollenberg, 2000).

On the other hand, policy and institutional framework factor play an important role in enforcing sustainable use of natural resources (Msofe, 2019). Institutions should therefore support informed conservation decisions by facilitating equitable participation in the planning processes, and providing information on options that best integrate conservation and human livelihoods across various spatial and decisional scales (Amede *et al*., 2014). Unfortunately, the level of success of policies and institutional arrangements in the protection of riverbanks is mainly affected by political polarization across national borders with most conservations occurring at local scale. Appropriate policies and institutions need to be developed and existing ones strengthened (Amede *et al*., 2014) in order to achieve sustainable river system protection and management in the long-term. During the last decades, the Integrated Water Resources Management (IWRM) imposed itself as the primary governance framework for water managers worldwide (Gareau and Crow, 2006). Unfortunately wetlands at local levels are perceived as less important because of their small size (Macharia *et al*., 2010) making them vulnerable. This is a challenges in most conservation policies (Macharia *et al*., 2010) showing that there is no panacea for conserving the riverine ecosystem. The Strategic Adaptive Management (SAM), a management framework has great potential because of its inter-linked process for navigating complexity and learning (Kingsford *et al*., 2011). While the framework (SAM) provides a holistic framework of management, which includes engagement of stakeholders, specification of a desired state, and learning by doing is necessary. It can be applied to conservation and management of all rivers, across disturbance spectrum from almost pristine systems through to rivers that are heavily exploited for human needs or that flow through heavily urbanized areas. This allows for the use of local knowledge to conserve riverbanks (Salafsky and Wollenberg, 2000). In southern Africa, SAM was implemented at the Crocodile River in northeastern of South Africa (Kingsford *et al*., 2011). Government of Zambia (GoZ) put in place necessary legal and institutional framework enshrined in The Constitution of Zambia 1991 (as amended in 2006). The Integrated Water Resources Management/Water Efficiency Plan (2008) identified key water resource management challenges outlining strategies for sustainable water resource development (Simfukwe *et al*., 2014). These have been adopted by most countries globally (Daré, Venot *et al*., 2018) including Zambia.

The main objective of the study was to quantify and synthesize the existing knowledge on the drivers of riverbank cultivation by linking three variables, riverbank cultivation, sustainable livelihoods, and conservation strategies through using a systematic review of data for southern Africa between 2010 to 2020. Understanding the complex interactions between drivers of riverbank cultivation, livelihoods, and conservation is critical to support policy for agriculture development and the sustainable use of riverbanks for agricultural production in the region. Whilst answering the following question: What are the socio-economic drivers of riverbank cultivation in southern Africa? The study will use the Environmental Kutznet Curve (EKC) Theory of environmental degradation. Findings from this systematic review can be used to promote dialogue and collaboration among stakeholders informing policymakers, researchers, and practitioners, facilitating evidence-based decision-making. Ultimately the research will contribute to the broader goal of achieving sustainable development and fostering resilience in riparian areas in southern Africa.

LITERATURE SOURCES AND ANALYSIS

The study search date starting in 2010 was selected as this is when numbers of riverbank cultivation, agriculture expansion and associated research papers rapidly increased in southern Africa. This is mainly due to a

number of factors including climate change that has resulted in extreme droughts and floods, and low economic opportunities to provide livelihoods which have drawn attention to the discourse. The reviewed literature sources were identified using keywords; river bank cultivation, livelihoods sustained by river banks, river banks conservation strategies. In order to minimize biases that might be found in narrative reviews (Collins and Fauser, 2005), papers which were identified, categorized, and included in the study are shown in Figure 1.

SYSTEMATIC REVIEW

The systematic review emphasizes on drivers of riverbank cultivation in southern Africa based on defined analytical criteria (Table 1). In order to provide detailed picture on drivers of riverbank cultivation in southern Africa, additional literature review was conducted on the initial search. Listed below are the steps in which articles were identified, categorized and included in the study (Collins and Fauser, 2005).

Figure 1. Southern Africa countries used in literature mapping between 2010-2020

Table 1. Inclusion and exclusion criteria for the review articles in the order of selection

Criteria	Included	Excluded	Justification for criteria application
Date of	2009 to 2019	Before 2009	Used available papers from selected databases that publication have a contemporary perspective on drivers of riverbank cultivation
Language of	English	Other languages	To increase readability and due to researchers' publication proficiency in English language
Country/location of study	Review minus introduction papers focused on southern Africa	Non-African	To remain within the scope of the of study systematic review
Article availability	Fully available Paper accessible	Full paper not	Due to access related issues
Type of article	Peer review research, journal article, review papers, grey literature	-	To increase validity of study findings
Main publication topic	Papers specifically on drivers of general riverbank	Papers that did not include drivers of 'riverbank cultivation'	To remain within the focused scope of the systematic review

Adapted from Jellason *et al.* (2021)

Search strategy. In the first step, the large proportions of the articles comprising 111 were identified for analyses on effects on livelihoods and resource conservation. These were largely sourced from Google Scholar, Science Direct (Scopus) and Web of Science to identify articles matching the keywords (Musasa and Marambanyika, 2020) based on our criteria. Articles used in the search were based on the date (2010-2020) (Figure 2), publications were in English and country of study. From this search, 68 articles were not specifically related to the issues of our study hence they were unsuitable and excluded. Of the remaining 43 articles, five articles were on effects on livelihoods and resource conservation. The remaining 38 articles were on drivers and impacts of riverbank cultivation. A database of bibliographic references, authors' names, articles titles, year of publication, southern African region focus, type of article were created in Microsoft Excel (Vincent and Cundill, 2021). Second step, articles containing the details of each paper, author, journal, year of publication, and study location were imported to Mendeley. The study restricted the sample studies that were conducted in southern Africa. Third step, in order to keep our task manageable, the study included from the search results for non-peer reviewed articles, reports,

grey literature, book chapters and media reports (Marambanyika and Beckedahl, 2016; Musasa and Marambanyika, 2020). The results shown depended on what the search yielded, i.e., academic articles that mentioned "riverbank cultivation", "environmental degradation", "provisioning ecosystem services", "population pressure", "lack of knowledge", "access to land". These were classified into two categories, i.e., those examining livelihoods, conservation, policy and those analyzing specific drivers of riverbank cultivation, which is the focus of interest here. The systematic search yielded 111 publications which were selected for this study. Of these 111 articles, 38 articles (Fig 1.) analyzed the drivers of riverbank cultivation and hence formed the basis for our systematic review of the drivers in scholarly literature of riverbank cultivation. Through this analysis, we aimed to compliment the work already done by Marambanyika and Beckedahl (2016) and Musasa and Marambanyika (2020) to promote sustainable wetland usage.

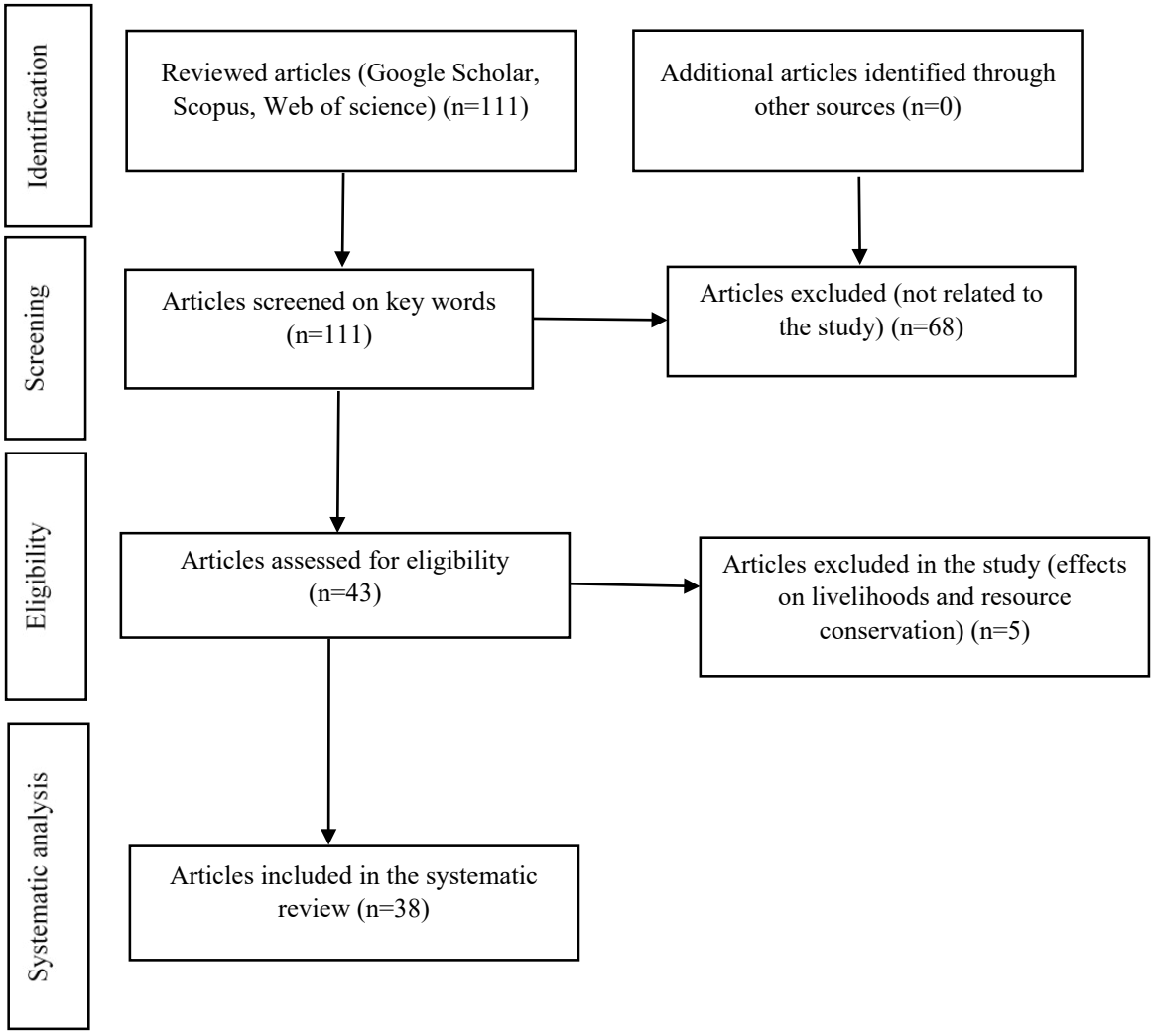

Fig 2. Flow chart for the systematic review methodology
Adapted from: Moher *et al*. (2009)

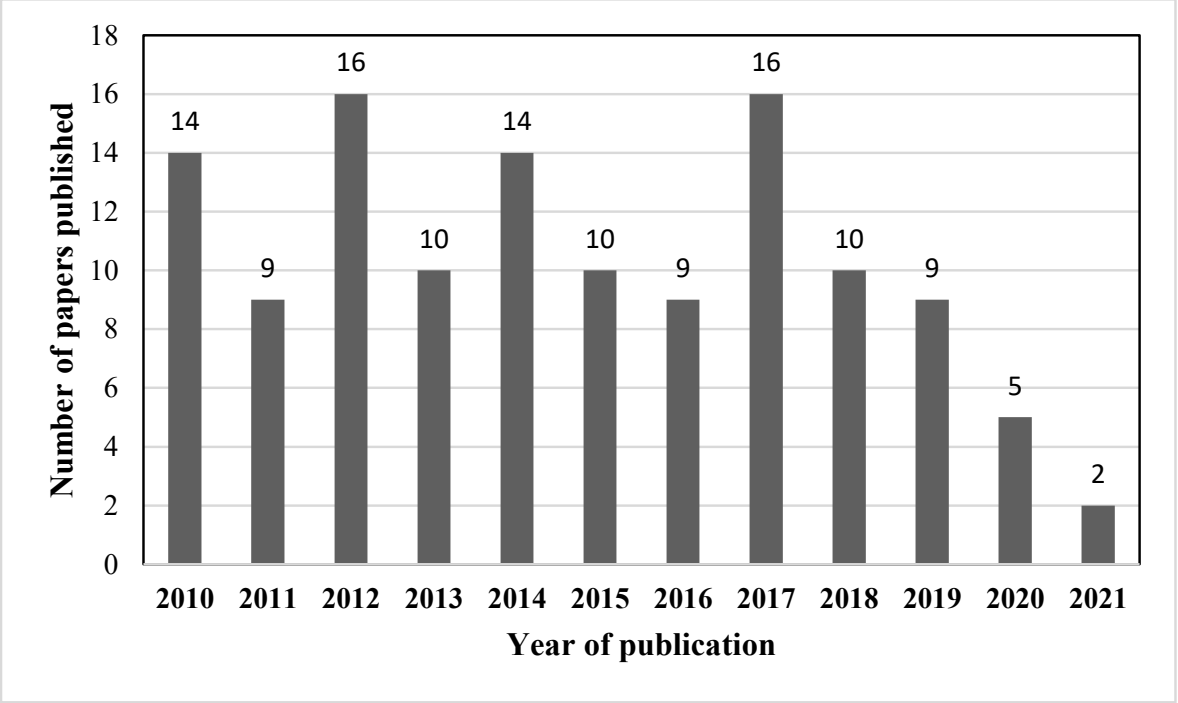

Figure 3. Number of articles published annually during 2010-2020

Analysis of the drivers of riverbank cultivation using the Environmental Kutznet Curve Theory. The theory highlights the rampancy of riverbank erosion caused by cutting down of trees that hitherto held the soil together in pursuit of livelihoods. Such riverbank erosion changes are inspired by anthropogenic activities whose justification is a combination of factors such as poverty reduction and sustainability of livelihoods, population pressures that drive people into dangerous riverbank settlements wherein they are exposed to riverbank degradation from recurrent flooding. This theory of change is supported by the Environmental Kutznet Curve Theory of environmental degradation that hypothesizes and the environmental damage first increases with income, then declines thereafter. This explains the income realised from riverbank cultivation and related activities but begins to decline when their anthropogenic activities translate to riverbank erosion and disasters that force relocation of human settlements, away from the 'attractive riverbank' (Ota, 2017; Karsch, 2019; Koilo, 2019). The reasoning behind the EKC hypothesis has been put succinctly as follows:

At low levels of development both the quantity and intensity of environmental degradation is limited to the impacts of subsistence economic activity on the resource base and to limited quantities of biodegradable wastes. As economic development accelerates with the intensification of agriculture and other resource extraction and the take-off of industrialisation, the rates of resource depletion begin to exceed the rates of resource regeneration, and waste generation increases in quantity and toxicity. At higher levels of development, structural change towards information-intensive industries and services, coupled with increased environmental

awareness (Stern, 2004).

Such an argument leads to a hypothesized relationship between environmental degradation and income per capita which takes the form of an inverted U sometimes called an "environmental Kuznets curve", EKC, after (Stern, 2004), the scholar who first hypothesized an inverted U for the relationship between a measure of inequality in the distribution of income and the level of income. If the EKC hypothesis generally holds, it could imply that instead of being a threat to the environment (Gardner, 2004), economic growth will be the means to environmental improvement (Panayotou, 1993; Stern *et al*., 1996; Gardner, 2004).

From the foregoing background in which many people increasingly depend on degraded ecosystems to sustain their livelihoods (Gann *et al*., 2002), systematic review needs to focus on riverbank cultivation, sustainable livelihoods, conservation and its benefits. Chapin *et al*. (2009) argue that since most of the world's biodiversity is not in protected areas but on lands used by people, conserving species and ecosystems depends on our understanding of social systems and their interactions with social ecological systems. Involving people in conservation requires paying attention to livelihoods and creating a local stake for conservation (Chapin *et al*., 2009). It also requires maintaining cultural connections to the land and at times restoring and cultivating new connections.

RESULTS

Drivers of streambank cultivation. Direct drivers and indirect drivers of ecosystem service flow were identified (Figure 3). Direct drivers include; access to land use, environmental degradation, decline related to climate change/ frequent drought, unmatched demand for arable land and indirect drivers include; unsustainable livelihoods, population pressures and lack of knowledge.

Types of crops grown. Studies that have been conducted in southern Africa show riverbank encroachments as human livelihoods strategy (Smart, 2014). Whilst riverbank cultivation is essential for communities as subsistence activity (Jayne *et al*., 2014) providing alternatives for dealing with declining yields in their upland fields or increasing food demand (Onyago, 2010; Arku *et al*. 2012; Chipatu, 2017) is needed. Variety of leafy vegetables and cash crops such as maize are mostly grown (Lee-Smith, 2010; Zezza and Tasciotti, 2010; Stewart *et al*., 2013; Voleníková, 2016) to generate income. Crops cultivated in riverbanks include various types of leafy vegetables,

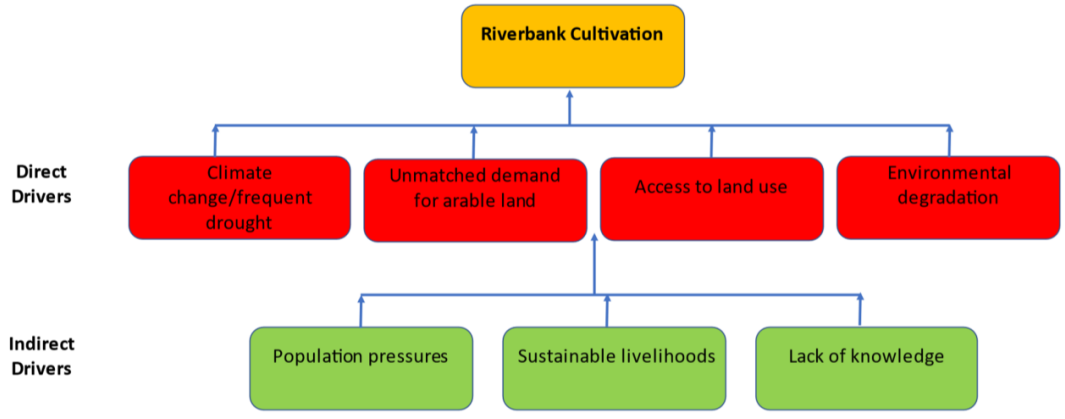

Figure 4. Interrelationships between direct and indirect drivers of biodiversity change and ecosystem services

legumes and small grains. Popular vegetables mostly grown include legumes (mainly beans) to minimize damage to the fragile environments (Jaspers-Focks and Algera, 2006). On the other hand, cultivation of rice is done in Malawi (Mumba and Kadewa, 2006), pearl-millet, sorghum, squash, green gram, cow peas in Mali (Matsuda, 1996), millet, pearl millet, sorghum and rice are also cultivated in Inland Niger Delta and Senegal. Cauliflower, cabbage, eggplant and cucurbits are common crops cultivated along the Ganga River basin (Singh *et al*., 2021) whilst potatoes, pumpkin, okra, tomatoes, onions, sweet potatoes, groundnuts, bananas, calabash gourd, sugarcane, water melon, cucumber are cultivated in Zimbabwe, Zambia, South Africa and Mozambique.

Methods of Cultivation. Subsistence farmers have adopted both traditional and other methods learnt from other communities which are safe practices that prolong cultivation of riverbanks (Zinhiva *et al*., 2017). Generally, hand hoeing and animal drawn ploughs are common methods used for land preparation in riparian areas. These methods conserve moisture compared to mechanical tillage methods (Motsumi *et al*., 2012). Community gardens, mixed cropping, cultivating perennial crops, use of live fences, systematic practice of agro-forestry using hydrophytic plants to create buffer strips along riverbanks (Zinhiva *et al*., 2017) are amongst other methods used in riverbank cultivation. Matsuda (1996) reported that riverbank cultivation methods, flood water farming, small scale hand irrigation and swamp rice cultivation are used in west Africa.

Human livelihood benefits from river banks/ riverine ecosystems. In their natural state, riverbanks provide a wide range of socio-economic benefits to human livelihoods. People cultivate riverbanks because of their fertile land where no fertilisers are needed as riverbanks provide better yields than upland farms that are depleted of nutrients (Das *et al*., 2014). Because of these benefits, there is over-cultivation, poor management of cultivated fields, and indiscriminate cutting down of trees (Das *et al*., 2014; Kaunda *et al*., 2014). All these lead to riverbank erosion along with river sedimentation, water pollution and fish habitat alteration creating a self-propelling spiral effect that affects riverbank settlers and eventually displaces such cultivators through environmental degradation. Oblivious to the danger riverbank cultivation bring upon the environment, livelihoods, access to land, Billa (2018) argues that the continuous erosion is endangering human livelihoods near the river bank floodplain. Munna *et al*. (2020) links loss of livelihood to loss of access to arable land and destruction of human settlements due to erosion. They however mention nothing about environmental degradation, lack of knowledge and population pressures in their arguments.

Sustainable Livelihoods. Several studies have highlighted the drivers of riverbank cultivation which have been a major target of scientific research and government programs. Perhaps, the major reason justifying investment in studies on riverbank cultivation are its socio-economic benefits (i.e., sustainable livelihoods) which cannot be overlooked. Traditionally environmental problems facing rivers and their urban regions have been understood as a biophysical, 'hard' system, and addressed technically through the engineering works in isolation from their social context (Prescott *et al*., 2016). However, riverbanks have now become the new agricultural frontier, especially in Sub-Saharan Africa, mainly due to the unreliable and changing rainfall patterns as a result of climate change. As a result, cultivating along riverbanks has now become rampant around cities and towns as people seek to counter the effects of poverty (Zinhiva, 2017). The resultant interactions between water bodies and these human activities clearly show that there is a relationship that lies between riverbank resources and the socio-economic

development discourse.

Conversion of wetlands to agricultural land for households is also driven by the need to sustain livelihoods through income generation (Kakuru *et al*., 2013; Akter *et al*., 2019; Ondiek e*t al*., 2020). The continuous increase in population and high demand for food production has led to the extensive use of land especially along the banks of rivers where water for agricultural activities is available all year round. As a consequence, the agricultural land area per head of population continues to grow (García-Ruiz *et al*., 2015). For the same reason, their contribution to sustaining livelihoods should not be overlooked in national economic development planning policies as well as ecological and scientific research.

There is more grounded proof of the roles which riverbanks play in some developing countries. For many years now farmers have used indigenous methods to cultivate riverbanks in order to meet food security and livelihood needs (Mkavidanda *et al*., 2001). Valley bottomlands, also known as freshwater marsh, are such examples and have been identified as indispensable for the expansion of food production (Majule, 2004; Kurosaki, 2007). In addition to improving household food security and income (Kaunda *et al*., 2007; Zidana *et al*., 2007) riverbank cultivation provides opportunities for smallholder farmers to either supplement their rain-fed crops or grow crops for sale to improve their incomes (Mlowoka, 2008a; Musamba *et al*., 2011). Farmers also derive social, economic and ecological benefits from riverbank cultivation (Iyango *et al*., 2009; Munishi *et al*., 2011; Hamisi *et al*., 2012; Baki, 2014; Apudo e*t al*., 2016; Das *et al*., 2017; Zinhiva, 2017; Musa, 2019) causing intense pressure for their conversion into other land uses while degrading them. It is therefore, imperative that livelihood approach be adopted for sustainable land use without degrading the environment. Of importance to note is the fact that not only do riverbanks provide substantial benefits to local society, but also to people who live far away from them (Mwakubo *et al*., 2009). Their ability to contribute (socio-economic) i.e., provide food and non-food products which contribute to income and food security for communities (Kakuru e*t al*., 2013) also makes their value a top priority which should be put to monetary value.

River systems protection/conservation strategies. The use of agricultural marginal lands like riparian areas for arable cropping is now rampant and fast spreading across global communities (Zinhiva, 2017). Whilst successful river conservation means improving social, political and economic values of rivers as well as ecological aspects. It is a broad and complex task (Sabater and Elosegi, 2013). Conservation of this ecosystem lags progress in other realms, reflected in high rates of biodiversity loss (Kingsford *et al*., 2016). However, conservation of river ecosystems remains a complex challenge demanding much to be done in order to truly integrate riverbank cultivation, human livelihoods and conservation into land use decision-making and management processes. Over the past decades, conservation strategies emphasized win-win solutions rather than conflict between conservation and development (Brown, 2002). The trade-offs between conservation and human livelihoods seemingly appear more as an opposition to win-win solutions (McShane and Wells, 2004; Sunderland *et al*., 2007). The sustainable livelihoods development of riverbank communities requires multidisciplinary and integrated efforts in addressing constraints in the various sectors such as agriculture, natural vegetation use, water resources, and fishing (Kangalawe *et al*., 2005). In order to make conservation a priority, this calls for objectivity in value services ecosystems to human livelihoods in economic terms since the two are tightly linked. Globally, there is growing evidence indicating

that there are many challenges to achieving both objectives simultaneously (McShane *et al*., 2011). For instance, the major challenge affecting implementation of some soil and water management practices has been lack of their coordination on the ground (Amede *et al*., 2014). Zambia and Malawi are a case in point where the irrigation policy allows farmers to farm along river banks while the environmental policy discourages riverbank cultivation as a measure to curb siltation which eventually results in drying up of rivers. This comes from a background of the direct linkages between biodiversity conservation and development which are based on the assumption that local people benefit directly from biodiversity and this provides an inherent incentive to stop external threats to the biodiversity (Salafsky and Wollenberg, 2000). Conservation of river ecosystem has direct if not immediate effects benefitting human livelihoods but this requires commitment from all stakeholders. In order for future generations to appreciate this sustainable effort, riverine areas should be Ramsar listed as ecosystems of international significance.

The full protection of riverine areas can only be achieved through implementation of management strategies at national and regional levels (Mulei and Onkware, 2018). Importanty, policy and institutional frameworks factor splay an important role in enforcing sustainable use of natural resources (Msofe, 2019). The economic, social, cultural, biodiversity and ecological significance of wetlands are widely acknowledged, and global efforts are being sought to prevent further degradation and loss (United Nations Environment Programme-World Conservation Monitoring Centre, 2010). Unfortunately, the level of success of policies and institutional arrangements in the protection of riverbanks is affected by political polarization across national borders with most conservations occurring at local scale. Appropriate policies and institutions need to be developed and existing ones strengthened in order to achieve sustainable river system protection and management in the long-term (Amede *et al*., 2014). Institutions can support informed conservation decisions by facilitating equitable participation in the planning processes and providing information on options that best integrate conservation and human livelihoods across various spatial and decisional scales.

The Strategic Adaptive Management (SAM), a management framework, has great potential because of its inter-linked process for navigating complexity and learning (Kingsford *et al*., 2011). The framework (SAM) provides a holistic framework of management, which includes engagement of stakeholders, specification of a desired state, and learning by doing. It can be applied to conservation and management of all rivers, across disturbance spectrum from almost pristine systems through to rivers that are heavily exploited for human needs or that flow through heavily urbanized areas. This allows for the use of local knowledge to conserve riverbanks (Salafsky and Wollenberg, 2000). In southern Africa, SAM was implemented at the Crocodile River in northeastern of South Africa (Kingsford *et al*., 2011). Government of Zambia (GoZ) put in place necessary legal and institutional framework enshrined in The Constitution of Zambia 1991 (as amended in 2006). The Integrated Water Resources Management/ Water Efficiency Plan (2008) identified key water resource management challenges outlining strategies for sustainable water resource development (Simfukwe *et al*., 2014) have been adopted by most countries (Daré *et al*., 2018) including Zambia.

Nexus between River banks cultivation, people's livelihoods and conservation. Climate change has progressively increased impacts on environmental degradation and environmentally dependent socio-economic systems with potential to cause substantial population displacement (Hamza *et al*., 2010).

Zembe *et al*. (2014) argue that environmental degradation is a problem affecting most developing countries. Citing the Millenium Ecosystem Assessment (2005a), Warner *et al*. (2010) concluded that 15 of 24 ecosystem services they reviewed were degraded or used unsustainably, affecting poor resource-dependent communities. The Percy *et al*. (2005), Millenium Ecosystem Assessment (2005b) highlights that two billion people living in arid, semi-arid, and sub-humid regions are extremely vulnerable to the loss of ecosystem services, such as water supply. For example, ten to twenty percent of drylands are already degraded (there is, however, uncertainty in the measurement of the extent of desertification), increasing pressure on dry land ecosystems for provisioning ecosystem services such as food, and water for humans, livestock, irrigation, and sanitation and frequently recurring droughts that can overcome coping mechanisms of communities (Warner *et al*., 2010). Literature reviewed highlights a nexus among poor communities, their natural environment, and common access resources like riverbanks for sustenance. A close nexus exists between environmental degradation and poverty, with poor rural households highly dependent on natural resources for livelihoods (Bann *et al*., 2012). The dependence on nature's contribution to human wellbeing by society the world over is well established (Nelson *et al*., 2005; Díaz *et al*., 2018). To that end, scholars argue that conservation can never be the solution to extreme poverty, but it can play a role (Fisher *et al*., 2005). Research work on the connection between social activities with the varied effects on river ecosystem structure and functions of riparian zones has been well documented (Grimm *et al*., 2008; Musa, 2019). Furthermore, Fisher *et al*. (2005) suggest that conservation can help find equitable and ecologically sustainable solutions in rural areas where poor communities depend on natural resources for livelihoods. The author (Fisher *et al*., 2005) insist that conservation has contributed to human well-being through safeguarding global public goods and maintaining ecosystems services such as are provided by riverbank ecosystems. At times, it has also exacerbated local poverty by denying poor people control over and access to natural resources underpinning their livelihoods. Peters (2004) underscored the importance of riverbanks to households with fields near water sources enjoying riverbank spill-over moisture and nutrients to harvest even under drought conditions. Other studies also highlight the challenge of balancing sustaining livelihoods and environmental degradation (Zaimes *et al*., 2006).

Wetlands also experience erosion since such areas are also used mainly for grazing (Dahwa *et al*., 2013). Communal lands however, face enormous pressures on wetlands for grazing and cultivation; locally, this has resulted in serious and very rapid gullying (Whitlow, 1988). In another study Schilling (2000) indicated that riverbank cultivation contributed to about 50% of the annual suspended sediment load in northeast Iowa River. Similarly, loss in agricultural land to erosion along the Nile River in Africa also led to reduction in agricultural production (Ahmed *et al*., 2015). The key finding in these studies is if river basins are over exploited, their capacity to meet different social, economic and environmental demands decreases.

Both agricultural production and income increases through multiple cropping seasons that is achieved through the excessive use of chemicals and fertilizers, pollute water bodies. Clear picture emerged from previous studies on Likangala River, Malawi, that fertilisers and pesticides applied in agricultural production contaminated the river water (Chimwanza *et al*., 2006). This finding is consistent with Safary *et al*. (2017), who in their research in Kenya commented that the use of agrochemicals polluted the groundwater. A similar study was conducted in Zimbabwe (Zinhiva, 2017)

on the Chiredzi River and indicated that agricultural fertilizers and biocides used by farmers eventually washed into nearby waters contributing to nutrient pollution and toxicity Other studies have shown how the use of fertilizers leads to collapsing of riverbanks and drying up of streams and water sources such as in Tanzania River Basin in Kilolo District (Kyando, 2007; Munishi, 2011) and Iringa District (Mkavidanda, 2001).

The impacts of riverbank erosion are multifarious, and countries are affected to different extents leading to varying degrees of landscape degradation and environmental and socio-economic impacts (Debanshi *et al*., 2014; Okayo *et al*., 2015). When the river erodes, communities are forced to migrate, resulting in them suffering socio-economic deprivation and property loss putting them at risk of poverty. In addition, riverine populations decrease after erosion as people become homeless (Rahman and Islam, 2018) and migrate to other livelihoods options. Riverbank erosion has severe social impact on land relocation and also causes population displacement.

DISCUSSION

There are several driving forces of riverbank cultivation across sub-Saharan Africa. This finding concurs with Geist and Lambin (2002) that underlying drivers of riverbank cultivation result in environmental degradation and include demographic, economic, institutional, cultural, and technological. This study identified that types of crops grown, methods of cultivation, human livelihoods benefits, sustaining livelihoods, and conservation strategies are influenced and shaped by the nature of ecosystems. At the same time, humankind has influenced and shaped its environment to enhance the availability of certain valued services (Nelson *et al*., 2005).

Riverbank cultivation is mostly driven by the desire to sustain livelihoods, and food security through income generation. Whist riverbanks provide for a wide range of ecosystem services, their contribution to livelihoods should not be ignored if future generations are going to benefit from them. Drivers of riverbank cultivation have been a major target of scientific research and government programs and for some reason, still remain one of the highest research priorities. Perhaps, the major reason justifying investment in studies on riverbank cultivation are its socio-economic benefits (i.e., sustainable livelihoods) which cannot be overlooked. Subsistence farmers take advantage of fertile sediments and soils carried by water as it flows in the riverine systems and deposit them in the riverbanks, enabling riverbanks to retain moisture all-year-round, and thus provide an opportunity for good crop production. Just like the rest of the world, southern Africa is not an exception to these dynamics. In particular, livelihoods and food security at household level in southern Africa is highly dependent on rain-fed agriculture for all-year-round water availability. This could be attributed to climate change which has greatly affected crop production forcing subsistent farmers to cultivate along riverbanks where fertile soil has moisture all through-out the year whilst degrading the ecosystem. Unfortunately, failure to address the activity may reverse development efforts achieved in the past ultimately eroding people's livelihoods. This will expose communities in southern Africa to risk of losing the valuable ecological and socio-economic benefits that they get from riverbanks. As such, the contribution of riverbank cultivation to sustainable livelihoods should not be overlooked in national economic development planning policies as well as ecological and scientific research. Instead, their value should be put to monetary value in order to understand their socio-economic contribution.

A close nexus exists between environmental degradation and poverty, with poor rural households highly dependent on natural

resources for livelihoods (Bann *et al*., 2012; Díaz *et al*., 2018). Riverbank cultivation is one of the major land-based and unfortunately a driver of environmental. While the different land-based activities are practiced along riverbanks to sustain livelihoods, they risk water sources to degrade and become vulnerable (Guzha *et al*., 2018). This remains a challenge to conservation efforts in southern Africa (Cundill, 2010). What is often overlooked is the fact that the environment should remain productive, assimilative and regenerative. Sadly, the environmental problems which riverbanks face have been understood as a biophysical, 'hard' system, and have been addressed technically through the engineering works in isolation from their social context (Prescott *et al*., 2016). It is now more urgent to assess the utilization of land from a socio-economic policy perspective and adjust policies in such a way that they can offer alternative means of livelihoods for the same people. Even though cultivating along the banks is viewed differently by varied groups, including local communities who own gardens, crop plots and fields management would help in sustainable use and management practices. Unemployment, hardship and poverty have also created more pressure on the riverbank use. These are signs for the much-needed objectivity in viewing the contributions of river and stream banks through an environmental policy. The environmental policy should bring out the significant role riverbanks play economically and ecologically thus making their conservation a priority and placing stakeholder participation at the centre of protection and preservation.

The review adopted theory of change supported by the Environmental Kutznet Curve Theory of environmental degradation that hypothesizes the environmental damage first increases with income, then declines thereafter.

We were aware that this approach may have excluded some relevant articles that did not use these keywords. Through using this process, we however, assumed that we have captured the bulk of the relevant scholarly literature necessary for this study.

CONCLUSION AND RECOMMENDATIONS

This review focused on the drivers of riverbank cultivation, livelihoods and conservation in southern Africa. Findings from the study show that direct drivers of riverbank cultivation in southern Africa are related to climate change/ frequent droughts, unmatched demand for arable land, access to land use, environmental degradation, and indirect drivers are sustaining livelihoods, growing population pressures, and lack of knowledge. The study emphasizes that riverbank cultivation together with livelihoods and conservation are randomly distributed pervading major catchments, sub-catchments, basins and tributaries with a variety of livelihood options. However, this will likely impede sustainability to livelihoods owing to the continuing growth of urban population putting pressure on the riverbanks. The study acknowledges that limited knowledge on the efficient use of natural resources, coupled with climate change, socio-economic and political dynamics have further worsened the unsustainable use of river banks in southern Africa. As such, landscape changes along Africa's major streams and rivers have become evident overtime. The unsustainable use of the resources will continue to degrade and deplete them to the extent of eventually failing to recuperate for future generations to use. Whilst Africa's land-use planning and related policies are equally responsible for natural resource management, they should find a balance between ecosystem protection, and utilization for sustainable livelihoods. Therefore, the monetary value of riverbanks and their conversations should be considered as the significant factors in sustainable land management, agricultural intensification and policy-making decisions. Inter-generational value of the river ecosystem which is not easily monetarized should be evidence to produce the economic benefits providing a strong

incentive for policy makers and managers to implement effective conservation measures for river ecosystems. This implies that the socio-economic values of riverbank cultivation should be assessed from a policy perspective.

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STATEMENT OF NO-CONFLICT OF INTEREST

The authors declare that there is no conflict of interest in this paper.

REFERENCES

Ahmed, T., Cesar, Q., Bhandhari, H. and Carnaje, G. 2015. Diversification of rural livelihoods in Bangladesh. *Journal of Agricultural Economics and Rural Development* 2 (2): 32–38.

Akter, K., Dey, S. and Hasan, S. 2019. Riverbank erosion and its impact on rural women: Case study of Ulania village in Bangladesh. *Asian Journal of Women's Studies* 25 (1): 76–95. https://doi.org/10.1080/12259276.2019.1577343

Amede, T., Desta, L. T., Harris, D., Kizito, F. and Xueliang, C. 2014. The Chinyanja Triangle in the Zambezi River Basin, Southern Africa : Status of, and Prospects for, Agriculture, Natural Resources Management and Rural Development. Colombo, Sri Lanka: International Water Management Institute (IWMI), CGIAR Research Pro.

Arku, G., Mkandawire, P., Aguda, N. and Kuuire, V. 2012. Africa's quest for food security:What is the role of urban agriculture? In Occasional Paper (Vol. 19). Retrieved from file:///C:/Users/TOsH/Downloads/Occa19.pdf. Accessed 3/12/2019

Ayerakwa, H. M. 2017. Urban households' engagement in agriculture: implications for household food security in Ghana's medium sized cities. *Geographical Research* 55 (2): 217–230. https://doi.org/10.1111/1745-5871.12205

Baki, A. 2014. Socio-economic impacts of Gorai riverbank erosion on people : A case study of Kumarkhali, Kushtia Institute of Governance Studies (IGS).

Bann, C., Shukurov, R., Boziev, L. and Rakhmatova, D. 2012. The economics of land degradation for the agriculture sector in Tajikistan the economics of land degradation for the agriculture sector in Tajikistan – A scoping study. UNDP-UNEP, Dushanbe.

Billah, M. M. 2018. Mapping and monitoring erosion-accretion in an alluvial river using satellite imagery - The river bank changes of the Padma river in Bangladesh. *Quaestiones Geographicae* 37 (3): 87–95. https://doi.org/10.2478/quageo-2018-0027

Brondizio, L. 2015. ScienceDirect The IPBES Conceptual Framework — connecting nature and people. 1–16.

Carpenter, S. R., Bennett, E. M. and Peterson, G. D. 2006. Scenarios for Ecosystem Services : An Overview. *Ecology and Society* 11 (1): 1-14.

Carpenter, S. R., Mooney, H. A., Agard, J., Capistrano, D., Defries, R. S., Díaz, S. and Reid, W. V. 2009. Science for managing ecosystem services : Beyond the Millennium Ecosystem Assessment. *Proceedings of the National Academy of Sciences* 106 (5): 1305-1312.

Chapin, F. S., Kofinas, G. P. and Folke, C. 2009. Principles of ecosystem stewardship: Resilience-based natural resource management in a changing world. Principles

of Ecosystem Stewardship: Resilience-Based Natural Resource Management in a Changing World. Springer Science and Business Media. 1–409. https://doi.org/10.1007/978-0-387-73033-2

Chimwanza, B., Mumba, P. P., Moyo, B. H. Z. and Kadewa, W. 2006. The impact of farming on river banks on water quality of the rivers. *International Journal of Environmental Science and Technology* 2 (4): 353–358. https://doi.org/10.1007/BF03325896

Chipatu, L. 2017. Environmental learning for coping with drought among small scale farmers of Luangwa District, Zambia. A Doctoral Thesis, the University of Zambia. 209pp.

Coleman, J. and Huh, O. 2003. Major Deltas of the World: A Perspective from Space. "Major World Deltas: A Perspectrive from space, 1–75pp.

Collins, J. A. and Fauser, B. C. J. M. 2005. Balancing the strengths of systematic and narrative reviews. *Human Reproduction Update* 11 (2): 103–104. https://doi.org/10.1093/humupd/dmh058

Cundill, G. 2010. Monitoring social learning processes in adaptive comanagement: Three case studies from South Africa. *Ecology and Society* 15 (3):..... https://doi.org/10.5751/ES-03467-150328

Dahwa, E., Mudzengi, C. P., Hungwe, T., Shoko, M. D., Poshiwa, X., Kativu, S. and Murungweni, C. 2013. Influence of grazing intensity on soil properties and shaping herbaceous plant communities in semi-arid Dambo Wetlands of Zimbabwe. *Journal of Environmental Protection* 4 (10):Article ID: 38685, 8 pages

Daré, W., Venot, J. P., LePage, C. and Aduna, A. 2018. Problemshed or watershed? Participatory modeling towards IWRM in North Ghana. *Water* 10 (6): 72. https://doi.org/10.3390/w10060721

Das, T. K., Haldar, S. K., Gupta, I. Das and Sen, S. 2014. River bank erosion induced human displacement and its consequences. *Living Reviews in Landscape Research* 8 (1): 1–35. https://doi.org/10.12942/lrlr-2014-3

Das, T. K., Haldar, S. K., Sarkar, D., Borderon, M., Kienberger, S., Das Gupta, I. and Guha-Sapir, D. 2017. Impact of riverbank erosion: A case study. Australasian *Journal of Disaster and Trauma Studies* 21 (2): 73–81.

Debanshi, J. and Mandal, S. 2014. Dynamicity of the River Ganga and Bank Erosion Induced Land Loss in Manikchak Diara of Malda District of West Bengal, India: A RS and GIS based Geo. *International Journal of Applied Remote Sensing and GIS* 3 (1): 43–56. Retrieved from https://www.researchgate.net/profile/Sujit_Mandal3/publication/309322157_Dynamicity_of_the_River_Ganga_and_Bank_Erosion_Induced_Land_Loss_in_Manikchak_Diara_of_Malda_District_of_West_Bengal_India_A_RS_and_GIS_based_Geo-spatial_approach/links/5809fffa08ae4

Díaz, B. S., Pascual, U., Stenseke, M., Martín-lópez, B., Watson, R. T., Molnár, Z. and Shirayama, Y. 2018. Assessing nature's contributions to people. *Science* 359 (6373): 270-272.

Fisher, R. J., Maginnis, S., Jackson, W. J., Barrow, E. and Jeanrenaud, S. 2005. Poverty and Conservation. In Poverty and Conservation. https://doi.org/10.2305/iucn.ch.2005.fr.ll.2.en

Gann, G. D. and Lamb, D. 2002. Ecological Restoration a means of conserving biodiversity and sustaining livelihoods International and the IUCN Commission on Ecosystem Management. 6pp.

Gardner, T. A. 2004. Limits to Growth? A Perspective on the Perpetual Debate. *Environmental Sciences* 1 (2): 121–138. https://doi.org/10.1080/15693430512331342592

Gareau, B. J. and Crow, B. 2006. Ken Conca, Governing Water: Contentious Transnational Politics and Global Institution Building. International Environmental Agreements: *Politics, Law and Economics* 6 (3): 317–

320. https://doi.org/10.1007/s10784-006-9007-1

Geist, H. J. and Lambin, E. F. 2002. Proximate causes and underlying driving forces of tropical deforestation. *BioScience* 52 (2): 143–150. https://doi.org/10.1641/0006-3568(2002)052[0143:PCAUDF]2.0.CO;2

Grimm, N. B., Foster, D., Groffman, P., Grove, J. M., Hopkinson, C. S., Nadelhoffer, K. J. and Peters, D. P. C. 2008. The changing landscape: Ecosystem responses to urbanization and pollution across climatic and societal gradients. *Frontiers in Ecology and the Environment* 6 (5): 264–272. https://doi.org/10.1890/070147

Guzha, A. C., Rufino, M. C., Okoth, S., Jacobs, S. and Nóbrega, R. L. B. 2018. Impacts of land use and land cover change on surface runoff, discharge and low flows: Evidence from East Africa. *Journal of Hydrology: Regional Studies* 15: 49–67. https://doi.org/10.1016/j.ejrh.2017.11.005

Gweya Apudo, M., Opiyo Odhiambo, K. and Kipchumba Rop, S. 2016. Impact of land use activities on Itare River Bank stability and water quality in south west Mau water catchment, Kenya. *IOSR Journal of Environmental Science* 10 (6): 15–27. https://doi.org/10.9790/2402-1006011527

Hamisi, H. I., Tumbo, M., Kalumanga, E. and Yanda, P. 2012. Crisis in the wetlands: Combined stresses in a changing climate - Experience from Tanzania. *Climate and Development* 4 (1): 5–15. https://doi.org/10.1080/17565529.2012.665009

Hersperger, A. M., Gennaio, M. and Verburg, P. H. 2010. Linking Land Change with Driving Forces and Actors : Four Conceptual. *Ecology and Society* 15 (4):1-17.

Iyango, L., Mafabi, P., Musinguzi, M., Namakambo, N. and Emanu, T. 2009. Mapping a better future: how spatial analysis can benefit wetlands and reduce poverty in Uganda. World Resource Institute, 1–39. Retrieved from http://pdf.wri.org/mapping_a_better_future.pdf

Jaspers-Focks, D. J. and Algera, A. 2006. Vetiver grass for river bank protection. Proceedings of the Fourth International Vetiver Conference, 1–14pp.

Jayne, T. S., Chamberlin, J. and Headey, D. D. 2014. Land pressures, the evolution of farming systems, and development strategies in Africa: A synthesis. *Food Policy* 48: 1–17. https://doi.org/10.1016/j.foodpol.2014.05.014

Jellason, N. P., Robinson, E. J. Z., Chapman, A. S. A., Neina, D., Devenish, A. J. M., Po, J. Y. T. and Adolph, B. 2021. A Systematic Review of Drivers and Constraints on Agricultural Expansion in Sub-Saharan Africa. 1–17pp.

José M. García-Ruiz, Beguería, S., Nadal-Romero, E., González- Hidalgo, J., Lana-Renault, N. and Sanjuan, Y. 2015. A Meta-analysis of soil erosion rates across the world. *Geomorphology* 239: 160-173.

Kakuru, W., Turyahabwe, N. and Mugisha, J. 2013. Total economic value of wetlands products and services in Uganda. Policy brief; no. 02/2013. https://doi.org/10.1155/2013/192656

Kangalawe, R. Y. M. and Liwenga, E. T. 2005. Livelihoods in the wetlands of Kilombero valley in Tanzania: Opportunities and challenges to integrated water resource management. *Physics and Chemistry of the Earth* 30 (11-16): 968–975. https://doi.org/10.1016/j.pce.2005.08.044

Kanianska, R. 2016. Agriculture and its impact on land-use, environment and ecosystem services. 3–26pp.

Karimi, P., Molden, D., Notenbaert, A. and Peden, D. 2013. Nile basin farming systems and productivity. pp. 133-153. In: The Nile River Basin. Routledge. 9780203128: 133–153. https://doi.org/10.4324/9780203128497

Karisa C. 2010. A negotiated framework for rehabilitation of riparian zones in Nairobi city : The case of Mathare river valley. *ISoCaRP Congress* 46: 1–13.

Karsch, N. M. 2019. Examining the Validity

of the Environmental Kuznets Curve. *Consilience: The Journal of Sustainable Development* 21(1): 32–50.

Kaunda, E. and Chapotoka, O. 2014. The conflict between poverty and river system management : The case study of Malawi, Southern Africa. Abstract submitted to the Second International Symposium on the Management of Large Rivers for Fisheries. Phnom Penh, Mekong River Commission.

Kaunda, E. K. W., Resources, N. and Jamu, D. 2007. Factors Influencing Cultivation of the Lilongwe and Linthipe River Banks in Malawi : A Case Study of Salima District. (July 2014). https://doi.org/10.3923/jas.2007.3334.3337

Kingsford, R. T., Basset, A. and Jackson, L. 2016. Wetlands : conservation's poor cousins. 916: 892–916. https://doi.org/10.1002/aqc.2709

Kingsford, R. T., Biggs, H. C. and Pollard, S. R. 2011. Strategic Adaptive Management in freshwater protected areas and their rivers. *Biological Conservation* 144 (4): 1194–1203. https://doi.org/10.1016/j.biocon.2010.09.022

Koilo, V. 2019. Evidence of the environmental Kuznets Curve : Unleashing the opportunity of industry 4 . 0 in emerging economies. (Wwf 2017).

Kumar, D. 2017. River Ganges–Historical, cultural and socioeconomic attributes. *Aquatic Ecosystem Health and Management* 20(1–2): 8–20. https://doi.org/10.1080/14634988.2017.1304129

Kurosaki, R. 2007. Multiple uses of small-scale valley bottom land: Case study of the Matengo in Southern Tanzania. *African Study Monographs* 36:19-38.

Kyando, F. E. 2007. Impact of valley bottom cultivation (Vinyungu) on poverty alleviation in Mtitu River Basin, Kilolo District, Iringa, Tanzania.

Lee-Smith, D. 2010. Cities feeding people: An update on urban agriculture in equatorial Africa. *Environment and Urbanization* 22 (2): 483–499. https://doi.org/10.1177/0956247810377383

Macharia, J. M., Thenya, T., Ndiritu, G. G., and Section, M. 2014. Eco-tourism in biodiversity conservation Management of highland wetlands in central Kenya : the importance of community education, awareness and eco-tourism in biodiversity conservation. *Biodiversity* 11(1-2): 85-90.

Marambanyika, T. and Beckedahl, H. 2016. Wetland utilisation patterns in semi-arid communal areas of Zimbabwe between 1985 and 2013 and the associated benefits to livelihoods of the surrounding communities. *Transactions of the Royal Society of South Africa* 71(2): 175–186. https://doi.org/10.1080/0035919X.2016.1152520

Matsuda, H. 1996. Riverbank cultivation on the lower Omo Valley: The intensive farming system of the Kara, South Western Ethiopia, Kyoto Bunkyo University Essays in NorthEast African, SENRI Ethnological Studies. pp. 1–28.

Mkavidanda, K. 2001. The Role of Traditional Irrigation Systems (Vinyungu) in Alleviating Povery in Iringa Rural District ,. The Role of Traditional Irrigation Systems (Vinyungu) in Alleviating Povery in Iringa Rural District, Tanzania.

Moher, D., Liberati, A., Tetzlaff, J. and Altman, D. G. 2009. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Journal of Clinical Epidemiology* 62(10): 1006–1012. https://doi.org/10.1016/j.jclinepi.2009.06.005

Motsumi, S., Magole, L. and Kgathi, D. 2012. Indigenous knowledge and land use policy: Implications for livelihoods of flood recession farming communities in the Okavango Delta, Botswana. *Physics and Chemistry of the Earth* 50–52, 185–195. https://doi.org/10.1016/j.pce.2012.09.013

Msofe, N. K. 2019. Socio-Ecological Drivers of Land Use Change and Wetland Conversion in Kilombero Valley Floodoplain, Tanzania. *Am. J. Environ. Resour. Econ* 4 (1): 1–11. https://doi.org/10.11648/j.

ajere.20190401.11

Mulei, J. M. and Onkware, A. O. 2018. Available Online at http://www.aerjournal.info Conservation Status of Swamp Wetlands in Uasin Gishu County, Kenya. *Africa Environmental Review Journal* 3 (1): 74-81.

Mumba, P., Resources, N. and Kadewa, W. 2006. The impact of farming on river banks on water quality of the rivers The impact of farming on river banks on water quality of the rivers. *International Journal of Environmental Science and Technology* 2: 353-358.

Munishi, P. T. K. 2011. Valley Bottom Wetlands Can Serve for Both Biodiversity Conservation and Local Livelihoods Improvements. *Ecosystems Biodiversity*

Munna, G. M., Alam, J. B., Uddin, M. M., Hossain, M. M. and Sabet, Y. 2020. Assessment of Socio-Economic Impacts of Surma River Bank Erosion Using GIS and Statistical Study. *International Journal of Science and Engineering Invention* 06 (01): 1–4. https://doi.org/10.23958/ijsei/vol06-i01/190

Musamba, E. B., Ngaga, Y. M., Boon, E. K. and Giliba, R. A. 2011. Impact of Socio-economic Activities around Lake Victoria: Land Use and Land Use Changes in Musoma Municipality, Tanzania. *Journal of Human Ecology* 35(3): 143–154. https://doi.org/10.1080/09709274.2011.11906400

Musasa, T. and Marambanyika, T. 2020. Threats to sustainable utilization of wetland resources in Zimbabwe : A review. *Wetlands Ecology and Management* 28: 681-696.. https://doi.org/10.1007/s11273-020-09732-1

Nabahungu, N. L. and Visser, S. M. 2011. Contribution of wetland agriculture to farmers' livelihood in Rwanda. *Ecological Economics* 71 (1): 4–12. https://doi.org/10.1016/j.ecolecon.2011.07.028

Ncube, M. 2017. Faculty of Commerce Institute of development studies paying for cultural ecosystem services: The case of apostolic sects (Vapostori) in Bulawayo Metropolitan province, Zimbabwe. A Doctoral Dissertation. National University of Science and Technology, Zimbabwe.

Nelson, G. C., Bennett, E., Berhe, A. A., Cassman, K. G., Defries, R., Dietz, T. and Zurek, M. 2005. Drivers of change in ecosystem condition and services. Ecosystems and Human Well-Being; Scenarios. *Millenium Ecosystem Assessment* 2: 173–222. Retrieved from http://books.google.com/books?hl=en&lr=&id=Q6jUX_BgWpIC&oi=fnd&pg=PA173&dq=Drivers+of+Change+in+Ecosystem+Condition+and+Services&ots=QKktL9UY-A&sig=5e0t87rE8nKKTMQ-Cbt8BnTaHW4

Ngome, I. and Foeken, D. 2012. My garden is a great help: Gender and urban gardening in Buea, Cameroon. *GeoJournal* 77 (1): 103–118. https://doi.org/10.1007/s10708-010-9389-z

Okayo, J., Odera, P. and Omuterema, S. 2015. Socio-economic characteristics of the community that determine ability to uptake precautionary measures to mitigate flood disaster in Kano Plains, Kisumu County, Kenya. *Geoenvironmental Disasters* 2 (1): 1-22. https://doi.org/10.1186/s40677-015-0034-5

Omondi, S. O. 2018. Economic analysis of small-scale poultry production in Kenyan medium-sized cities of Kisumu and Thika. 1-34pp. In: International Association of Agricultural Economists (IAAE) 2018 Conference, July 28-August 2, 2018, Vancouver, British Columbia.

Ondiek, R. A., Vuolo, F., Kipkemboi, J., Kitaka, N., Lautsch, E., Hein, T. and Schmid, E. 2020. Socio-economic determinants of land use/cover change in Wetlands in East Africa: A case study analysis of the Anyiko wetland, Kenya. *Frontiers in Environmental Science* 7: 207. https://doi.org/10.3389/fenvs.2019.00207

Onyago, C. 2010. Urban and peri-urban agriculture as a poverty alleviation strategy among low income households: The case

of orange farm, South Johannesburg. 230. Retrieved from http://uir.unisa.ac.za/bitstream/handle/10500/3562/dissertation_onyango_c.pdf?sequence=1

Ota, T. 2017. Economic growth, income inequality and environment: assessing the applicability of the Kuznets hypotheses to Asia. *Palgrave Communications* 3 (1):. https://doi.org/10.1057/palcomms.2017.69

Panayotou, T. 1993. Economic growth and the environment. Paper prepared for and presented at the Spring Seminar of the United Nations Economic Commission for Europe, Geneva, March 3. Harvard University and Cyprus International Institute of Management. 49pp.

Percy, S., Lubchenco, J., Almeida, F., Armsworth, P., Bennett, A., Ebi, K. and Yohe, G. 2005. Millennium ecosystem assessment business and industry synthesis team synthesis team members synthesis team co-chairs business council for sustainable development-Brazil World Business Council for Sustainable development a report of the millennium ecosystem. Millennium Ecosystem Assessment, 36. Retrieved from http://www.alexandrina.org/CSSP/Event/Material/MEA_businessesdocument.353.aspx.pdf

Peters, P. E. 2004. Informal Irrigation in Lake Chilwa Basin Stream-bank and Wetland Gardens. BASIS Report. Madison, WI: BASIS CRSP.

Prescott, M. F. and Ninsalam, Y. 2016. The synthesis of environmental and socio-cultural information in the ecological design of urban riverine landscapes. *Sustainable Cities and Society* 20: 222–236. https://doi.org/10.1016/j.scs.2015.09.014

Rahman, M. M. and Islam, M. N. 2018. Riverbank Erosion Impact on Changing of Cropping Pattern: A study on the Padma Charland. *Asian Journal of Plant Science and Research* 8 (2): 1–7.

Sabater, S. and Elosegi, A. 2013. Good News : Progress in Successful River. *International Journal of Science and Engineering Invention* 6 (01): 1-4.

Safary, L. M., Mulwa, A. and Ariga, E. S. 2017. Introduction of agricultural activities on wetlands and its influence on physical environment of Nairobi County. *International Journal of Scientific Research and Innovative Technology* 4 (4): 37–50.

Salafsky, N. and Wollenberg, E. 2000. Linking livelihoods and conservation: A conceptual framework and scale for assessing the integration of human needs and biodiversity. *World Development* 28 (8): 1421–1438. https://doi.org/10.1016/S0305-750X(00)00031-0

Salihu, D. and Musa, T. S. 2019. Using geographic information system to evaluate land use and land cover affected by flooding in Adamawa State, Nigeria. 1–11pp.

Schilling, K. E. 2000. Patterns of discharge and suspended sediment transport in the walnut and squaw creek watersheds, Jasper county, Iowa: water years 1996-1998.

Scoones, I. 2007. Livelihoods perspectives and rural development. *Journal of Peasant Studies* 36 (1): 171–196. https://doi.org/10.1080/03066150902820503

Simatele, D., Binns, T. and Simatele, M. 2012. Urban livelihoods under a changing climate: perspectives on urban agriculture and planning in Lusaka, Zambia. *Journal of Human Development and Capabilities* 13 (2): 269-293.

Simfukwe, T., Casarotto, C., Kalinda, T. and Tembo, G. 2006. Rural household water use in the Kafue River Basin in Zambia. pp. 1–8. In World Congress on Water, Climate and Energy, Dublin. https://doi.org/10.13140/2.1.5066.2404

Singh, R., Patel, S. K., Tiwari, A. K. and Singh, G. S. 2021. Assessment of flood recession farming for livelihood provision, food security and environmental sustainability in the Ganga River Basin. *Current Research in Environmental Sustainability* 3: 100038. https://doi.org/10.1016/j.crsust.2021.100038

Smakhtin, V. and Molden, D. J. and Cascão, A. C. 2013. The Nile river

basin: Water, agriculture, governance and livelihoods. In The Nile River Basin: Water, Agriculture, Governance and Livelihoods (Vol. 9780203128). https://doi.org/10.4324/9780203128497

Smart, J. 2014. Urban agriculture and economic change in the Zambia Copperbelt: The cases of Ndola, Kitwe and Luanshya. Doctoral Dissertation, University of Otago, New Zealand.

Stern, D. I. 2004. The rise and fall of the environmental Kuznets Curve. *World Development* 32 (8): 1419–1439. https://doi.org/10.1016/j.worlddev.2004.03.004

Stern, D., Common, M. S. and Barbier E. B. 1996. Economic growth and environmental degradation: The environmental Kuznets curve and sustainable development. *World Development* 24 (7): 1151–1160.

Stewart, R., Korth, M., Langer, L., Rafferty, S., Da Silva, N. R. and Van Rooyen, C. 2013. What are the impacts of urban agriculture programs on food security in low and middle-income countries? *Environmental Evidence* 2(1):1-13.https://doi.org/10.1186/2047-2382-2-7

Taruvinga, T. and Mushunje T. 2010. Socio-economic factors that influence households' participation in wetland cultivation: A Binary Logistic Regression of wetland cultivators and noncultivators. No. 308-2016-5063. 2010.

UNEP-WCMC. 2010. The Ramsar Convention on wetlands and its indicators of effectiveness. International Expert Workshop on the 2010 Biodiversity Indicators and Post-2010 Indicator Development.

United Nations. 2015. Wetlands and Ecosystem Services.

Van der Zaag and Savenije. 2006. Water as an economic good. The value of pricing and the failure of markets. Unesco-IHE. pp. 1-32.

Vincent, K. and Cundill, G. 2021. The evolution of empirical adaptation research in the global South from 2010 to 2020. *Climate and Development* 0(0): 1–14. https://doi.org/10.1080/17565529.2021.1877104

Voleníková, L. 2016. The role of urban agriculture in household wellbeing : Case study of community - based urban agriculture in Ndola, Zambia. *Development, Environment and Foresight* 2 (2): 80–90.

Warner, K., Hamza, M., Oliver-Smith, A., Renaud, F. and Julca, A. 2010. Climate change, environmental degradation and migration. *Natural Hazards* 55 (3): 689–715. https://doi.org/10.1007/s11069-009-9419-7

Whitlow, R. 1988. Land degradation in Zimbabwe. A Geographical Study. University of Zimbabwe (UZ) / Department of Natural Resources.

Zaimes, G. N., Schultz, R. C. and Isenhart, T. M. 2006. Riparian land uses and precipitation influences on streambank erosion in Central Iowa. *Journal of the American Water Resources Association* 42 (1): 83-97.

Zembe, N., Mbokochena, E., Mudzengerere, F.H. and Chikwiri, E. 2014. An assessment of the impact of the fast track land reform programme on the environment: The case of Eastdale Farm in Gutu District, Masvingo. *Journal of Geography and Regional Planning* 7 (8):160-175.

Zezza, A. and Tasciotti, L. 2010. Urban agriculture, poverty, and food security: Empirical evidence from a sample of developing countries. *Food Policy* 35 (4): 265–273. https://doi.org/10.1016/j.foodpol.2010.04.007

Zidana, A., Kaunda, E., Phiri, A., Khalil-Edriss, A., Mitaya, G. and Jamu, D. 2007. Factors influencing cultivation of the Lilongwe and Linthipe river banks in Malawi: A case study of Salima District. *Journal of Applied Sciences* 7 (21): 3334–3337. https://doi.org/10.3923/jas.2007.3334.3337

Zinhiva, H., Murwendo, T. and Rusinga, O. 2017. Streambank Cultivation along Chiredzi River in Zaka District, Zimbabwe: An activity widely practiced but institutionally condemed. *International Journal of Agriculture, Environment and Bioresearch* 2: 79-96.