Open Journal of Biodiversity and Ecosystems *Vol. 1, 2026* DOI:10.2218/

Drivers and Pressures of Wetland Degradation in Malawi: A Narrative Review

Davies Ezra Chogawana[1], Eleanor S. Devenish-Nelson [2], Mphatso Martha Kalemba[3]
[1] Biodiversity Division, Malawi Environment Protection Authority, Lilongwe, Malawi
[2] The University of Edinburgh, Edinburgh, United Kingdom
[3] Biodiversity Division, Environmental Affairs Department, Lilongwe, Malawi
Email:
chogawana@gmail.com

Received: July 2026
Accepted for publication: May 2026
Published: July 2026

Abstract

Wetlands in Malawi provide vital ecosystem services, yet they face increasing anthropogenic and environmental pressures that have resulted in their degradation. This review synthesised findings to identify and analyse the key drivers and pressures contributing to wetland degradation in Malawi. Three major wetland ecosystems in Malawi – Lake Chilwa, Elephant Marsh and the Kasungu floodplain – were represented, from six studies. The most prominent drivers identified include population growth, poverty, weak governance, hydro power and irrigation development, commercial agriculture, climate change and invasive alien species. These drivers result in direct pressures such as wetland encroachment for agriculture, human settlement, resource overexploitation and altered hydrology. The review highlights the interconnected nature of these drivers and underscores the need for integrated management approaches that address both immediate pressures and their underlying causes. Despite limitations in geographic scope and data availability, the findings offer critical insights for policy and practice aimed at sustaining Malawi's wetland ecosystems. Further research is recommended, particularly in underrepresented regions and in relation to emerging threats such as invasive alien species, climate change and commercial land use expansion.

Keywords: Wetland degradation, wetland conservation, Malawi, Lake Chilwa

1. Introduction: Wetlands in Malawi

Malawi is endowed with diverse natural resources, with approximately 20% of its land covered by water bodies and wetlands (Fig.1) (Chiotha et al., 2018). Major wetlands in the country include Elephant Marsh and Lake Chilwa in the southern region, the Kasungu inland floodplains in the central region and the Vwaza Marshes in the northern region, all of which provide critical ecological services and support local livelihoods (Chiotha et al., 2018; Kosamu et al., 2012; Manda et al., 2023; Wood, 2011).

Two of Malawi's wetlands are designated as Ramsar sites: Elephant Marsh (61,556 ha; Ramsar Site 2308) and the Lake Chilwa wetland (240,000 ha; Ramsar Site 869), both located-on community lands (Chiotha et al., 2018). The Vwaza Marsh, in contrast, is the only major wetland under formal protected area management, designated as a Wildlife Reserve (Manda et al., 2023). The other wetlands in Malawi lie in communal areas, with the inland floodplains in central Malawi recognized as highly suitable for agriculture (Wood, 2011). The distribution of wetlands in Malawi can be seen in Figure 1.

1.1 Drivers and Pressures of Wetland Degradation

Wetland degradation is driven by both direct pressures and underlying drivers. Here, pressures refer to direct, localized actions that degrade wetlands, while drivers are the broader socio-economic, institutional, or environmental forces that give rise to those pressures (Asselen et al., 2013; Dzoga et al., 2020). The consequences of wetland degradation are significant, especially in a country so dependent on the ecosystem services from wetland habitats (Kafumbata et al., 2014). For example, overfishing can diminish dietary protein availability in a country where fish is the primary source of animal protein (Bonaccio et al., 2017; Kosamu et al., 2012). Increased sediment load from unsustainable

agriculture on wetland degrades critical breeding habitats for sensitive bird species such as Rynchops flavirostris

(African Skimmer), which depend on sandbanks for nesting (Branch, 2016). Similarly, sediment deposition disrupts fish spawning grounds, threatening aquatic biodiversity and undermining the reproductive success of fish species (Brown et al., 2022; Kosamu, 2014). Moreover, wetlands play a critical role in climate change mitigation and adaptation by protecting communities from flooding through their water attenuation functions and by providing irrigation to support recovery after droughts (Forsythe and Turpie, 2016). Continued wetland degradation and loss, however, reduces the capacity of communities to cope with climate related challenges (Kafumbata et al., 2014). Without wetlands, people lose critical options for adapting during periods of drought, water scarcity and other climate stresses (Wood, 2011.). Collectively, these interlinked processes not only diminish biodiversity but also compromise the ecological resilience of wetlands, threatening their long-term functionality and the ecosystem services they provide.

Understanding the underlying drivers of wetland degradation is therefore a critical step towards establishing the enabling conditions necessary to effectively safeguard these ecosystems from further harm. Globally, wetland degradation is driven by multiple interacting factors such as agricultural expansion, economic development and population growth, which are predominant contributors to wetland loss and degradation (Asselen et al., 2013; Convention on Wetlands et al., 2025; Kundu et al., 2024). Often, a single driver can result in multiple pressures; for instance, population growth leads to both expanded agriculture and increased settlement (Asselen et al., 2013). Conversely, certain pressures may stem from multiple drivers; for example, wetland conversion for agriculture may arise due to population growth, economic demand, or climate change-induced water scarcity (Asselen et al., 2013). In Malawi, reported pressures include agricultural expansion, human settlement, overexploitation of biological resources and water extraction (Manda et al., 2023). These pressures are driven by factors such as population growth, poverty, limited awareness of wetland values and institutional weaknesses (Kosamu et al., 2012). The two Ramsar sites are the most studied wetlands in Malawi as their designation has stimulated scientific interest and research. The other wetlands have only a few papers on them or remain understudied. Therefore, this study provides a synthesis of the available literature, highlighting trends in wetland degradation across these better studied areas, while acknowledging that generalizations to the entire country are limited by gaps in coverage and the small number of existing publications.

1.2 Objective of the Study

To conduct a narrative review on the key drivers and pressures contributing to wetland degradation in Malawi,

with the aim of identifying those drivers and pressures that have the greatest impact.

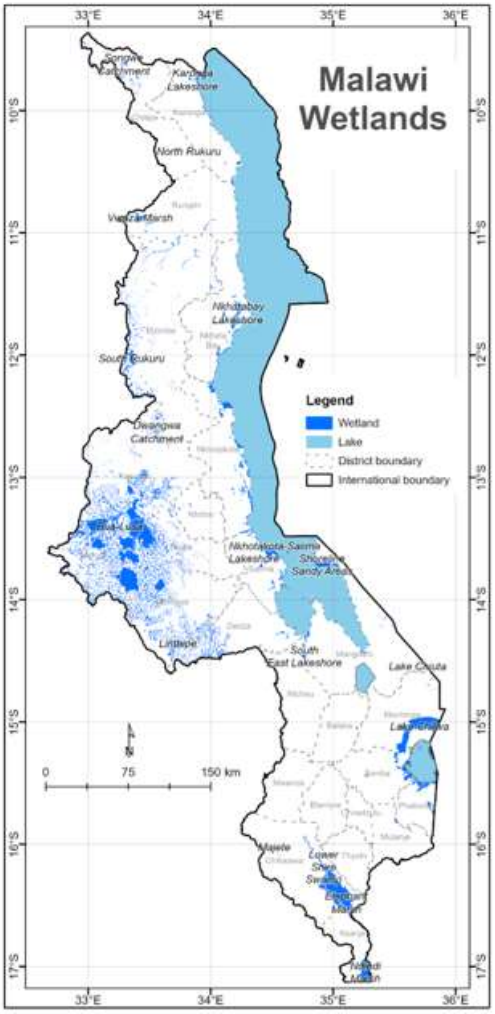

Figure 1*: Distribution of Wetlands in Malawi.*

2. Methods: Determining Drivers and Pressures

To provide a clear and logical understanding of drivers and pressures, this study defines them as follows: drivers are societal factors that lead to activities contributing to wetland degradation, whereas pressures are the direct activities causing wetland degradation (Dzoga et al., 2020). The Drivers–Pressures–State–Impact–Response (DPSIR) framework was used as a reference point to guide the assessment of drivers and pressures. The framework provides a logical structure by linking underlying societal drivers to direct pressures, and by illustrating the subsequent impacts and responses (Dzoga et al., 2020). To determine the key pressures and drivers of wetland degradation in Malawi, the study employed a narrative literature review. Literature reviews are increasingly being used in scientific research to synthesize existing knowledge and provide a comprehensive understanding of a chosen topic (Pautasso, 2019). There are two types of literature reviews that can be undertaken for a study – systematic and narrative (Pautasso, 2019).

A systematic review is aimed at answering a research question using a pre-defined protocol (Holland and DeVille, 2021; Ojala et al., 2021; Pullin, 2016). It is guided by a research question which directs the researcher to conduct the relevant search, with facts and results from the reviewed journals synthesized to answer the question (Fatorić and Seekamp, 2017). This method prevents the author's bias towards their own perspective on the question posed by the research (Schmidt, 2005).

A narrative review provides an overview of the current state of knowledge on a subject and synthesizes qualitative evidence from multiple studies in a concise and coherent manner (Holland and DeVille, 2021; Ojala et al., 2021; Pautasso, 2019). Unlike systematic reviews, narrative reviews can utilise published articles that used different methodologies and research questions but include data which answers the objective of the review (Pautasso, 2019). Narrative reviews are used for qualitative data synthesis and can utilise articles which do not include statistical analysis (Holland and DeVille, 2021). The research question is usually broader and not narrowed down as in systematic search (Holland and DeVille, 2021). The narrative review also follows an order of search which starts by defining the search question, identifying the key search words for the topic and conducting a search (Holland and DeVille, 2021; Ojala et al., 2021). The narrative review is criticized for biasness as it does not have a pre-defined protocol (Pullin, 2016). Narrative review accommodates the use of grey literature, which can be subject to biasness from an institutions or projects perspective. Whilst, systematic reviews have been criticized for their narrow inclusion criteria, which may exclude valuable contextual information and evidence from non-peer-reviewed sources, thereby limiting the breadth of perspectives considered on a given topic (Pautasso, 2019). This study examined the drivers and pressures influencing wetland conservation, which provided the context for understanding wetland degradation in Malawi. A narrative review approach was chosen to enable the synthesis of a broad range of literature and to capture the diversity of underlying causes. The scarcity of peer-reviewed studies on wetlands in Malawi necessitated the inclusion of grey literature, which provided context-specific and locally relevant insights that are often absent from academic sources. Employing a narrative review was therefore appropriate, as it allowed for a comprehensive and descriptive analysis of the issue while integrating both scholarly and practice-based evidence (Holland and DeVille, 2021).

A scoping search was done on Web of Science to check availability of peer reviewed journals on wetlands degradation in Malawi, but the search resulted in few articles. Therefore, this narrative review expanded its search to Google Scholar to review other published work on wetlands in Malawi. Grey literature from government agencies, internationally recognised websites like Ramsar and working papers were utilised. Grey literature increases the scope of information as it contains data that might not be published due to its null/negative results, thereby reducing biasness (Pappas and Williams, 2011). Further, grey literature gives more recent data, which is mostly provided by experts from the field, which reduces time lag

in accessing emerging issues (Haddaway and Bayliss, 2015).

The key search terms for the study were; Status of wetlands in Malawi, Wetlands Degradation in Malawi, Utilisation of wetlands in Malawi, Pressures on Wetlands

in Malawi and Access to Wetlands. The articles for review were selected for inclusion by evaluating the titles of the articles that the broader search produced. The articles which did not meet the inclusion criteria of having either Malawi, Pressures, Degradation or Wetland in their title were excluded. The remaining articles were subsequently screened by reviewing their abstracts to assess their relevance to the research question concerning the drivers and pressures influencing wetland degradation in Malawi. Articles that did not address these aspects were excluded from the review. The Final list of articles was then examined in full to determine if they had relevant data. Finally, the data collected from the chosen articles was summarised, explaining in detail the significance of wetlands degradation and underlying drivers and pressure on wetlands.

3. Results

The search managed to retrieve 69 articles. Of the 69 articles retrieved, eleven articles were excluded as they were duplicates. The remaining 58 articles were subjected to preliminary screening based on their titles; 42 articles were excluded using this criterion. Abstracts of the remaining 16 articles were reviewed for relevance to drivers and pressures of wetland loss in Malawi, leading to the exclusion of 10 articles. Of the 69 articles that were retrieved, only 6 articles qualified for detailed review as per the objective of the search. Table 1 summarises the selected studies.

The studies returned by the search only represented three of Malawi's wetlands, located in two regions of Malawi (South and Central). Lake Chilwa, Elephant Marsh and Kasungu floodplains are distributed across 7 of Malawi's 28 districts. Five were peer reviewed articles; one was a commissioned report for Ramsar site preparation.

3.1 Key drivers identified

Findings from the narrative review identified six primary drivers contributing to wetland degradation in Malawi:

3.1.1. Population Growth

Population growth was identified as a driver in all six reviewed articles. Malawi experienced a population increase of 35% between 2008 and 2018, representing an annual growth rate of 2.8% (Government of Malawi,

2018). Rapid population growth has resulted in increased pressure on wetland from unsustainable agricultural practices (Brown et al., 2022; Schuyt, 2005).

3.1.2. Poverty

Poverty was cited in five of the reviewed studies. Over 70% of Malawians live below the poverty line (Xu et al., 2019) and wetland resources are often overutilised by impoverished people, leading to its degradation (Kosamu et al., 2012).

S/N	Study Title	Location	Author, Publication Year
1	Climate Resilient Livelihoods and Sustainable Natural Resource Management in The Elephant Marsh, Malawi.	Elephant Marsh Wetland	Branch, 2016
2	Conditions for Sustainability of the Elephant Marsh Fishery in Malawi.	Elephant Marsh	Kosamu, 2014
3	Common Pool Resource Management in Lake Chilwa, Malawi: A Wetland Under Pressure.	Lake Chilwa Wetland	Mvula and Haller, 2009
4	Riparian Ecosystems Resilience and Livelihoods Strategies Under Test: Lesson from Lake Chilwa in Malawi and Other Lakes in Africa.	Lake Chilwa Wetland	Kafumbata, Jamu and Chiotha, 2014
5	Economic Consequences of Wetlands Degradation for Local Populations in Africa.	Lake Chilwa Wetland	Schuyt, 2005
6	Enhancing Sustainable Agriculture and Wetlands Interaction in Small Inlands Wetland Systems.	Kasungu inland flood plains	Wood, 2011

3.1.3. Government Policies and Programs

Three studies identified government policies and programs as contributing factors. Policy direction on development activities puts pressure on the extent of utilisation of wetland resources (Wood, 2011).

3.1.4. Hydropower and irrigation development

Water abstraction from upstream sources due to irrigation and hydro power generation was cited in three studies as a major threat. Excessive withdrawal of water is a pressure that impacts the hydrological flows of wetlands, thereby impacting their ecological integrity and negatively affecting species dependent on consistent water flows (Brown et al., 2022; Kafumbata et al., 2014).

3.1.5. Climate change

Climate change was cited in three articles as a driver of wetland degradation by increasing frequency of droughts and dry spells, resulting in drying and water stress of wetlands (Jørstad and Webersik, 2016). Lake Chilwa has been recorded as the wetland most affected by climate change in Malawi (Kafumbata et al., 2014), having experienced substantial fluctuations in water levels associated with droughts, erratic rainfall, and flooding events, resulting in adverse effects on aquatic habitats and the ecosystem services. Areas that rely on wetlands as a means of climate adaptation, like Simulemba in Kasungu, have also suffered due to wetland degradation caused by climate change (Wood, 2011).

3.1.6. Commercial Agriculture

Commercial agriculture was noted in two articles as a driver of wetland degradation. The pressures of agro-chemical and population increase as a result of the establishment of commercial farms poses a threat to wetlands (Brown et al., 2022).

3.1.7. Invasive Alien Species

Invasive alien species were highlighted in one study as a driver on wetland biodiversity loss. These species out-compete native species in wetlands, which puts pressure on the ecosystems structure, thereby deteriorating habitat quality (Branch, 2016).

4. Discussion

This review sets out to identify and analyse the primary drivers and pressures contributing to wetland degradation in Malawi. The reviewed studies provide a comprehensive understanding of the multiple anthropogenic and environmental pressures acting on wetlands, and the underlying socio-economic and policy drivers. Seven major drivers were identified and are discussed together with the pressures arising from each, in order of significance.

4.1.1. Population growth

The identification of population growth as the most important driver reflects the rapid growth that has significantly increased pressure on Malawi's wetlands (Brown et al., 2022). Rising population has led to the pressure of increased food demand, prompting the expansion of agricultural activities into wetland areas (Schuyt, 2005). Similar trends have been reported in the Kilombero Wetland in Tanzania, where over 50% of the area has been converted to agriculture due to population pressure (Materu et al., 2018). The loss of wetland area compromises the provision of essential ecosystem services (Koko et al., 2020). For example, intensive cultivation within wetlands results in soil erosion and sedimentation (Mvula and Haller, 2009), degrading habitat quality. Increasing sediment loads can have multiple negative impacts, such as altering important migration stopover points for the Rynchops flavirostris (African Skimmer), a

species sought after by birdwatchers (Branch, 2016), as well as disrupting fish spawning grounds (Kakuru et al., 2013). Such impacts on ecosystem services could ultimately lead to a reduction in the quality of life for the human populations who depend on these wetlands.

4.1.2. Population growth

With over 70% of Malawians living below the international poverty line of $1.90 per day (Machira et al., 2023), dependence on wetlands for subsistence is high, resulting in the high importance of poverty as a driver. In their efforts to meet basic needs, impoverished communities often overexploit wetland resources (Kosamu et al., 2012). This means that pressures from unsustainable fishing methods, including the use of gill nets and mosquito nets, have decimated fish populations and inadvertently harmed non-target species, such as the Nettapus auritus (pygmy goose) in the Elephant Marsh (Brown et al., 2022). Overfishing also reduces food availability for predators like the Haliaeetus vocifer (fish eagle) and the Crocodylus niloticus (Nile crocodile) in the Elephant Marsh (Brown et al., 2022; Kosamu, 2014). Poaching is another pressure arising from extreme poverty; for instance, the Hippopotamus amphibius (hippopotamus) population in the Lake Chilwa Wetland has been nearly extirpated due to poaching (Kafumbata et al., 2014; Mvula and Haller, 2009). Similar poverty-driven degradation patterns have been reported in Zimbabwe and Kenya (Mahlatini et al., 2020; Terer et al., 2004) and demonstrate that this is a pervasive regional driver.

4.1.3. Hydropower and Irrigation Development

Malawi faces a pressing need to provide sufficient food and energy for its population. Currently, only about 15% of Malawians are connected to the national electricity grid. To address this energy deficit, the government has been developing hydropower stations, while on the food security front, irrigation has been promoted to increase agricultural productivity. However, both hydropower generation and irrigation development have emerged as major hydrological drivers of wetland degradation. Excessive water withdrawals from upstream areas for irrigation alter natural flow regimes, thereby reducing water availability within wetlands (Brown et al., 2022). This disrupts ecological processes and affects species dependent on water flows (Kafumbata et al., 2014). In the Lake Chilwa Wetland, upstream irrigation activities have reduced inflows, leading to declining fish populations (Kafumbata et al., 2014). Similarly, the Elephant Marsh, which depends on the Shire River for its hydrological regime, faces increasing pressure from upstream water abstractions and flow regulation associated with hydropower and irrigation schemes along the river. Three hydropower stations are currently operational, and construction will soon begin on a fourth. The Shire Valley Transformation Programme is also developing a 43,000-hectare irrigation scheme on the same Shire River (Shire Valley Transformation Program - Phase 1 - 2023). These developments risk further altering the hydrological regime of the wetland and highlight the potential for irrigation and hydro power generation developments to become increasingly important drivers of wetland degradation.

4.1.4. Government Policies and Programmes

Government initiatives, while aimed at addressing food insecurity and poverty, have unintentionally driven wetland degradation. Following the 2000/01 droughts, Malawi promoted irrigation as a strategy to boost food production (Wood,2011). Wetlands specifically faced the pressure of being targeted for irrigation development and, in Lake Chilwa alone, 2,000 acres were converted for this purpose (Mvula and Haller, 2009; Schuyt, 2005). Fertilizer subsidy programmes further incentivized winter cropping, primarily conducted in wetlands (Wood, 2011.). This intensification of agriculture introduces agrochemicals into wetland ecosystems, harming aquatic fauna (Kosamu, 2014). Current agricultural programmes lack adequate provisions to protect the ecological integrity of wetlands (Kosamu, 2014). Similar outcomes have been observed in Tanzania and Zimbabwe, where wetlands targeted for agricultural expansion under poverty alleviation programmes experienced degradation (Mahlatini et al., 2020; Materu et al., 2018). Wood et al (2025) discuss the policy tension between conservation and livelihood development in wetlands and call for the need to balance wetland protection and local needs, preventing a strong ‘conservationist perspective’, which has affected promotion of multiple wetlands uses. This demonstrates that absence of policy direction in wetland use continues to be a driver of wetland degradation.

4.1.5. Climate Change

Climate change has increased the frequency of droughts, floods and dry spells, leading to the drying of wetlands and water stress (Chiotha et al., 2017). This has caused wetland degradation and the loss of critical ecosystem services, undermining nutrient cycling and hydrological regulation, which are essential for agriculture and fishing (Makwinja et al., 2024). Droughts have reduced water volumes or caused complete drying of wetlands; for instance, Lake Chilwa Wetland has dried up on several occasions (Kafumbata et al., 2014). Similarly, high evapotranspiration rates have been reported at Elephant Marsh (Makwinja et al., 2024).

Reduced hydrological flow in wetlands negatively affects crop and fish production, thereby impacting the livelihoods of local communities (Kafumbata et al., 2014). As a coping mechanism to climate induced droughts, communities often cultivate along the edges of wetland basins in search of residual moisture (Branch, 2016). This practice leads to siltation, agro-pollution, sedimentation and loss of wetland marshes, thereby further degrading the wetland and reducing ecosystem services (Makwinja et al., 2024).

Although wetlands are considered an adaptation option in Malawi, (Jørstad and Webersik, 2016) emphasize the need to identify additional adaptation strategies, as wetlands are increasingly threatened by climate change, making them unpredictable and unreliable. Communities that depend on wetlands for climate change adaptation are particularly affected by wetland degradation (Chiotha et al., 2017; Jørstad and Webersik, 2016), highlighting the need for multiple, complementary adaptation options and

recognition that climate change is a driver of wetland degradation.

4.1.6. Commercial Agriculture

Commercial farming operations are emerging as localized but significant drivers of wetland degradation

(Brown et al., 2022). In the Elephant Marsh, the proximity of the Illovo Sugar Plantations poses risks of agrochemical runoff, though direct impacts are yet to be documented (Branch, 2016). Pressures from the use of heavy machinery and land clearance threatens indigenous vegetation and disrupts natural wetland functions (Brown et al., 2022; Mvula and Haller, 2009). Moreover, employment opportunities associated with commercial agriculture attract migrants, leading to local population increases, which in turn place additional pressure on nearby wetlands such as Lake Chilwa and the Elephant Marsh (Branch, 2016).

4.1.7. Invasive Alien Species

While not identified here as a leading driver, the spread of invasive alien species is increasingly recognised as an emerging threat to wetland ecosystems in Malawi (Branch, 2016). In the Elephant Marsh, invasive plants such as Pistia stratiotes (Water Lettuce), Azolla filiculoides (Waterfern), and Pontederia crassipes (Water Hyacinth) have been reported in abundance (Branch, 2016). These species alter habitat structure, reduce water quality, and diminish the availability of suitable habitat for birds like the pygmy goose, as well as for aquatic invertebrates and fish (Branch, 2016). In the Lake Chilwa Wetland, Prosopis Juliflora (Mesquite) and Pontederia crassipes (Water Hyacinth) obstruct sunlight penetration, inhibiting photosynthesis and reducing biodiversity (Schuyt, 2005).

4. Limitations of the Study

This review is subject to limitations. First, the search returned a small number of peer-reviewed literature on wetlands in Malawi. Secondly the geographic focus of the reviewed studies was biased toward southern Malawi, particularly Lake Chilwa and Elephant Marsh, leaving central and northern wetlands underrepresented. The small sample size means that the relative importance of key drivers (e.g. invasive species) may be underestimated. Further, important but localized pressure may have been overlooked due to geographic biases.

5. Conclusion

The literature review has identified key drivers and pressures of wetland degradation and how these are impacting wetlands values in three major wetlands in Malawi. Wetland degradation in Malawi is driven by a complex interplay of socio-economic, policy and environmental factors. High poverty levels and rapid population growth drive communities to overexploit wetland resources in pursuit of food security and livelihoods. In response to food insecurity, government has developed policies and programs to avert hunger. However, these programs have resulted in unintended negative consequences on wetlands. These human and policy pressures are further compounded by environmental factors such as climate change, which accelerates wetland drying and exacerbates resource loss. Together, these socio-economic, policy and environmental dynamics interact to reinforce the cycle of wetland degradation.

6. Recommendations

Effective wetland conservation in Malawi requires a multi-level response that addresses drivers and direct pressures. This includes development of wetland policy that recognizes the multiple use values of wetlands and the need for its conservation. Farmers in wetland areas should adopt agriculture practices that reduce the need for increasing land areas for production. They should also cultivate high value crops that increase income for rural communities. Alternative livelihoods to agriculture should be promoted in wetland communities and there should be mainstreaming of wetlands issues in public and private sector investment and development programs. Other responses should be to improve governance and enforcement of environmental regulations, integration of wetland protection into broader land-use planning and recognition of wetlands in Strategic Environmental Assessment and Cumulative Assessments. Further research is needed in underrepresented regions and on the impacts of emerging threats such as invasive alien species and climate change.

7. Declaration

The authors declare no competing interests.

References

Asselen, S.V., Verburg, P.H., Vermaat, J.E., Janse, J.H., 2013. Drivers of Wetland Conversion: a Global Meta-Analysis. PLoS ONE 8, e81292. https://doi.org/10.1371/journal.pone.0081292

Bonaccio, M., Ruggiero, E., Di Castelnuovo, A., Costanzo, S., Persichillo, M., De Curtis, A., Cerletti, C., Donati, M.B., De Gaetano, G., Iacoviello, L., Iacoviello, L., Donati, M.B., De Gaetano, G., Vermylen, J., De Paula Carrasco, I., Giampaoli, S., Spagnuolo, A., Assanelli, D., Centritto, V., Spagnuolo, P., Staniscia, D., Zito, F., Bonanni, A., Cerletti, C., De Curtis, A., Di Castelnuovo, A., Lorenzet, R., Mascioli, A., Olivieri, M., Rotilio, D., Bonaccio, M., Costanzo, S., Gianfagna, F., Giacci, M., Padulo, A., Petraroia,

D., Magnacca, S., Marracino, F., Spinelli, M., Silvestri, C., dell'Elba, G., Grippi, C., De Lucia, F., Vohnout, B., Zito, F., Persichillo, M., Verna, A., Di Lillo, M., Di Stefano, I., Pampuch, A., Pannichella, A., Vizzarri, A.R., Arcari, A., Barbato, D., Bracone, F.,

Di Giorgio, C., Panebianco, S., Chiovitti, A., Caccamo, S., Caruso, V., Rago, L., Cugino, D., Ferri, A., Castaldi, C., Mignogna, M., Guszcz, T., Di Giuseppe, R., Barisciano, P., Buonaccorsi, L., Centritto, F., Cutrone, A., Fanelli, F., Santimone, I., Sciarretta, A., Sorella, I., Plescia, E., Molinaro, A., Cavone, C., Galuppo, G., D'Angelo, D., Ramacciato, R., 2017. Fish intake is associated with lower cardiovascular risk in a Mediterranean population: Prospective results from the Moli-sani study. Nutrition, Metabolism and Cardiovascular Diseases 27, 865–873. https://doi.org/10.1016/j.numecd.2017.08.004

Branch, W.R., 2016. Climate Resilient Livelihoods and Sustainable Natural Resource Management in The Elephant Marsh, Malawi: Biodiversity of the Elephant Marsh: Herpetofauna. https://doi.org/10.13140/RG.2.1.3926.6803

Brown, C., Joubert, A., Turpie, J., Reinecke, K., Birkhead, A., Forsythe, K., Davies, T., Mgoola, W., Nyirenda, J., Arthur, R., 2022. The Elephant Marsh, Malawi – Part 3: the application of an eco-social model to assess options for managing ecological status. African Journal of Aquatic Science 47, 405–420. https://doi.org/10.2989/16085914.2022.2044750

Chiotha, S., Jamu, D., Nagoli, J., Likongwe, P., Chanyenga, T., 2018. Socio-Ecological Resilience to Climate Change in a Fragile Ecosystem: The Case of the Lake Chilwa Basin, Malawi, 1st ed. Routledge. https://doi.org/10.4324/9781351057103

Chiotha, S., Likongwe, P.J., Sagona, W., Mphepo, G.Y., Likoswe, M., Tsirizeni, M.D., Chijere, A., 2017. LAKE CHILWA BASIN CLIMATE CHANGE ADAPTATION PROGRAMME IMPACT: 2010 – 2017.

Convention on Wetlands, Robertson, H., Fennessy, S., Hilton, G., Job, N., Kumar, R., Simpson, M., Aggestam, F., Aldred, M., Chacón, A., Costanza, R., Davidson, N., Field, C., Finlayson, C.M., Gandra, F., Gillis, L.G., Hernández-Blanco, M., Moritsch, M., Thornton, S., Wood, K., Van 'T Hoff, V., 2025. Global Wetland Outlook 2025: Valuing, conserving, restoring and financing wetlands. Convention on Wetlands. https://doi.org/10.69556/GWO-2025-eng

Development Projects : Shire Valley Transformation Program - Phase 1 - P158805 [WWW Document], n.d. URL https://projects.worldbank.org/en/projects-operations/project-detail/P158805 (accessed 3.7.24).

Dzoga, M., Simatele, D.M., Munga, C., Yonge, S., 2020. Application of the DPSIR Framework to Coastal and Marine Fisheries Management in Kenya. Ocean Sci. J. 55, 193–201. https://doi.org/10.1007/s12601-020-0013-y

Fatorić, S., Seekamp, E., 2017. Are cultural heritage and resources threatened by climate change? A systematic literature review. Climatic Change 142, 227–254. https://doi.org/10.1007/s10584-017-1929-9

Forsythe, K., Turpie, J., 2016. Climate Resilient Livelihoods and Sustainable Natural Resource Management in The Elephant Marsh, Malawi.

Government of Malawi, 2018. 2018 Population and Housing Census Preliminary Report.

Haddaway, N.R., Bayliss, H.R., 2015. Shades of grey: Two forms of grey literature important for reviews in conservation. Biological Conservation 191, 827–829. https://doi.org/10.1016/j.biocon.2015.08.018

Holland, I., DeVille, N.V., 2021. Measuring Nature Contact: A Narrative Review. Int. J. Environ. Res. Public Health.

Jørstad, H., Webersik, C., 2016. Vulnerability to climate change and adaptation strategies of local communities in Malawi: experiences of women fish-processing groups in the Lake Chilwa Basin. Earth Syst. Dynam. 7, 977–989. https://doi.org/10.5194/esd-7-977-2016

Kafumbata, D., Jamu, D., Chiotha, S., 2014. Riparian ecosystem resilience and livelihood strategies under test: lessons from Lake Chilwa in Malawi and other lakes in Africa. Phil. Trans. R. Soc. B 369, 20130052. https://doi.org/10.1098/rstb.2013.0052

Kakuru, W., Turyahabwe, N., Mugisha, J., 2013. Total Economic Value of Wetlands Products and Services in Uganda. The Scientific World Journal 2013, 1–13. https://doi.org/10.1155/2013/192656

Koko, I.A., Misana, S.B., Kessler, A., Fleskens, L., 2020. Valuing ecosystem services: stakeholders' perceptions and monetary values of ecosystem services in the Kilombero wetland of Tanzania. Ecosystems and People 16, 411–426. https://doi.org/10.1080/26395916.2020.1847198

Kosamu, I., 2014. Conditions for Sustainability of the Elephant Marsh Fishery in Malawi. Sustainability 6, 4010–4027. https://doi.org/10.3390/su6074010

Kosamu, I., De Groot, W., Kambewa, P., De Snoo, G., 2012. Institutions and Ecosystem-Based Development Potentials of the Elephant Marsh, Malawi. Sustainability 4, 3326–3345. https://doi.org/10.3390/su4123326

Kundu, S., Kundu, B., Rana, N.K., Mahato, S., 2024. Wetland degradation and its impacts on livelihoods and sustainable development goals: An overview. Sustainable Production and Consumption 48, 419–434. https://doi.org/10.1016/j.spc.2024.05.024

Machira, K., Mgomezulu, W.R., Malata, M., 2023. Understanding poverty dimensions and transitions in Malawi: A panel data approach. Research in Globalization 7, 100160. https://doi.org/10.1016/j.resglo.2023.100160

Mahlatini, P., Hove, A., Maguma, L.F., Chemura, A., 2020. Using Direct Use Values for Economic Valuation of Wetland Ecosystem Services: A Case of Songore Wetland, Zimbabwe. GeoJournal 85, 41–51. https://doi.org/10.1007/s10708-018-9947-3

Makwinja, R., Curtis, C.J., Tesfamichael, S.G., 2024. Vulnerability of Ecosystem Services and Functions of Elephant Marsh, Malawi, to Land Use and Land Cover Change. Wetlands 44, 102. https://doi.org/10.1007/s13157-024-01860-1

Manda, L., Salako, K.V., Kataya, A., Affossogbe, S.A.T., Njera, D., Mgoola, W.O., Assogbadjo, A.E., Sinsin, B., 2023. Co-management brings hope for effective biodiversity conservation and socio-economic development in Vwaza Marsh Wildlife Reserve in Malawi. Front. Conserv. Sci. 4, 1124142. https://doi.org/10.3389/fcosc.2023.1124142

Materu, S.F., Urban, B., Heise, S., 2018. A critical review of policies and legislation protecting Tanzanian wetlands. Ecosyst Health Sustain 4, 310–320. https://doi.org/10.1080/20964129.2018.1549510

Mvula, P.M., Haller, T., 2009. Common pool resource management in Lake Chilwa, Malawi: a wetland under pressure. Development Southern Africa 26, 539–553. https://doi.org/10.1080/03768350903181332

Ojala, M., Cunsolo, A., Ogunbode, C.A., Middleton, J., 2021. Anxiety, Worry, and Grief in a Time of Environmental and Climate Crisis: A Narrative Review. Annu. Rev. Environ. Resour. 46, 35–58. https://doi.org/10.1146/annurev-environ-012220-022716

Pappas, C., Williams, I., 2011. Grey Literature: Its Emerging Importance. Journal of Hospital Librarianship 11, 228–234. https://doi.org/10.1080/15323269.2011.587100

Pautasso, M., 2019. The Structure and Conduct of a Narrative Literature Review, in: Shoja, M., Arynchyna, A., Loukas, M., D'Antoni, A.V., Buerger, S.M., Karl, M., Tubbs, R.S. (Eds.), A Guide to the Scientific Career. Wiley, pp. 299–310. https://doi.org/10.1002/9781118907283.ch31

Pullin, A., 2016. Selecting appropriate methods of knowledge synthesis to inform biodiversity policy. Biodivers Conserv.

Schuyt, K.D., 2005. Economic consequences of wetland degradation for local populations in Africa. Ecological Economics 53, 177–190. https://doi.org/10.1016/j.ecolecon.2004.08.003

Terer, T., Ndiritu, G.G., Gichuki, N.N., 2004. Socio-economic values and traditional strategies of managing wetland resources in Lower Tana River, Kenya. Hydrobiologia 527, 3–15. https://doi.org/10.1023/B:HYDR.0000043332.96368.c5

Wood, A., 2011. Enhancing sustainable Agriculture-Wetland Interactions in the small inland wetland systems of Malawi.

Wood, A., Thawe, P., Snell, M., 2025. Analysing wetland enterprise in northern Malawi using a modified community capitals framework: the case of garlic farming. Journal of Rural Studies 119, 103780. https://doi.org/10.1016/j.jrurstud.2025.103780

Xu, T., Weng, B., Yan, D., Wang, K., Li, X., Bi, W., Li, M., Cheng, X., Liu, Y., 2019. Wetlands of International Importance: Status, Threats, and Future Protection. IJERPH 16, 1818. https://doi.org/10.3390/ijerph16101818