

The role of golf courses in climate change adaptation through enhancing vegetation and forest cover in arid and semi-arid lands, Kenya

Benjamin Yatich Kiprop^{1*}

Lilian Macharia²

Stephen Mailu³

^{1*}bykiprop@gmail.com

^{1,2,3}National Defence University, Kenya

<https://doi.org/10.51867/ajernet.6.2.60>

Submitted: 15th May 2025; Accepted: 26th May 2025; Published: 16th June 2025

ABSTRACT

This study focuses on the possibility of using golf as an avenue for climate change adaptation in arid and semi-arid lands (ASAL) of Kenya. These regions are highly exposed to environmental problems such as water scarcity, soil degradation, and deforestation, among others, due to climate change. This study sought to find out how golf courses as managed green spaces could provide adaptation possibilities, particularly in the strategies of vegetation and tree cover maintenance. The study was guided by the Green Theory which was postulated by Robert E. Goodin. The study used an exploratory research design. The target population included local community members, golf players, caddies, climate change experts, and national and county government officials within sports and the environment. The study used stratified purposive sampling to ensure adequate representation from different sub-groups within the target population. Emphasis was given to what the vegetation of golf courses can contribute to the increase of the forest, which in turn could replace the loss of forest areas and support native species. The quantitative data obtained from the Likert scale questionnaires were analysed through statistical methods with the help of the Statistical Package for the Social Sciences (SPSS); the presentation was in descriptive statistics, such as frequency. Qualitative data gathered from in-depth interviews were transcribed and coded, then thematically analysed with the help of NVivo software. This analysis facilitated the identification of key themes and patterns. The findings suggest that golf courses help increase forested cover by planting local trees, reducing desertification and creating microclimates that help various species thrive. The study concludes that integrating golf courses in climate adaptation strategies is a unique and underutilised method for conserving the environment in ASAL counties. Golf courses demonstrate that sports infrastructure can be used for sustainable land use and help with climate resilience. However, maximising their impact requires a multi-sectoral approach involving policymakers, environmental agencies, and local communities. Key recommendations were to involve giving incentives to golf courses that follow sustainable practices, including golf course management in community land use plans and raising public awareness about the environmental advantages of golf. It is important to build stronger partnerships between golf clubs and local governments to promote knowledge transfer and capacity-building for sustainable water and vegetation management.

Keywords: Arid and Semi-Arid Lands (ASAL), Climate Change Adaptation, Forest Cover, Golf Courses, Vegetation Cover

I. INTRODUCTION

Climate change is one of the most pressing issues of the 21st century, affecting ecosystems, economies, and societies worldwide. The Paris Agreement signed in 2015, provides an international climate change mitigation framework that is aimed at preventing global warming from rising above 2 °C above pre-industrial levels (United Nations Framework Convention on Climate Change, 2015). In order to achieve this, countries have pledged to develop their own Nationally Determined Contribution which are the specific plans on how they intend to address climate change. The NDCs are crucial in the fight against climate change, as they outline each country's strategy to reduce greenhouse gas emissions and enhance climate resilience. These commitments vary from country to country, reflecting national circumstances, capacities, and development priorities. While some nations focus on transitioning to renewable energy, others emphasize afforestation, energy efficiency, or adaptation measure.

Sports have long been recognized as a powerful tool for social change, uniting people across different backgrounds and fostering a sense of unity. Recently, there has been a growing interest in the relationship between sports and environmental sustainability, where different sports associations and events have started implementing measures to lessen their impact on the environment and advocate for climate change adaptation. Sports as a global industry are known to have a large environmental footprint. The sector is involved in the emission of greenhouse gases through transport, energy used in the sporting facilities, and the manufacturing of sporting equipment (Bekken &

Soldat, 2021). But at the same time, sports have the potential of increasing the awareness of the public and policy-makers on environmental problems, of encouraging environmentally friendly behaviors among fans and athletes, and of shaping the formulation and implementation of policies to minimize negative impacts of human activities on the environment.

As a result, many international sports organizations have gradually started to embrace their role in combating climate change. For example, the International Olympic Committee (IOC) has set its goal at lowering CO₂ emissions by 45% till 2030, and become climate neutral by 2024. In the same regard, Federation Internationale de Football Association (FIFA) has committed to the 2026 World Cup being the tournament with no carbon footprint while being on the process of having a clear strategic plan to address emissions in all aspects of FIFA's business (FIFA, 2021). These commitments suggest an increasing understanding of the sports fraternity of the importance of sports fun as well as the responsibility of environmental conservation.

Golf specifically has come under much criticism because of the huge land use, water, and chemical requirements for course management. However, the sport has also seen a great advancement in sustainability measures within the recent past (Hauschel, 2018). The Golf Environment Organization (GEO) Foundation has put in place sustainability guidelines for golf courses and tournaments to ensure that they only exploit the resources in a sustainable manner while also preserving the bio-diversity (Millington *et al.*, 2018). These guidelines are meant to make sure that the golf courses have a responsible and sustainable usage of resources as well as the conservation of the biological diversity and the natural setting (Millington, Darnell & Millington, 2018). This change of approach is in line with a growing awareness among the golfing fraternity of the detrimental effects that it has been having on the environment.

Golf in Kenya started in the colonial time with the first golf course built in Nairobi in 1906. Currently, there are over 40 golf courses in Kenya that are used by locals as well as foreign players (Mungai, 2014). The Kenya Golf Union was formed in 1928 and is the governing body of golf in the country responsible for the growth of the game. Kenyan golf courses are not without their environmental problems such as water issues, soil erosion, and the issue of preserving wildlife while maintaining the golf courses (Kariuki *et al.*, 2013). However, they also offer possibilities for the incorporation of sustainable practices and support for the country's climate change mitigation plans.

A number of golf courses in Kenya have already embarked on the process of adopting sustainability. For instance, Vipingo Ridge golf resort located in Kilifi county in the Kenyan coast has adopted various environmentally friendly measures such as using of drought resistant grass species and efficient irrigation systems in the water management. In addition to its water conservation efforts, Vipingo Ridge is also considering other sustainable practices such as using organic manure and pest control that do not harm the environment (Africa Waste and Environment Management Centre [AWEMAC], 2022). In these endeavours, Vipingo Ridge is providing a good model for other golf courses in Kenya, showing that it is possible to engage in this sport and at the same time conserve the environment.

Furthermore, the economic aspect of golf course offers an opportunity for diversification in ASAL counties since most of the counties have scarce and limited opportunities for sustainable income. Hence, through implementing the concept of environmental sustainability in golf course design and management, these facilities can potentially attract the 'green' tourists and golfers who are concerned with the environment, as such will lead to job creation and revenue generation for the local communities (Juma & Khademi-Vidra, 2019).

1.1 Statement of the Problem

Climate change is a major threat to human security especially in Arid and Semi-Arid Lands (ASAL) counties in Kenya, as it compounds existing vulnerabilities and creates new threats. The effects of climate change such as droughts, floods and other extreme weather conditions have resulted to scarcity of resources such as water and arable land, thus increasing competition and conflict among the communities (van Baalen & Mobjörk, 2018). This climate-induced insecurity has affected livelihoods, displaced people and put a lot of pressure on social relations in these areas hence the need for effective adaptation strategies (Dramé, 2024). Combating climate change and its effects on security in ASAL regions is vital for the development and stability of Kenya. Although various adaptation measures have been implemented, innovative approaches that leverage existing infrastructure and practices that enhance resilience and promote sustainable resource management are required. In this regard, sports facilities especially golf courses present an unexplored avenue for climate change adaptation in ASAL counties.

Golf courses, with their extensive green spaces and water management systems, offer potential solutions to some of the environmental challenges faced by ASAL regions (Hauschel, 2018). The measures used in the maintenance of the golf courses like efficient water usage in irrigation, water conserving landscaping and sustainable water usage in the maintenance of the turf could be utilized to solve water rationing and land deterioration problems in the surrounding communities (Drake *et al.*, 2023). Furthermore, golf clubs often have access to resources and

expertise that could be leveraged to implement broader environmental conservation initiatives and community outreach programs.

Nevertheless, there is significant research gap on the role of sports facilities like golf courses in promoting climate change adaptation in ASALs. Although there is literature on the environmental effects of golf courses in different settings, there is limited research on the contribution of these courses in building the resilience to climate change in water scarce regions such as the ASAL counties in Kenya.

1.2 Research Objectives

The general objective of the study is to examine the role of vegetation and tree cover in golf course in increasing the forest cover in ASAL counties in Kenya

II. LITERATURE REVIEW

2.1 Theoretical Review

2.1.1 Green Theory

This study will be based on Green Theory. The Green Theory was coined by Robert E. Goodin in 1992. It recognizes that climate change is the dominant environmental issue of this age which is caused by reliance on fossil fuels. It takes the perspective that climate change is a direct consequence of human collective activities (Goodin, 1992).

Green theory is based on key tenets. First, it emphasizes the intrinsic value of nature and the interconnectedness of all living beings, rejecting the anthropocentric view that nature exists solely for human use. Second, it supports the concept of sustainable development and the proper relationship between man and the environment. Third, Green Theory supports social and environmental justice because environmental problems primarily affect vulnerable populations. Fourth, it requires a radical transformation of social, economic and political relations to respond to ecological crises (Ari & Gökpınar, 2019).

Green theory can be useful in examining Golf courses as an avenue of climate change adaptation in ASAL counties in Kenya. The focus of the theory on sustainability supports the aim of adjusting the sports infrastructure and practice to new climate conditions. Golf courses which are known to their greenery, with water, vegetation cover and proper soil erosion control can be seen from green theory perspective an area where sustainability can be practiced and environmental consciousness can be encouraged and replicated to the surrounding environment. (Wheeler & Nauright, 2006).

Additionally, Green theory emphasizes the symbiotic relationships in ecosystems may be useful for the development and maintenance of golf courses in ASAL areas, including the use of indigenous plant species, efficient water use and environmentally friendly maintenance practices. Furthermore, the theory emphasizes on social justice which can be applied to how the development of golf clubs in ASAL areas must be in the best interest of the people inhabiting those areas and not a way of worsening their plight (Millington & Wilson, 2016).

However, Green Theory is not without its criticism, critics argue that the theory is idealistic and unpractical for implementation especially in developing countries which are struggling with numerous economic problems. They also argue that the theory is unattainable because it calls for a complete redesign of the current systems, while others have argued that it is possible to make gradual changes within the current systems (Humphrey, 2013). Moreover, critics argue that Green Theory may fail to capture the challenges that are associated with the preservation of the environment and the promotion of economic growth especially in ASAL counties where the scarcity of resources is a significant problem. Despite these criticism, Green Theory is still useful in understanding golf courses as an avenue for climate change adaptation in ASAL counties. Its approach is more integrative than most environmental theories, giving a framework for approaching the complex problem of climate change adaptation through sports facilities like the golf courses.

2.2 Empirical Review

2.2.1 Vegetation and Tree Cover in Sports facilities

Traditionally, sports facilities have been viewed as huge consumers of land and resources, recent studies highlight how vegetation and tree cover can assist urban greening, biodiversity conservation and climate adaptation. Sports facilities in many countries are being designed or retrofitted with sustainable landscaping using native plants and trees to increase ecological value. For example, tree cover within stadiums and sports complexes can offer a natural wind barrier, reduce heat, and increase air quality by absorbing carbon dioxide and releasing oxygen (Zeng, 2021). Sports facilities with significant vegetation are particularly important in urban areas in reducing the urban heat island effect, particularly as global temperatures rise.

Nguyen *et al.* (2020) in their article 'Vegetation trends associated with urban development' state that linking nature to recreational areas could be useful and play a huge role in ensuring ecological integrity. For instance, the authors state that the maintenance of Hyde Park in London has incorporated many features such as sports fields, play areas, and dense tree coverage. The Park is home to native animals and plant varieties and natural elements of the area that boost the ecological scenery. This has in turn resulted in improved bird and insect activities as well as air quality within the region. The authors conclude that this method of application on sports facilities opens up a possibility to meet the people's needs for recreation while addressing the question of ecological restoration, proving that sustainable development and city' construction cannot and should not be implemented separately.

Gregory *et al.* (2022) in their research 'Ecological functions and human benefits of urban forests', analyses the Central Park in New York City and describe how it has integrated sports fields with woodlands and water bodies. The authors argue that this integration has improved the park's function as a habitat for migratory birds and other wildlife that inhabit the area. He also noted that through the planting of different species of vegetation such as indigenous trees and shrubs, the health of soil in the park as well as the urban biodiversity has improved. Gregory concludes that incorporating natural elements like woodlands, water bodies, and Indigenous vegetation into urban sports fields can significantly enhance both ecological functions and human benefits.

Croeser *et al.* (2020) in their study 'Sustainable Cities', argues that the Sydney Olympic Park in Australia has sports fields integrated with large-scale revegetation and wildlife strips. The authors add that It incorporates native plant species, wetland and bushland that provide for both recreation and wildlife sustenance as well as boosting forest cover in the park. Creative approaches such as integrating ecological practices with sports facility design and construction have the potential to enhance the quality of the urban environment by increasing biological diversity, reducing pollutant load in water and preventing heat islands according to Gordon and White. The authors believe that this case is illustrative of the capability of sports facilities to be developed with the double advantage of ecological and recreational value.

Lonsdorf *et al.* (2021) in their article 'Landscape and Urban Planning', discusses the application of green infrastructure within the USA, and the utilization of the Millennium Park in Chicago as a case study. According to the research findings, green infrastructure aspects are incorporated into the park's sports and recreation facilities. Speaking of the amenities, green roofs or walls, native plantings, and water management has not only improved the park's ornamental value but also ensured the creation of the pollinators' and birds' habitats. Thus, the authors conclude that that the park design enhances the forest cover and the overall urban ecology; thus, perfection of the integration of the sports facility with green facilities to serve the broader ecological agenda.

Yang *et al.* (2021) in their research 'Journal of environmental management' addresses the role of forest management in urban recreation areas that include Beijing Olympic Forest Park. Their studies demonstrate that such areas have been successfully reclaimed and adapted for purposes of recreation that include planting trees and the provision of habitats. The Park comprises sporting amenities that are surrounded by other features such as reforested land making it have better ecological conditions. The authors conclude that such integrations with forest management concepts can be applied to improve urban sports facilities and offer recreational value for citizens and environmental quality to boost local species.

Abua *et al.* (2023) in their research, 'Sustainability', discusses sustainable land use management within urban Africa with particular reference to sports facilities. As an example of the inclusion of ecological components in recreational places, he uses Lekki Leisure Lake found in Lagos Nigeria. The authors discuss, how this lake has implemented local trees and greens that have improved the ecological surroundings of the area. The authors argue that this project has led to better water quality as well as the provision of suitable wildlife habitats to these Oregonians, thus showing how the non-urban leisure facilities in African cities can play a positive role in environmental management.

Puplampu and Bofo (2021) in their research 'Environmental Challenges', explores the function of urban green amenity spaces in delivering ecosystem service in West Africa using Accra Sports Stadium in Ghana. Their research shows the extent to which the management of the stadium incorporates ecological stances. The authors add that the management attempts to enhance tree cover and cover the structure with ecological features. Native plantings and green corridors have increased both the biological and perceptual quality of the habitats available in and around the stadium. The authors conclude that such efforts have enhanced local forest cover as well as serving other beneficial ecological services like temperature control and air filtration, opening the way to how sports facilities in West Africa could help undertake environmental and conservation objectives.

Dietz *et al.* (2023) in their research 'Land use policy', investigates reforestation of recreation grounds in Sub-Saharan Africa. The authors draw focus to Lusaka National Park in Zambia; the locations allocated for sports and recreation have been developed with consideration to ecology. Several green cover plantations in the park and the construction of habitat have enhanced the level of forest cover and the overall level of biodiversity. The authors

recommend that converting the sports facility design into a reforestation project can establish multiple-use recreational zones and show the potential of the sports facilities regarding the reforestation and conservation of the arid regions.

Golf courses globally, for example, have infrastructures, staff, and equipment that could easily be used for vegetation management. They offer an environment in which the growth of trees and vegetation can be predetermined to produce the desired results as far as ecology is concerned. Further, since the operations of the golf courses bring in revenues, the same revenues can be utilized to maintain and preserve natural resources. Colding and Folke (2019) conducted research on how biodiversity was supported in golf courses and reforested areas in a temperate zone and showed that even though species richness was significantly higher in the reforested areas, certain valuable species were also supported in well-managed golf courses. This implies that other forms of vegetation, such as golf courses, can assist conventional reforestation strategies by offering varied ecological niches to differing species.

In Kenya, golf courses are known for their prospect of participating in the community and increasing awareness. Golf Clubs such as the Muthaiga Golf Club have been used as a means of launching the environmental conservation campaign and, in the process, educating the golf enthusiasts and the society at large. This social component is not always as similar to the more conventional reforestation initiatives, which could contain significantly less exposure and utilization by the public (Grillotti Di Giacomo *et al.*, 2021). But, at the same time, it is crucial to note that one must not be over-enthusiastic about golf courses as instruments for raising the density of trees. Most of the golf courses are used for leisure, and their environmental benefits usually follow as a bonus. Nevertheless, this kind of treatment to create or maintain a surface that is playable requires considerable inputs that, at times, may harm ecological interests, mainly where the inputs used are chemical fertilizers and or pesticides. Also, the positional design of landscapes such as golf courses is sometimes not friendly to the biological needs of some species, thus making them poor conservation areas.

The opportunities for vegetation management arise from the fact that golf courses require large and controlled areas of grass, which can significantly help in raising the forested area. Several studies have looked into the feasibility of having golf courses integrated into multifunctioning ecological systems that can promote the presence of various species and increase green infrastructure. For example, Petrosillo *et al.* (2019) posed an important question on whether a golf course land can sustain biodiversity and ecosystem services. A review of 239 papers from academic library databases revealed that Golf courses have influenced water and soil negativity but positively influenced species richness, ecological functions, and tourism, predominantly in urban environments.

In addition, one of the most targeted aims of vegetation management on concern golf courses is the liberalization of native plant species. In the authors' opinion, the management practices have emphasized such aspects as soils, biological diversity, ecosystem services, water quality, and quantity and have provided specific good practices for amphibians, birds, turtles, and bee species. Local species are generally produced healthier and result in less water and chemical usage than exotic species. They also benefit the native animals by offering them roosting and nesting places and food, which keep the wildlife diversity afloat. Tanner and Gange (2018) observed that golf courses with large proportions of native vegetation are home to more diverse insects and birds than those containing non-native plants.

Another area of focus in vegetation management is the establishment of trees and shrubs to provide micro-habitats and wildlife travel ways. This, at the same time, serves to increase the general biodiversity and the connectivity in split habitats of different landscapes. In their study, Nguyen *et al.* (2020) established that vegetation corridors in golf courses are suitable for the conservation of native species, especially in the urban and peri-urban regions. More importantly, more tree cover in golf courses has consequences for microclimate control and wildlife promotion in the respective areas. Trees are highly beneficial for moderating microclimates by reducing levels of direct radiation, decreasing wind flow, and being able to impact humidity. In this respect, such effects may generate more beneficial circumstances for people and animals in areas of high temperatures. In the recent work of Nguyen *et al.* (2022), the authors analyzed the cooling role of tree cover on golf courses in urban scenarios and concluded that the golf course areas with higher tree canopy cover recorded lower surface temperatures compared with open grassy fields. This cooling effect can be especially helpful in Arid and Semi-Arid Lands (ASAL), where ASAL conditions are characterized by predominantly high temperatures and water limitation.

III. METHODOLOGY

This study used an exploratory research design and combined both quantitative and qualitative research approach. Given that this is relatively new topic and not many studies have been done in this area, the exploratory research design was the right fit (Creswell & Creswell, 2018). Through exploration, the study aimed to uncover new insights of golf courses as a unique avenue to increase forest and vegetation cover which could help with climate change adaptation in ASAL areas

The target population that the study used included golf club management, local community members, golf players and caddies within the selected golf courses in ASAL counties, this was due to their deep knowledge of golf courses especially the greening aspect of it. In addition to those the study also targeted national and county government officials especially those from Ministry of environment as well as a few experts in climate change adaptation and sports development as their insights on the feasibility of using golf courses as an avenue for climate change adaptation was very key. To ensure adequate representation of the different sub groups within the target population, the study used stratified purposive sampling. The study used William Cochran's formula which considers a population of 10,000 with a 10% margin of error.

The Cochran's formula is:

$$n = (Z^2pq)/e^2$$

Where:

$Z = 1.96$ (for 95% confidence level)

$p = 0.5$ (maximum variability)

$q = 1 - p = 0.5$

$e = 0.10$ (10% margin of error)

$N = 10,000$ (population size)

$$n = (1.96^2 \times 0.5 \times 0.5) / (0.10^2)$$

$$n = (3.8416 \times 0.25) / 0.01$$

$$n = 0.9604 / 0.01 \quad n = 96.04$$

$$n = n / (1 + (n-1)/N)$$

$$n_{\text{adjusted}} = 96.04 / (1 + (96.04-1)/10,000)$$

$$n_{\text{adjusted}} = 96.04 / 1.0095$$

$$n_{\text{adjusted}} \approx 96 \text{ respondents}$$

Of the 96, 67 respondents are for questionnaire whereas 29 respondents are Key informants

For data analysis, the study analysed both qualitative and quantitative data, to begin with, the data underwent proper cleaning. Then the data collected through close ended questionnaire using likert scale questions were processed and analysed in quantitative format through the use of statistical methods using the Statistical Package for the Social Sciences (SPSS). Analysis gave percentages and frequency as descriptive statistics. The data was presented in tables and graphs so it would be clear and easy to visualize and show the trends and patterns.

Qualitative data on the other the interviews were transcribed, coded and analyzed by themes using the NVivo software. By conducting this analysis, the key ideas and trends relating to the objectives were found. The analyzed qualitative findings were discussed thematically using narrative descriptions, which was supported by direct verbatim quotes from participants. This enriched the study by adding the perspectives of the respondents. With qualitative and quantitative approaches together, this study showed a full and complete view of how golf clubs help with adapting to climate change in Kenya's ASAL areas.

IV. FINDINGS & DISCUSSION

Climate change has exacerbated challenges such as deforestation, water scarcity and land degradation, hence integrating golf courses as avenues for sustainable land management strategies is a unique opportunity. This study investigates how golf courses can help increase vegetation and forest cover, making ASAL regions resilient against climate change. The study's findings in line with the objective points to the major contribution golf courses can make to climate change adaptation in Kenya's ASALs. The study looks at how the vegetation in golf courses affects the forest cover and how this helps to protect against climate change. It covers important topics such as using local trees, controlling desertification and building microclimates that benefit the environment.

4.1 Demographic Characteristics

4.1.1 Gender Characteristics

The figure 1 below is a pie chart displaying the gender distribution and characteristics of the respondents

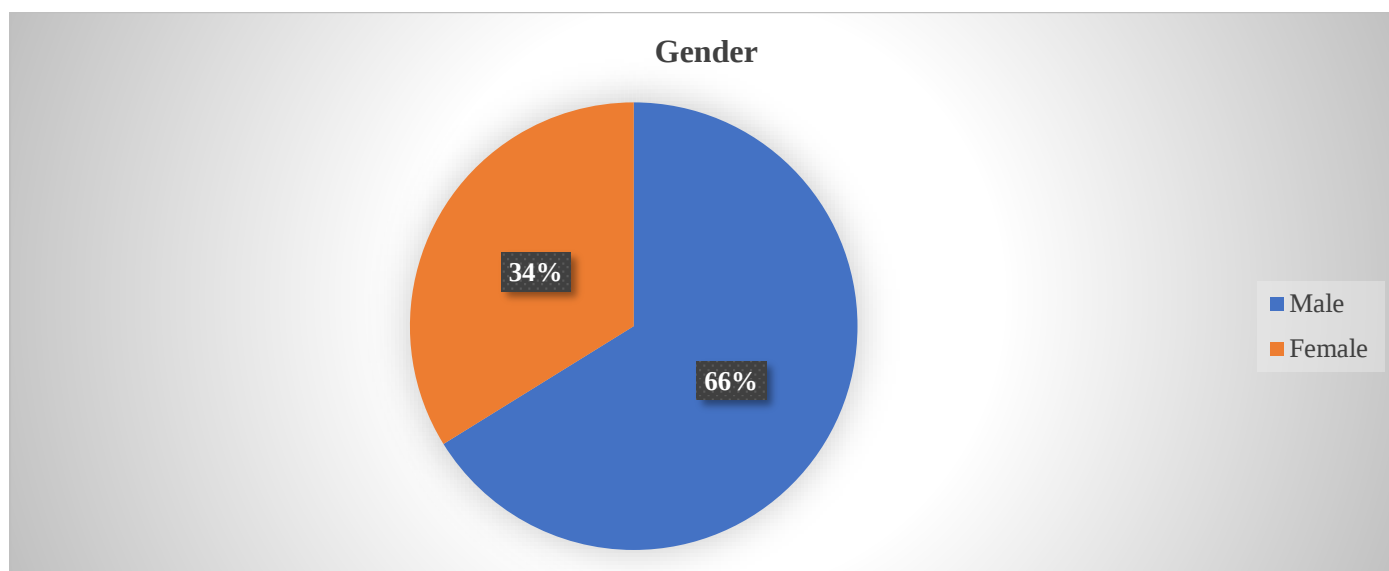


Figure 1
Gender of Respondents

The study involved 45 male participants and 23 female participants out of a total of 68 participants. The high number of male respondents corresponds to the trend of gender disparities in golf as a sports and course management in Kenya. Engaging both male and female participants means establishing a broad range of views on environmental and operational measures concerning the management of a golf course. Fewer women's voices may introduce more perceptive concerns on sustainability issues and their community engagement approaches.

4.1.2 Role/Position

Figure 2 is a horizontal bar chart displaying the distribution of the respondents in terms of their role and position.

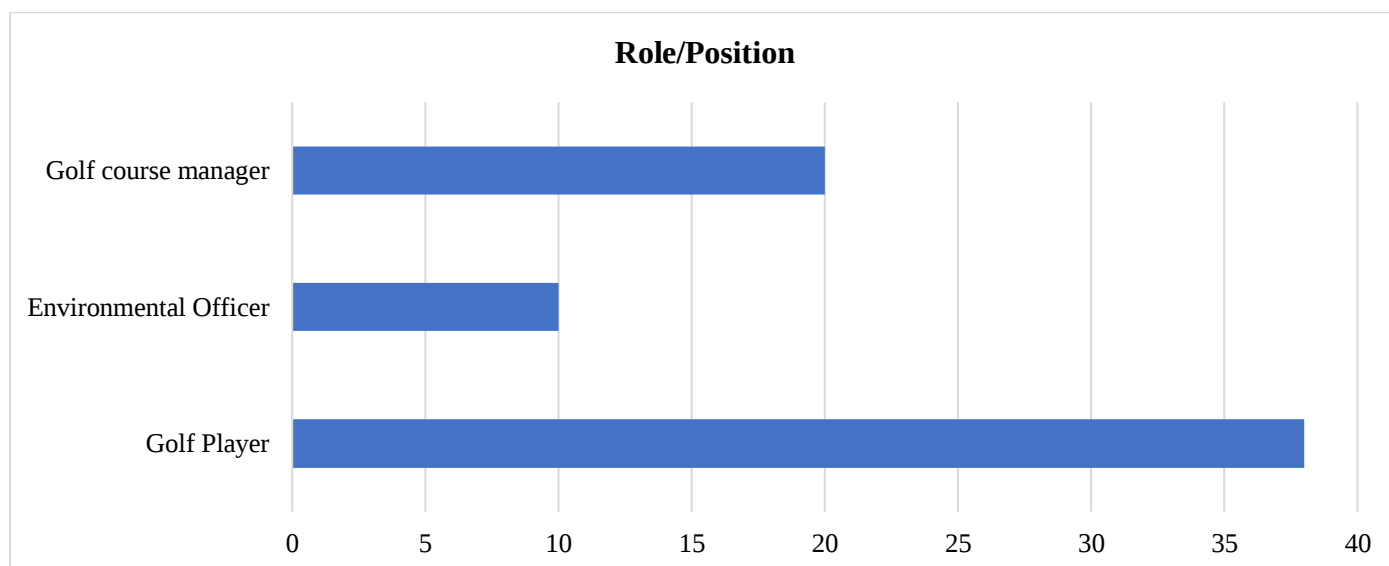


Figure 2
Role/Position of Respondents

Out of the total respondents, the majority of them were golf players 38 (55.9%), environmental officers at 10 (14.7%) and 20 (29.4%) were golf course managers. Golfers, by their very nature have useful recommendations on the physical environment of the golf courses and the effects that they may have on the play. While the environmental officers give technical knowledge on ecological sustainability and the practices to be taken into consideration, the golf course managers already have practical experience in soil, vegetation and water management. These two roles provide a perfect balance and give a broad perspective on the accommodation of the environment within the study environment.

4.1.3 Years of Experience

The pie chart below demonstrates the respondent's distribution in terms of their years of experience.

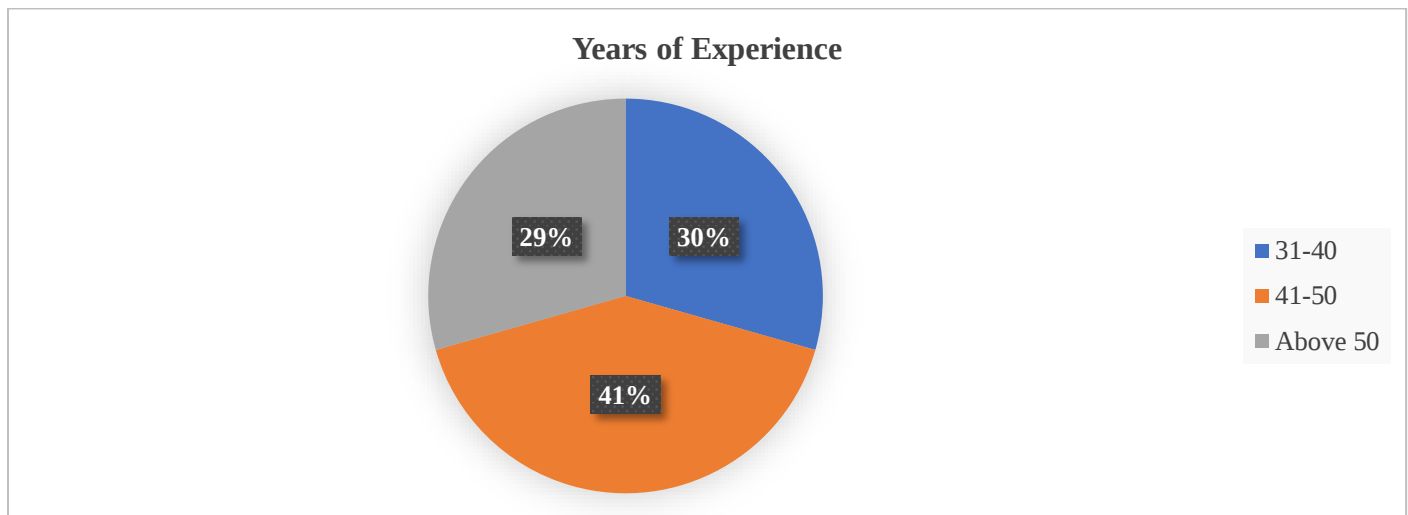


Figure 3
Years of Experience of Respondents

Of the respondents, those aged between 31-40 years constituted 30% of the sample, while those aged 41-50 years and above 50 years constituted 41% and 29%, respectively. A majority of the participants are experienced in their careers (70% are above 41 years old), thereby producing accurate responses on issues related to the impact of climate change on golf course operations and their practices. Their long-term observations are useful in analyzing the progress of environmental conservation endeavors and the usage of water and soil in the long run.

4.2 The Role of Vegetation and Tree Cover in Golf Courses in Increasing the Forest Cover in ASAL Counties in Kenya

The respondents were asked the role of vegetation and tree cover in golf courses in increasing the forest cover in ASAL counties in Kenya in a close ended Likert scale questionnaire. Table below displays Likert scale rating data on the statements assessing the role of vegetation and tree cover in golf courses from the various respondents.

Table 1

Data on the Role of Vegetation and Tree Cover in Golf Courses in Increasing the Forest Cover in ASAL Counties in Kenya.

Statement	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
The golf course has significantly increased the number of Indigenous trees in the ASAL area	9	5	3	18	15
The vegetation cover in the golf course helps reduce local temperatures and improves microclimate	9	6	5	16	14
The golf course maintains a diverse range of plant species that support local biodiversity enhancement	7	8	4	14	17
The green spaces in the golf course contribute to improved air quality and carbon sequestration	9	6	4	18	13
The golf course's vegetation provides important wildlife corridors and habitat restoration	6	9	8	16	11

From the table, it emerged that 33 respondents (66%) either agreed or strongly agreed with this statement, suggesting that golf courses have acted as a positive force, which has led to the planting of more indigenous trees in the ASAL regions. However, 14 respondents (28%) in the study disagreed or strongly disagreed with the statement, while eight respondents (6%) were neutral on the same statement.

"The golf course has significantly increased the number of indigenous trees in the ASAL area, contributing to reforestation efforts and enhancing ecological resilience. By prioritizing the planting of drought-resistant native species, the course not only restores degraded landscapes but also improves soil stability and water retention." (KII 012)

The extensive agreement reflects on the aspects presented in this study regarding the function of golf courses for tree planting and conservation, as Nguyen et al. (2020) noted that sports facilities, including golf courses, can be useful in the afforestation processes by incorporating native tree species. A number of interviews with several environmental officers revealed the effect that tree planting programs within golf courses, especially foreign ones, enhance the ecological value by planting only indigenous trees.

"The vegetation cover in the golf course helps reduce local temperatures and improves the microclimate by providing natural shade and increasing moisture retention in the soil. The presence of trees and grass lowers surface temperatures, mitigates the heat effect and enhances air quality." (KII 018)

About this statement, 30 of the respondents, or 60%, agreed or strongly agreed, thus showing increased awareness of the cooling effect of vegetation on golf courses. Conversely, only 15 respondents (30%) strongly disagreed with the statement, and five respondents (10%) had no opinion. This is in concordance with Gregory et al. (2022), arguing that vegetation such as that observed on golf courses helps to cool areas within cities, thus minimizing the effects of the urban heat island. Further, interviews with managers of the golf courses were a good way to establish that tree canopies and ground cover have a significant influence on temperature and, thus, make it possible to live or survive in the microclimate.

"The golf course maintains a diverse range of plant species that support local biodiversity enhancement by creating habitats for various flora and fauna. The mix of indigenous trees, shrubs and grasses attract pollinators, birds and small mammals, fostering a balanced ecosystem." (KII 004)

About the conservation of diverse plant species by golf courses, 31 participants (62%) agreed or strongly agreed, while 15 participants (30%) disagreed or strongly disagreed. This implies that golf courses are viewed as a habitat for immigrant species and therefore, people tend to undertake expansion activities within such areas. According to Colding & Folke (2019), properly maintained golf courses can be suitable habitats for various plant species, contributing to overall biodiversity. Some of the environmental officers who were interviewed reported that native species of plants are used in landscaping to reduce their dependence on water and improve their sustainability.

"The Green Spaces in the Golf Course Contribute to Improved Air Quality and Carbon Sequestration"

The survey results revealed that 31 (62%) respondents agreed or strongly agreed with the statement, while 15 (30%) disagreed or strongly disagreed with the same statement. Several similar papers, including Dietz et al. (2023), also show the relation between green areas and the improvement of air quality as well as carbon storage potential. Studies from interviews that were conducted gave a clue in the fact that most of the respondents living close to golf courses observed that the quality of air in the surrounding area has changed and, in most cases, it had improved through aerating vegetation within the golf courses.

"The golf course's vegetation provides important wildlife corridors and supports habitat restoration by connecting fragmented ecosystems and offering shelter for various species. The presence of indigenous trees, shrubs and grasslands creates safe passage for wildlife which can be key for climate change adaptation in ASAL." (KII 009)

Regarding this statement, 27 respondents (54%) responded either affirmative or strongly affirmative – an indication that golf courses are considered to be promoters of wildlife conservation. However, 15 respondents (30%) strongly disagreed, and another 8 respondents (16%) gave a neutral response. According to the work of Ren et al. (2022), golf courses, which have different types of trees and plants, are of huge importance for animals to move and recover habitats. Environmental officers agreed with this assertion during the interviews and commented that some of the golf courses in Kenya have been established with the objective of conserving or even rehabilitating wildlife species.

The studies suggest that golf courses in ASAL regions play a positive role in enhancing vegetation and forest cover. Most of these standpoints reflect the positive impact that these kinds of facilities have on the environment, according to most of the respondents. Golf courses can also be described as ecological resources in that, apart from their use for recreation, they provide habitats, shelter, endurance and variation of temperatures. This is in consonance with the conceptual framework of this study derived from Green Theory, which advocates for sustainability and protection of the environment. According to the literature, using vegetation management practices in golf courses could increase sustainability besides climatic change mitigation (Nguyen et al., 2020).

From the conducted interviews, valuable information concerning the aspects of ASAL counties and golf courses in relation to climate change adaptation was obtained. The informants stated that there is a need to plant tree species that naturally grow in ASAL and it should be accompanied by suitable vegetation. Identification of tree and grass species that could be grown on the soil was revealed to be another important recommendation to be implemented for sustainability.

"First, we study the terrain and test the soil. Indigenous trees are prioritized because they are more adaptable. Grass is equally important because bare land dries quickly without it." (KII 015)

This result is supported by Gregory *et al.* (2022), whereby the authors argued that incorporation of Indigenous species in the golf course environment regenerates the ecosystem and boosts environmental sustainability. In addition, Kula, from the work of Nguyen *et al.* (2020), also indicates that grass cover also aids in soil moisture retention as it also prevents soil erosion.

the findings of the study of ASAL counties on the implication of golf courses to climate change adaptation. The study established that golf courses are a massive bonus to vegetation cover and forest regeneration in as much as they afford to plant between 400 and 1,000 trees every year and only use native tree species. Green coverage assists in managing the effects of climatic change through modification of micro-climates, increasing bio-diversity and help in absorbing carbon. With regards to soil maintenance and control of erosion, golf courses employ grass cover, especially the Kikuyu grass, shrubs and man-made features like terraces. These practices have been of benefit not only to the golf course environment.

V. CONCLUSION & RECOMMENDATIONS

5.1 Conclusion

This research revealed that golf courses in ASAL counties improved and enhanced vegetation and forest cover in the region. Most golf courses have working relationships with bodies such as NCBA and KCB, whereby tree planting is carried out annually in parts or as a large-scale tree planting campaign with targets that may range between 400 and 1000 trees. According to the respondents, such measures focus on planting indigenous trees to prevent the likelihood of the ecosystem changing and the type of trees that support the complementary vegetation.

The other key factor mentioned in relation to the stability was grass cover, which was said to be essential in the virtually controlled environment. According to the informants, proper management of grass, particularly dry-land species, enables it to conserve water and prevent water at the surface from evaporating whenever the ASAL regions experience dry conditions. The research also established that golf courses analyze the soil in a bid to ascertain suitable vegetation so that plant varieties are suited for the topographical and climatic conditions of that region.

Golf courses, like other open land spaces, also have an important function of moderating the microclimatic conditions by maintaining vegetation cover. More than half of the respondents were of the opinion that golf course vegetation helps reduce temperatures around the area and improves the quality of air, besides acting as a carbon sink. Also this vegetation helps in the establishment of green wildlife passageways for the habitation of native species of animals to enhance their standard. The findings stressed the importance of the ecological value of sports facilities with vegetation density.

The study established that golf courses play a key role in the expansion of forest cover and improving vegetation in the ASAL counties. With an afforestation rate of between 400 and 1000 trees every year and focusing on native species, golf courses have emerged as important entities in afforestation activities. The research also determined that sustaining the grass cover, particularly the drought-resistant ones like Kikuyu grass, helps to prevent water runoff. This has been highlighted by the fact that apart from recreational activities, golf courses also have conservation values. It is noteworthy that the use of native vegetation and growing grass species fit the concept of sustainability and climate change resilience. These findings support the literature regarding the significance of urban and peri-urban green spaces in countering climate impacts and supporting biodiversity. The research establishes that golf courses are good adjuncts to traditional afforestation activities because they create other habitats for plant and animal species to survive.

According to the study, the cross-cutting benefits of golf courses were noted, both environmentally, socially and economically. These are carbon capture and storage, the promotion of increased biological diversity, the enhancement of public awareness and employment on environmental issues. Making a social contribution through the employment supply for neighborhood caddies and other supporting staff, golf courses create favorable economic impacts on the local economy. In addition, it was discovered that most golf courses engage stakeholders in the locality on matters concerning environmental conservation, which helped foster a sense of ownership and responsibility for the courses.

The study establishes that sports facilities, especially golf courses, can be useful in the management of climate change in ASAL counties. It becomes clear that through vegetation management, soil conservation and efficient water use in golf courses, they are geared towards building climate change resilience or promoting environmental sustainability. Therefore, there is an urgent need to acknowledge and expand the benefits of sport-based paradigms towards tackling environmental problems. Thus, the study is useful for policymakers, environmentalists and others interested in the use of recreational spaces for climatic change adaptation and sustainable development.

5.2 Recommendations

The following are proposed recommendations on how golf courses could contribute to climate change adaptation in ASAL counties. These recommendations are in line with objectives on increasing trees and vegetation

cover through sustainable tree planting, involving community through corporate responsibility to ensure golf courses can contribute to climate change adaptation.

5.2.1 Tree Cover Enhancement Plan

The study recommends a clear and practical Tree Cover Enhancement Plan should be put in place with measurable goals of the number of trees to grow within and around the golf courses. Such a plan should aim to grow indigenous and native trees that thrive in the area which can in turn help in climate change adaptation. This is because tree obstacles in and around golf courses helps achieve sustainability and also benefits the environment. Furthermore, establishing corporate partnerships to support tree planting activities and letting community-based organizations organize and maintain the trees will ensure lasting impact. In addition, a Tree Stewardship Program can be set up to teach and hire local people in tree care, encouraging residents to care for their environment.

5.2.2 Community Integration and Corporate Social Responsibility (CSR)

Community integration and Corporate Social Responsibility (CSR) initiatives are essential to ensuring that the benefits of golf courses extend beyond exclusive memberships. The study hence recommend that the golf community should put in place integration programs that will allocate at least 30% of golf club memberships to local residents at subsidized rates. In addition, the golf courses should also offer environmental training programs to the local communities in order to raise awareness on the importance of golf courses in climate change adaptation in order to increase community participation in tree and vegetation nurturing. This can easily be achieved through incorporation of local schools in the area to help with both Environmental Education and Tree Planting Programs. Companies should focus CSR projects on important environmental matters like planting trees, saving water and preventing soil erosion. Creating Joint Environmental Action Committees that bring together local residents, those who manage the golf courses and government officials will help make decisions that are good for the environment.

5.2.3 Sustainable Operations and Environmental Audits

The study also recommends the need for regular sustainable operations and environmental audits on the ecological footprints of golf courses in order to enhance the effectiveness in climate change adaptation. Every golf facility should also embrace full transition into biodegradable materials such as wooden tees instead of plastic ones. This should include a proper sustainability action plan with clear objectives, a timeline and performance indicators of golf courses contribution to climate change adaptation in ASAL. Performing Sustainability Audits every year will allow for tracking of progress, find out what challenges are face and record essential environmental performance details. Golf courses should also strive to collaborate with well recognized environmental certification body in order to achieve recognized sustainability certificates which highlights their commitment to the environment.

REFERENCES

- Abua, M. A., Iwara, A. I., Eneyo, V. B., Akpan, N. A., Ajake, A. O., Alarifi, S. S., Gómez-Ortiz, D., & Eldosouky, A. M. (2023). Runoff, sediment loss and the attenuating effectiveness of vegetation parameters in the rainforest zone of Southeastern Nigeria. *Sustainability*, 15(7), 6262. <https://doi.org/10.3390/su15076262>
- Ari, T., & Gökpınar, F. B. (2019). Green theory in international relations. In *Theories of international relations II* (pp. 162–176). Anadolu University Press.
- AWEMAC. (2022). *Strategic environmental assessment (SEA) final report for the proposed Vipingo Mixed Use Development Master Plan, Kilifi County*. National Environment Management Authority.
- Bekken, M. A. H., & Soldat, D. J. (2021). Estimated energy use and greenhouse gas emissions associated with golf course turfgrass maintenance in the northern USA. *International Turfgrass Society Research Journal*.
- Colding, J., & Folke, C. (2019). The role of golf courses in biodiversity conservation and ecosystem management. *Ecosystems*, 12, 191–206.
- Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). Sage Publications.
- Croeser, T., Ordóñez, C., Threlfall, C., Kendal, D., van der Ree, R., Callow, D., & Livesley, S. J. (2020). Patterns of tree removal and canopy change on public and private land in the City of Melbourne. *Sustainable Cities and Society*, 56, 102096.
- Dietz, J., Treydte, A. C., & Lippe, M. (2023). Exploring the future of Kafue National Park, Zambia: Scenario-based land use and land cover modelling to understand drivers and impacts of deforestation. *Land Use Policy*, 126, 106535.
- Drake, E., Vonhof, M., & Maslo, B. (2023). Bat use of golf courses depends on surrounding landscape context. *Urban Ecosystems*, 26, 1469–1482.

- Dramé, A. (2024). Climate change and community conflicts in Sub-Saharan Africa: A review of the evidence. *African Journal of Environment and Science Technology*, 18(3), 62–68. <https://doi.org/10.5897/AJEST2024.3262>
- FIFA. (2021). *FIFA's climate strategy, Football for the planet*. <https://publications.fifa.com/en/annual-report-2021/around-fifa/fifa-climate-strategy/> (Accessed May 27, 2025)
- Goodin, R. E. (1992). *Green political theory*. Polity Press.
- Grillotti Di Giacomo, M. G., De Felice, P., Ivona, A., & Spagnoli, L. (2021). Golf: Is it a new form of sustainable tourism or a violation of traditional rural vocations? Italy and Brazil: Comparison between two case studies. *Sustainability*, 13(11), 6125.
- Hauschel, B. (2018). *Stormwater management benefits golf course and community*. Village Greens Golf Course, Port Orchard, WA. United States Golf Association.
- Humphrey, N. (2013). *Social and emotional learning: A critical appraisal*. Sage. <https://doi.org/10.4135/9781446288603>
- Juma, L. O., & Khademi-Vidra, A. (2019). Community-Based Tourism and Sustainable Development of Rural Regions in Kenya; Perceptions of the Citizenry. *Sustainability*, 11(17), 4733. <https://doi.org/10.3390/su11174733>
- Kariuki, C., Nzioki, N., & Murigu, J. (2013). The development of golf estates in Kenya—Their impact and sustainability. *AfRES, afres2013_114*, African Real Estate Society (AfRES).
- Lonsdorf, E. V., Nootenboom, C., Janke, B., & Horgan, B. P. (2021). Assessing urban ecosystem services provided by green infrastructure: Golf courses in the Minneapolis-St. Paul metro area. *Landscape and Urban Planning*, 208, 104022.
- Millington, R., Darnell, S. C., & Millington, B. (2018). Ecological modernization and the Olympics: The case of golf and Rio's "green" games. *Sociology of Sport Journal*, 35(1), 8–16.
- Mungai, J. M. (2014). Challenges of strategy implementation by Kenya Golf Union (Master's thesis). University of Nairobi.
- Nguyen, T. T., Barber, P., Harper, R., Linh, T. V. K., & Dell, B. (2020). Vegetation trends associated with urban development: The role of golf courses. *PLoS ONE*, 15(2), e0228090.
- Nguyen, T. T., Eslick, H., Barber, P., Harper, R., & Dell, B. (2022). Cooling effects of urban vegetation: The role of golf courses. *Remote Sensing*, 14(17), 4351.
- Petrosillo, I., Valente, D., Pasimeni, M. R., Aretano, R., Semeraro, T., & Zurlini, G. (2019). Can a golf course support biodiversity and ecosystem services? The landscape context matters. *Landscape Ecology*. Springer Science and Business Media LLC.
- Puplampu, D. A., & Bofo, Y. A. (2021). Exploring the impacts of urban expansion on green spaces availability and delivery of ecosystem services in the Accra metropolis. *Environmental Challenges*, 5, 100283.
- Ren, Y., Guo, M., Yin, F., Zhang, M.-J., & Wei, J. (2022). Tree cover improved the species diversity of understory spontaneous herbs in a small city. *Forests*, 13(8), 1310. <https://doi.org/10.3390/f13081310>
- Tanner, R. A., & Gange, A. C. (2018). Effects of golf courses on local biodiversity. *Landscape and Urban Planning*, 71(2-4), 137–146.
- UNFCCC. (2015). *Paris Agreement*. United Nations Framework Convention on Climate Change. https://unfccc.int/sites/default/files/english_paris_agreement.pdf
- van Baalen, S., & Mobjörk, M. (2018). Climate change and violent conflict in East Africa: Integrating qualitative and quantitative research to probe the mechanisms. *International Studies Review*.
- van Baalen, S., & Mobjörk, M. (2018). Climate change and violent conflict in East Africa: Integrating qualitative and quantitative research to probe the mechanisms. *International Studies Review*, 20(4), 547–575. <https://doi.org/10.1093/isr/vix043>
- Wheeler, K., & Nauright, J. (2006). A global perspective on the environmental impact of golf. *Sport in Society: Cultures, Commerce, Media, Politics*, 9(3), 427–443.
- Yang, K., Sun, W., Luo, Y., & Zhao, L. (2021). Impact of urban expansion on vegetation: The case of China (2000–2018). *Journal of Environmental Management*, 291, 112598.
- Zeng, Z. (2021). The impact of vegetation change and climate in coastal cities on public sports: The impact of urban heat island. *Arabian Journal of Geosciences*, 14(10), 901. <https://doi.org/10.1007/s12517-021-07199-9>