

Co-Benefits of University Green Infrastructure and Student Well-Being: Case Study of Kisii University, Kenya

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Abstract

Green infrastructure (GI) is the combined structure and types of green spaces (GS) which deliver environmental, social, and economic benefits. “Green campuses” have gained prominence as a vital part of sustainability efforts in higher education and well-being. Studies suggest that the prevalence and severity of mental health issues among university students has been increasing over the past decade in most countries. Although university services have tried to address this growing problem, individual-based interventions have limited effects on well-being of a large population. Over the years since, its charter in 2013, Kisii University has developed and expanded the construction of administration, tuition blocks, amphitheaters, library and laboratories and cabro paved paths. This came along with GI improvements around most of these building. With the completion of the administration blocks and amphitheaters, significant GI improvements have been carried out. The objective of the study was to evaluate the opinion of students on these GI improvements with regard to their social and mental well-being. The assessment was carried out in the second semester January to May 2025. A proportionate random survey of 567 students from each of the eight schools of the university, was conducted using questionnaires. The student ages were such that 57.4% were less than 20 years old and 41.3% were between 21 - 25 years old. Responses showed that 52.7% were moderately familiar and 42.9% were very familiar with the concept of green spaces. 75% of the students noted that it was a better environment, 65% felt happier, and 66% used the environment to clear their minds. The students frequently (42.3%) and occasionally (51.1%) noted that they use the landscape to alleviate feelings of stress, anxiety and sadness. With regard to spending time in the greenspaces 47.3% students noted that they always felt mentally refreshed and rejuvenated and 50.4% believe that increased access to these spaces impacts the overall mental health of the student community. In

response to the importance of prioritization of preservation and creation of green spaces by institutional planners, 56.9% and 33.6% of the students felt that it was very important and extremely important respectively giving a combined response of 90.5%. The functionality of the landscape would be enhanced by including sitting areas and tables, waste disposal bins, tables, good lighting at night, and be accessibility for those differently enabled students. Therefore, improvement of the green spaces enriches the student experience and support which is in line with Kisii University's mission of creating a transformative environment that enriches the student experience, for sustainable development.

Keywords

Green Infrastructure, Green Spaces, Kisii University, Student Well-Being, Mental Wellness

1. Introduction

Several definitions have been attributed to the planted areas linked with other elements in the environment that make up the landscape. Adopting the definition developed by [1], Green infrastructure (GI) refers to a system of interconnected ecosystems, ecological-technological hybrids, and built infrastructures providing contextual social, environmental, and technological functions and benefits. This definition adopts a more comprehensive view of the aspects of GI and the co-benefits. This is because as a planning concept, GI considers the diverse types of urban ecosystems and built infrastructures which function in relation to one another to meet socially negotiated goals. According to [2] and [3], urban green spaces are a component of green infrastructure which means that they are part of the physical environments with some degree of vegetation. Green campus infrastructure or Green Spaces [4] [5] or Academic Greenspaces [6] or Green Areas [7] can therefore be defined as the planned integration of natural ecosystems (areas covered with plants) and physical infrastructure of tertiary institutions that create a sustainable built environment that meets social benefits. These spaces also contribute to the realisation of the Sustainable Development Goals (SDGs) specifically SDG 11 (making cities and human settlements inclusive, safe, resilient and sustainable) and SDG 13 (Action to combat climate change and its impacts).

Universities around the world are addressing challenges posed by climate change by creating a more sustainable built environment in which green spaces are integral parts of the landscape because of the benefits there-of. Moreover, the university environment is an integral space for formal student education, creativity and innovation and concurrently provides a nurturing environment in which students develop independence, learn life skills and develop their personal and social identity at a significant stage in life [6] [8]. It is in this context that many educational institutions have adopted a socioecological approach to health and

holistic well-being of individuals through the interaction with the environment [9]. Kisii University champions climate change mitigation and has been improving the university green spaces.

There is positive evidence that human-nature contact plays a vital role in the overall well-being and quality of life of people by bolstering immunity and reducing stress related inflammation [10], mental health through improved cognitive function and emotional well-being [11], stress reduction [12]; attention restoration, cognitive performance [13] and avoidance of negative moods, such as anger, frustration and aggression [14] and the potential of fostering new social identities, thus also enhancing social well-being, social cohesion and sustainable development throughout the entire academic calendar [5].

The World Health Organization [2] [15] has linked urban green spaces to multifunctional benefits such as improved health, well-being, mental health, physical activity, social cohesion, and economic valuation, enhance local resilience and promote sustainable lifestyles. In accordance to WHO, health is a daily resource that can be created and lived by people within the settings of their everyday life where they learn, work, play and love' and that institutions can contribute to the well-being of the people by managing the greenspaces. These green spaces can also provide co-benefits such as biodiversity conservation, reduced air and noise pollution, mitigate against extreme weather events such as heat islands, rainfall and flooding, and carbon capture and storage [2] [15].

Mental wellness prevalence and severity among college students has been on the increase worldwide and has become a major world concern [16]. Institutions have set up strategies aimed at addressing the mental health challenges of the student population such as access to student counselling support, and social inclusivity. However, addressing this growing problem as an individual-based intervention has limited effects on well-being of the ever-growing university student population.

According to [17], University students may often experience mental fatigue from the time spent dealing with routine academic and social activities such as studying, completing assignments, working on reports and projects, preparing presentations, taking exams, and engaging in other activities that require sustained directed attention. The effects of mental fatigue may reduce the efficiency of their scholarly efforts, thus leading to lower academic achievement. The mental fatigue has been explained in the attention restoration theory (ART), which notes that directed attention is voluntary, central to maintaining focus, controls distractions and requires effort [18]. Therefore, with sustained use, it is possible to get fatigue and thereby becoming less effective resulting in reduced ability to focus attention, inaccurate, increased errors and heightened irritability, commonly referred to as mental fatigue.

Natural environments are thought to be especially effective as settings that restore attention [19]. There is vast knowledge on the restorative effects of green-spaces with regard to reducing stress, mental fatigue, depression and enhancing

people's moods and vitality [20]. Since many activities lead to mental fatigue in university students, it would be important to provide restoration breaks to refresh their cognitive abilities. Institutions of learning often adopt a socioecological understanding of promoting the well-being of students by improving the interactions between individuals and the environment. GI promotes people's health by improving their mental, physical and social well-being. Studies have shown that green spaces play a significant role in enhancing positive mental health, in the context of psychological recovery between human health and the environment [6].

The role of the natural environment in mental and health well-being of university students has not been well amplified despite the increased correlation to mental and health well-being of people in urban settings. The objective of the study was to examine the role and if there are any co-benefits of Kisii University green infrastructure improvements and student well-being.

2. Methodology

Kisii University started as a constituent university college of Egerton University and was granted full public University charter in 2013 [21]. It is located in Kisii County about 2km from town centre along the Kisii Kilgoris road. The university infrastructure has been evolving in construction in both concrete and mortar and with the green environment. Currently the university main campus encompasses a wide range of administration buildings, main library, tuition blocks, student hostels, medical service unit and laboratories among other utility service areas. There are eight academic which include school of Agriculture and Natural Resource Management, School of Health sciences, School of Law, School of Education and Human resource development, School of Business and Economics, School of Pure and Applied Sciences, School of Information Science and Technology, School of Arts and Social Sciences. The university is also equipped with sports facilities. In tandem with the university's growth and evolution, additional infrastructural plans have been undertaken to augment the existing infrastructure, enhance its aesthetic appeal and thereby also facilitate the convenient accessibility to the increasing student enrollment.

The study was conducted among students at Kisii University by using a questionnaire survey during the January to May 2025 semester. The study targeted a total student population of 60,571 enrolled across eight faculties of the university. A stratified proportionate random sampling technique was employed. Stratification was based on the eight schools, with each school constituting a distinct stratum. This approach was chosen to guarantee that students from all faculties were adequately represented in the sample, reflecting the diversity of academic programs and experiences within the institution. The sample size of 567 students was representative of the student population. The survey was done using a google form whose link was shared via WhatsApp through cohort representatives. Participation was voluntary and students had to log in only once to take the survey. De-

scriptive data analysis was computed to provide an overview of the characteristics of the study and presented in graphical presentations and tables. The GI improvements upgrades that the university has undertaken include the main entrance through the university gate, landscaped green spaces surrounding the tuition blocks, the library precinct, and nature trails along the river. Additional enhancements have been made around the new administration block. To improve accessibility and movement within the campus, the university has also upgraded internal roads by installing cabro paving and constructing pedestrian footpaths.

3. Results

3.1. Sociodemographic Information and Familiarity with Green Spaces

Out of the 567 questionnaires distributed, 530 were successfully completed and returned, yielding a response rate of 93.4% which underscored strong participant engagement. The study was done among students of Kisii University with an age group profile that ranged from 17 to 30 years with 57.4% being less than 20 years old and 41.3% were between 21 - 25 years old of and only 1.3% were older than 26 years old (**Figure 1**). 62.2% of the students were male and 38% were female students. This study therefore largely represented the student age group range of between 17 - 25 years which is the age group of the majority of undergraduate students.

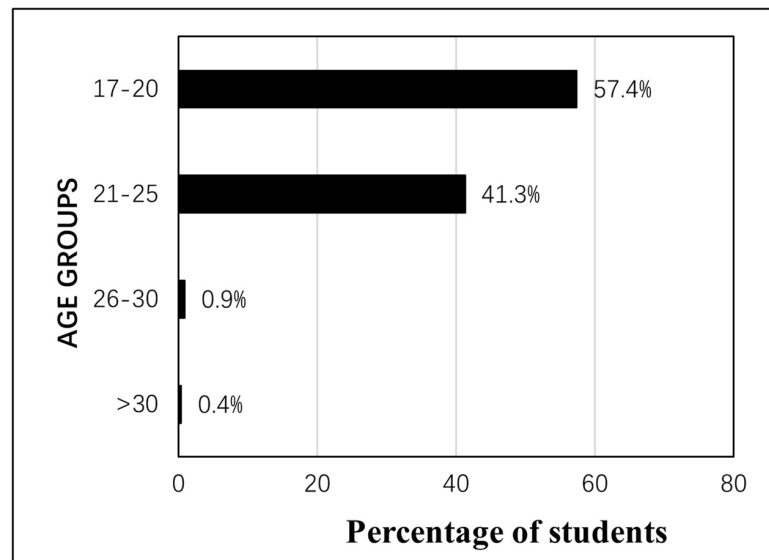


Figure 1. Sociodemographic information.

Most students shared that they were at least moderately (52.7%) to very familiar (42.9%) with the concept of Green Spaces (**Figure 2**). There was a percentage of 4.4% who completely have no familiarity with the green spaces. This could be that they may not have interacted with the term but can decipher that it has something to do with environment and climate change adaptation terms.

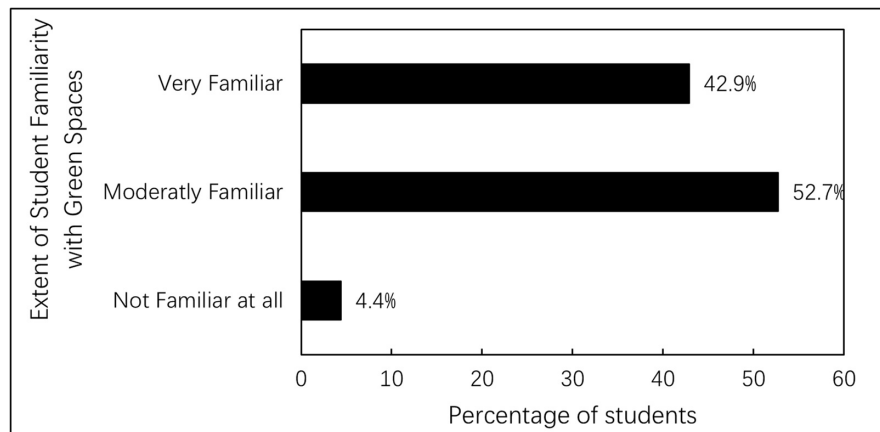


Figure 2. Familiarity of students with the concept of Green Spaces.

3.2. Student Experience with the Green Spaces

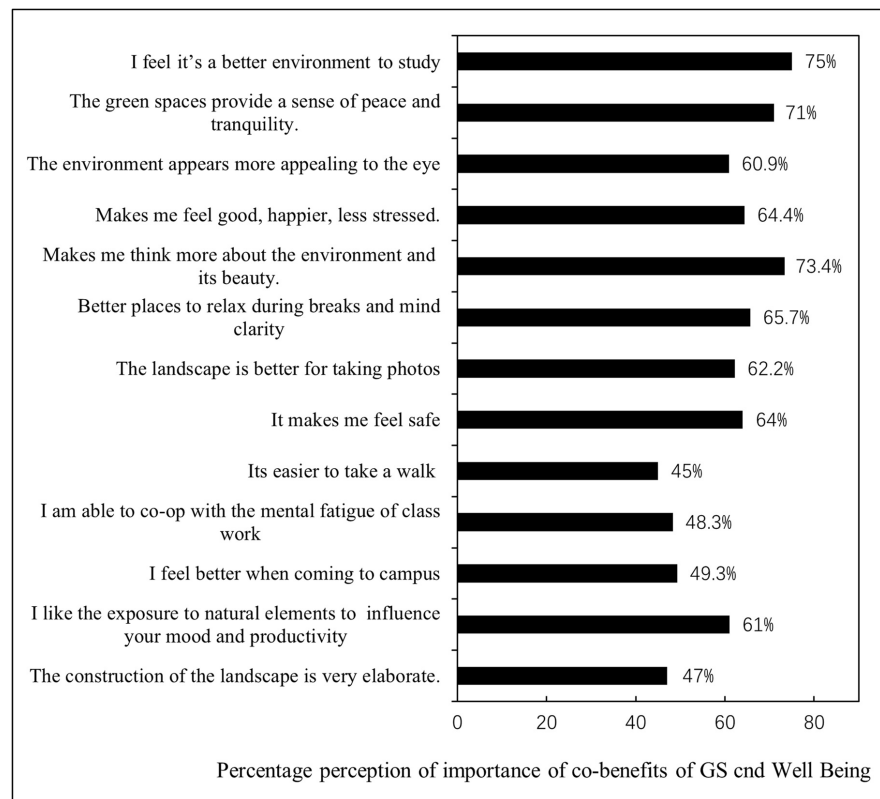


Figure 3. Description of the cumulative student experiences with the Green Infrastructure Improvements at Kisii University.

The responses of the student experiences with the GI improvements at Kisii University were varied and were not mutually exclusive (**Figure 3**). Responses from students indicated that 75% acknowledged that the environment felt better as a study environment, 71% felt that the GS provided a sense of peace and tranquility, and 73.5% stated that they often thought of the environment and its beauty. They also noted that the greenspaces made them appreciate the aesthetic beauty of the

environment (60.9%) and 62.2% noted that the landscape was better for taking photos. According to 47% of the students, GI construction was very elaborate and 49.3% noted that they felt better when coming to campus. The students (65.7%) acknowledge the Green spaces contributed to better places for relaxation during breaks and for clarity of the mind. The GS also helped 48.3% of the students to coop with the mental fatigue of class. 64.4% of the students appreciated the GI made them feel good, happier, and less stressed while 64% stated that they felt safe 45% stating that they found it easier to take walks.

The students acknowledged that the landscape provided safe walking places, such as the nature trail (**Figure 4**) and exposure to nature to relax, refresh and influence mood (**Figure 5**) and was aesthetically appealing (**Figure 6**).

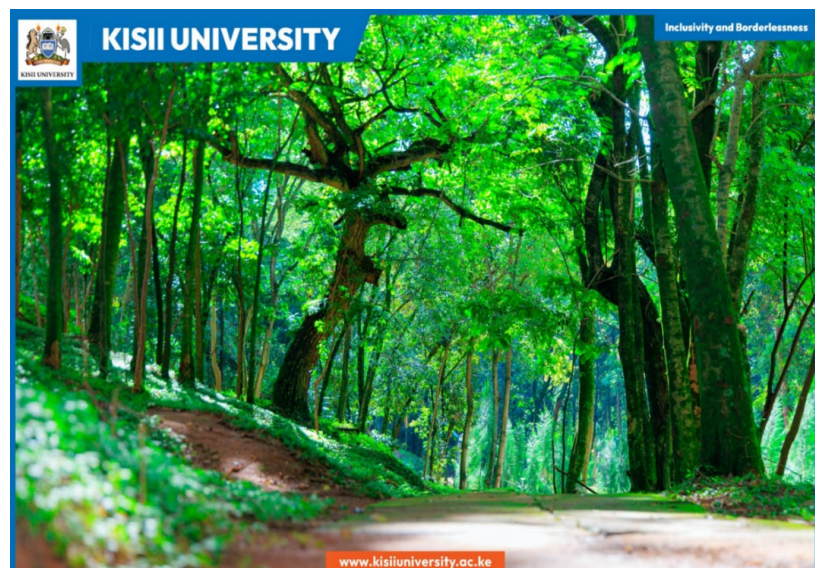


Figure 4. Nature walk tracks on the GS.



Figure 5. Students relaxing socializing and refreshing next to the tuition blocks between class breaks.



Figure 6. The aesthetically appealing GI, cabro paved walkways and tranquil ambience of the University administration front.

3.3. Students' Health and Well Being

A combined total of 93.4% of the students frequently (42.3%) and occasionally (51.1%) use the landscape to alleviate feelings of stress, anxiety and sadness (**Figure 7**). Only 6% of the sampled students said that they have not so far used the green space.

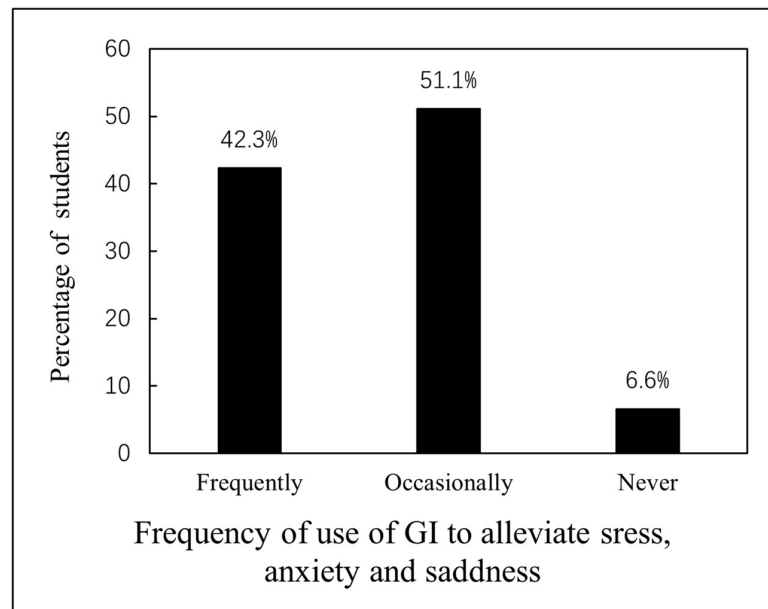


Figure 7. Use of GI to alleviate stress, anxiety and sadness.

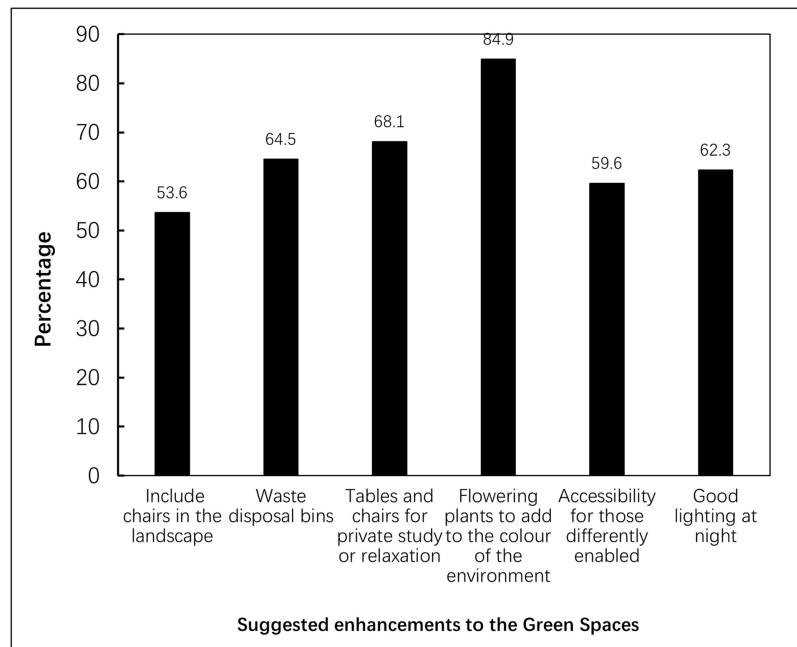
The role of the green spaces on the student mental well-being and health was evaluated and presented in **Table 1**. 47.3% of the students strongly agreed that they often felt mentally refreshed after spending time in Green Spaces. 50.4% of the students strongly agreed that increasing access to green spaces can positively impact the overall mental health of the community.

Table 1. Rejuvenates and promotes mental well-being and health of the student community.

Evaluation Variable	Strongly agree (Always)	Agree (Often)	Somehow Agree (Sometimes)	Disagree (Rarely)	Strongly Disagree (Never)
Do you often feel mentally refreshed or rejuvenated after spending time in green spaces?	47.3%	22.8%	24.6%	3.4%	1.9%
Do you believe that increasing access to green infrastructure can positively impact the overall mental health of the student community?	50.4%	35.2%	9.7%	2.1%	2.6%

3.4. Recommendations by Students

The students were asked to give the choices of the given additions to the landscape that they would like added into the landscape. They noted that the functionality of the landscape would be enhanced by including chairs or sitting areas, waste disposal bins, tables and chairs, good lighting at night, and be accessible for those differently enabled as depicted in **Figure 8**. Most students (84.9%) felt that addition of flowering plants into the landscape was very necessary in order to brighten up the green spaces.

**Figure 8.** Student suggestions for any landscape enhancements.

The responses to the student perceptions on the importance of the university planners prioritizing the green space developments are depicted in **Figure 9**. A combined total percentage of 90.5% of students noted that it was both very important (56.9%) or extremely important (33.6%) for the university planners and policy makers to prioritize the development of the green spaces in the university. Only less than 1% of the students did not feel this was of importance as a priority.

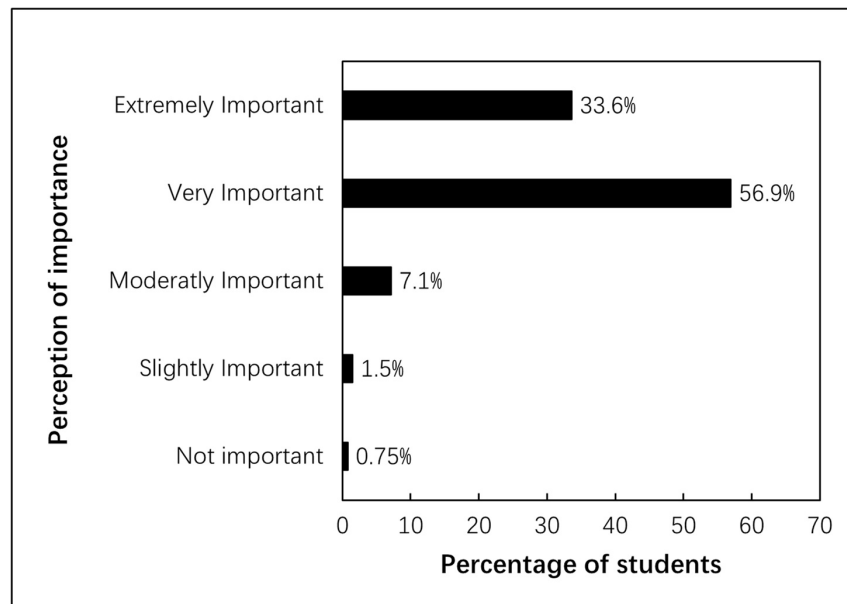


Figure 9. Importance of Prioritization of Green Spaces by Institutional Planners and Policy Makers.

4. Discussions

Several studies have shown that university life can have stressful moments precipitated by academic pressures and stressors typical of starting and attending college [16] [22] [23]. An increasing number of university students face mental health difficulties but the university student support services struggle to meet the demand largely due to limited resources and staff needs [24]. A large number of students do not seek professional help and thereby this leads to untreated conditions that affect their academic performances and retention. A survey of German students [22] revealed that students reported physical and mental health issues and indicated that they felt stressed, exhausted and suffered from generalized anxiety disorder. Students tend to report physical and mental health concerns more often than their peers. This study also indicated that one quarter of the students indicated feeling considerably stressed and exhausted, and every fifth female student suffered from generalised anxiety disorder [22]. A survey representative of American undergraduates illustrates some of the struggles that students are facing with 87% of students stating that they felt overwhelmed by all they had to do, 55% felt overwhelming anxiety, 33% felt so depressed that they found it difficult to function, and 9% seriously considered suicide [25]. Although the evaluation by [24], questioned the student opinion on online support systems for mental wellness, majority of the students preferred a support system that is interactive and personalized, and provides relaxation exercises and building of social skills. This points to the need for physical interaction with university green spaces. Students at Kisii University experience these moments of mental fatigue, anxiety, depression, academic demands, socio-economic pressures and stress during their stay in campus.

Studies have shown that green spaces offered by university have the capability to reduce stress levels, improve mental restoration, mental and psychological health, quality of life and well-being [5] [6] [26]. This has resulted in universities worldwide having green spaces as integral parts of their campuses because they recognize the significant benefits derived from them which include improved mental and physical health, encouraging healthy social cohesion opportunities and for recreation and leisure, promoting sustainable lifestyles, encouraging healthy social interaction [5]. Numerous studies have shown that green spaces have a positive impact on student's health and well-being and several unrelated to health benefits and likewise the on-going green infrastructure developments at Kisii University are serving the same purpose of enhancing student well-being and mental health. A study by [5], exposed the importance of frequent use of green areas in life and the needs to improve campus green spaces due to the degradation of greenspace area and safety issues resulting in a more appropriate campus environment for students. The result showed that more than 60% strongly agreed and aware with this as greenspace has the potential to provide a variety of positive outcomes in support of the university students' mental health [5]. This involves reducing stress, anger, fear, and improving academic performance, behavior, and social integration [5] [26] examined the role of GI in improving the quality of life in university campuses of University of Bucharest and University Politehnica of Bucharest. The study revealed that green spaces on university campuses have a significant impact on reducing stress levels, improving mental restoration, and increasing the overall well-being of students. Additionally, the study finds that students prefer green areas within the campuses due to their proximity, but these areas often lack facilities and equipment for recreation and sports. Most of them are constantly facing the stress caused by factors coming from both the university and urban areas, but the green areas have an important role in reduction daily stress and even increase the cohesion of the community. The students at Kisii University expressed a diverse package of experiences with the green infrastructure initiatives at the university. In general, most of the responses carried more than 40% of the positive experiences with the environment such as the environment being better for academics, safer, peaceful, enhancing social activities (taking photos), aesthetically appealing and elaborate. There are several studies that concur with the students experiences at Kisii University. The in-depth study by [6] in which they studied a campus green space called the Hofgarten where students spent time, noted that the academic green spaces can act like therapeutic landscapes because they support the students physical, mental and social well-being during these periods of academic demands. The study showed that these spaces can serve as places of recreation, recovery and social inclusion and interactions and concluded that it has the potential to promote well-being and social ties among students and even employees as well as the general public.

Kisii University students also gave recommendations for the green spaces such as inclusive accessibility especially for those differently enabled, inclusion of

chairs and tables, waste disposal bins, umbrellas, night lighting and more flowering plants [26]. The study found that students preferred green areas within the campuses due to their proximity. However, these areas lacked facilities and equipment for recreation and sports and recommended that the campuses should have recreational areas, sports areas, and garden areas to increase the level of comfort with the campuses.

Some of the benefits of the green spaces that the students at Kisii University stated was that they could relax during breaks and when they needed to clear their minds. This is the restorative ability of the environment. According to the attention restoration theory (ART), directed attention is key to maintaining focus and controlling distractions [18] [27]. This results in what is called mental fatigue which means an individual has reduced attention, increase in irritability and performance errors and is therefore consequently less effective. The attention restoration theory envisions that the environment promotes recovery from mental fatigue. [28] studied the restorative benefits of differing types of greenspaces use among undergraduate students living in the university setting, found that students that frequently engaged with the green spaces in active ways reported higher quality of life, better overall mood and lower perceived stress. University green spaces provide opportunities for students to rejuvenate and help in healing [29]. In line with [17], a study from the Netherlands suggests that students prefer indoor and outdoor university spaces with at least some type of greenery. Such university spaces were regarded as more restorative than study-breaks or learning spaces without any greenery or views of nature [30]. Similarly, a study targeting three universities in the USA and Scotland [31] showed that students who perceive their campus as being green also tend to rank campus restorativeness more highly. Highly ranked campus restorativeness, in turn, was associated with a greater quality of life. A beneficial effect of the use of campus Greenspace on perceived quality of life was confirmed in a survey among undergraduate students in Texas [32].

Kisii University students experience peace and tranquility, felt good and happier and less stressed when they interacted with the green spaces. These are experiences that have been reported by among college students. [6] reported that students experienced reduced stress and improved mood and mental recovery when they spent time in the Hofgarten especially during examination time. A study involving universities campuses in Bucharest, Romania evaluated the impact of green infrastructure located near or on the campuses, on the student's quality of lives and found out that green areas have an important role in reducing stress caused by both the university and the urban areas and also increased cohesion of the community [26]. They concluded that it is important to have available study areas, recreation areas, sports areas and gardens. Evaluation also increased the interest of students for green spaces especially for their aesthetics. [4] and [26] noted that green spaces created on campus are like rehabilitation landscape that help to alleviate stress, help in character development and emotional formation which are key to the cultivation of high-quality talents. Numerous studies have shown that viewing or spending time in

Greenspace appeared to have stimulating effects on better self-reported health. [28] found that daily interactions with green spaces in childhood was associated with the frequent use by university students and found that the barriers to use of the green-spaces was the lack of awareness of the opportunities and lack of adequate time. Likewise in the study by [6] students appreciated the design aspects of the Hofgarten, such as cleanliness and calmness, and that the green space promoted a feeling of being away from demands and daily stress.

The green spaces at Kisii University also provided comfortable opportunities for students to experience positive solitude moments because it has become easier to take walks and felt safe. Solitude moments are popularly known for refreshing and find meaning during alone time. Research has demonstrated that solitude contributes to an individual's capacity for self-reflection, self-awareness, independent thinking, and evaluation and is considered a part of healthy maturation [33]. The student responses reinforced that positive solitude is volitional, rich in meaning and enjoyable and can be used to enhance well-being. Taking walks is a physical activity that is a major pathway to health since it the well-being of the mind and body as we engage with nature.

Kisii University students largely appreciated the beauty of the environment in that it appeared more appealing and gave them a better feeling of coming to campus. The green space enhancement has not only improved the aesthetic image of the institution but has also improved the student's mood and feelings when coming onto campus. [34] 70% of the students of Copperbelt University, Zambia appreciated the aesthetic value of the green space development. Green spaces can also be represented as murals in which college students rated indoor campus settings with dramatic nature murals may provide attentionally fatigued students with opportunities for restoration when views of nature are unavailable [17].

[35] investigated the importance of integrating healing gardens into high-rise built university campuses with regard to improving mental health and sustainability. They demonstrated that small, interactive green spaces provide intimate, restorative natural environments that relieve stress and also encourage community well-being and also regulate temperature and enhanced physical comfort in heavily built areas. Campus green spaces are therefore critical for the effective design, utilization and management of the university because it contributes to the overall development and attractiveness of the university.

Numerous studies have reported the importance of green spaces in enriching the social interaction, inclusion and fostering social well-being of university students [5] [6] [26] [34]. Green spaces have provided a place for social inclusion and identity among students and this can help in promoting well-being among students. The improvement of the green spaces in Kisii University has already given the students an opportunity to interact, socialize, relax and thereby establishing stronger community ties. The students especially liked taking photographs and other social activities and recreation in the landscape. According to [13], the interacting pathways through which nature contribute to health is through improv-

ing air quality, enhanced physical activity, stress reduction and greater social cohesion. Landscapes have the potential to promote physical well-being through the promotion of physical activity in daily life, through walkable environments and sidewalks make and whereby people feel safe [36].

[8] concluded that a health promoting university should enable students discover and explore their potential, help them in making healthy choices and contribute to enriching and developing social, economic cultural and recreational activities. The forgoing indicates that university green spaces need to be planned for, developed and maintained because they extend the student support system in mental health and well-being. In this study slightly over 90% of the students evaluated recommended that the installation of green spaces should be prioritized by the university planners and policy makers.

According to [37], the application of the green campus concept is very effective in sustainably managing the campus environment and can bring positive change to teaching and learning activities. However, the largest challenge is the lack of knowledge about green campus and commitment to protecting the environment. Likewise, to their conclusion, the implementation of a green campus concept depends on the readiness and willingness as well as a change in the mindset and persistent efforts of all involved parties. This means the university management should be willing to implement. In agreement with [38] noted, university managers and planners should prioritize the design of green spaces so that to enhance the students experience, foster community engagement and contribute to the sustainability of the environment.

5. Conclusions and Recommendations

The green spaces created in Kisii University are a form of therapeutic everyday living spaces that potentially supports healthy campus life, through alleviating stress, improving mental fatigue, and providing a platform for relaxation, recreation, physical and social well-being among students. It also serves as a place of recreation and recovery from concentration fatigue. The aesthetic appeal of the institution has been enhanced as it also contributes to sustainability and biodiversity conservation and mitigation against climate change aspects. It is important to understand the student perceptions, preferences and how they utilize the green spaces for effective design and management decisions. Since they serve as health-promoting settings, it is therefore necessary to ensure that they are easily accessible to all and new ones are continuously established or the characteristics, and functions of existing ones enhanced. Kisii University could also initiate “green exercise” [28] for the students to improve interaction with the environment. This research demonstrates that GI is both for aesthetic luxury and a core component of sustainable campus health and environmental conservation.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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