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Urban green system changes and its impact on access to ecosystem services: A case of Dar es Salaam City, Tanzania

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Abstract

Urban green systems play a significant role in the provision of ecosystem services necessary for the well-being and resilience of cities, however, urban expansion and anthropogenic activities exacerbate its degradation. This paper examines changes in vegetation cover and the community's views on access to ecosystem services in Dar es Salaam City. Qualitative data were collected to get the community's views on the changes. The 30 resolution Landsat imagery (combined bands) of June 2000, July 2012, and July 2018 were used to formulate the Normalized Difference Vegetation Index (NDVI) and Normalized Difference Water Index (NDWI) in analysing changes in green systems using ArcGIS software tool where the area covered by vegetation, water, and bare land for each year was determined. Analysis indicated that vegetation cover decreased from 910,800m2 to 321,300m2 and from 192,600m2 to 141,300m2 in Kijichi and Mbweni respectively between 2000 and 2012. The decrease affected the supply of ecosystem services necessary for human well-being and for microclimate moderation. The communities showed willingness to engage with other actors to promote green systems. The study recommends that the government should strengthen the role of neighboring communities in revitalizing the urban green systems for their well-being and microclimate moderation potentials.

Keywords: Urban; Green systems; Ecosystem services; ArcGIS; Dar es Salaam City

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1. Introduction

The vulnerability of urban communities found in informal settlements to natural hazards and the difficulties experienced in accessing ecosystem services are serious challenges in many African cities (Erman et al., 2019; Mwageni and Kiunsi, 2021). Natural hazards such as flooding and heat islands are experienced in many cities, including Dar es Salaam. Flooding for instance becomes intense during the rainy season, accompanied by losses of properties and people's lives (Anande and Park, 2021; Erman et al., 2019). Furthermore, the disappearance of green systems, including vegetation cover intensifies the possibility of risks such as extreme flooding which affects activities conducted beside the riverbanks such as vegetable production (Mwageni and Kiunsi, 2021). Moreover, the loss of vegetation cover leads to the loss of livelihood options for the urban poor who depend on ecosystem services to meet their well-being such as grass harvestores for livestock keepers and those who collect firewood (Doggart et al., 2020; Kideghesho, 2015).

In addition, the loss of vegetation increases temperature; for example, the average annual maximum temperature in Dar es Salaam City increased from 31oC to 31.3oC between 1986 and 2016 and raised at the rate of 0.046 oC each year (Malekela and Nyomora, 2019). The average annual minimum temperature increased from 20.7oC in 1986 to 23.2oC in 2016, which increased at the rate of 0.064 per year (ibid). An increase in temperature also exacerbates heat islands' effect (Almenar et al., 2021; Anande and Park, 2021; Nyanhoko et al., 2020; Zommers et al., 2016). The disappearance of green systems generally affects well-being and human development, including the neighbouring communities. Such effects exacerbate inequalities among the urban poor who depend on ecosystem services (Kideghesho, 2015). Currently, there is little evidence of how the communities associate the disappearance of green systems with difficulties encountered in accessing ecosystem services.

Drivers for the disappearance of vegetation cover such as urbanization and expansion of the brown environment are extensively discussed in the literature (Erman et al., 2019; Karutz et al., 2019; Wu et al., 2020; Almenar et al., 2021; Lourdes et al. 2021). Following potracted of loss of vegetation cover and the associated negative impacts in Tanzania urban areas, the Tanzania Forest Services (TFS), which is in charge of maintaining the studied green systems have engaged in patrolling and rehabilitating the degraded part by planting trees to overcome the degradation. Nevertheless, success has been minimal as encroachment continues. The question that arises is, if the encroachment and unsustainable harvesting are done within the nose of the surrounding communities, what are their views on the changes, and do they really see changes as a problem?

Studies on urban green systems concentrated on explaining the impact of its decline, such as flooding (Doggart et al., 2020; Erman et al., 2019; Mabula et al., 2017; Mwageni and Kiunsi, 2021); and loss of livelihood options (Kideghesho, 2015). Almenar et al. (2021) concentrated on the linkage of Nature-Based Solutions, Ecosystem Services, and Urban Challenges. This paper, therefore, draws attention to the changes in urban green systems and communities' views on the disappearance of vegetation cover and its effects on access to ecosystem services. Specifically, the paper attempts to answer the following questions (i) what have been the changes in green systems in Dar es Salaam City? (ii) how do urban communities view the occurrence of changes and its impact due to the disappearance of vegetation? (iii) how have the urban settlements neighbouring green systems associated the loss of vegetation with access to ecosystem services? And (iv) what initiatives are in place to overcome the situation in the urban areas? The potential benefit of answering these questions

is to arrive at an alternative institutional arrangements and division of roles that will ensure successful maintenance of urban green systems where the community take active role.

1.1. Understanding green systems and ecosystem services

Cities usually rely on existing green systems to thrive and contribute to the presence of ecosystem services in the area. Urban green systems are areas connecting water and vegetation and can comprise a semi-natural or natural environment (Blazy et al., 2021; Well and Ludwig, 2020; Brown and Mijic, 2019). Green systems can be a forest connected with rivers, basins, reservoirs, and parks linked to drainage systems. The contribution of urban green systems to ecosystem services includes the resilience and the ecological benefits urban residents enjoy (Baskent, 2020; Ciwk et al., 2021; Tan et al., 2020). Green systems usually provide important ecosystem services ranging from ecological, economic as well as socio-cultural ones. From an ecological point of view, green systems contribute to a balanced microclimate, reduce air pollution, and increase air quality (Millennium ecosystem assessment, 2005; Costanza et al., 2017). Furthermore, green systems contain a positive social effect as it reduces psychological distress (Bush, 2020; Willems et al., 2021); help people recover from cardiovascular diseases (Li et al., 2017), and provide aesthetic value (Kang et al., 2020; Vargas-Hernández et al., 2018).

Urban green systems are considered important because of their numerous contributions toward climate-change-related impacts, including reduced heat stress, inland, and coastal flooding, prevention of pollution, and an increase in air quality (Kabisch et al., 2017). However, urban ecosystems are exposed to complex interactions between the socio-economic and biophysical environment in comparison to those in rural areas, thus affecting the provision of ecosystem services (Wu et al., 2020). The complex interaction between socio-economic and biophysical is experienced in cities of the global south such as those in Ghana, Nigeria and even Dar es Salaam city in Tanzania (Mensah, 2014; Ekong, 2017; Karutz et al., 2019). Maintenance of urban green systems is necessary to support the provision of important ecosystem services and enhance the resilience of cities. It is one of priority of the global agenda such as the Sustainable Development Goals and New Urban Agenda. The Sustainable Development Goals for example, Goal 15 require the maintenance of terrestrial areas to enhance resilience (United Nations, 2017).

Despite the contribution of green systems and the concern of international agendas, most cities in the global south including Dar es Salam experienced inadequate enforcement of rules supporting urban green systems hence the causes of their degradation (Ekong, 2017; Karutz et al., 2019; Mensah et al., 2017). In urban and peri-urban Dar es Salaam, the green systems experienced encroachment because of uncontrolled informal settlement development and anthropogenic activities which contribute to the loss of ecosystem services (Lupala et al., 2014; Mdemu and Burra, 2016), thus threatening the presence of vegetation cover. The disappearance of vegetation cover might contribute to the shortage in supply and costs in attaining necessary services for human well-being and development. The challenges related to the loss of urban green systems on the resilience of cities are of global and national concern and its effect on ecosystem services is critical to urban dwellers. However, it is imperative to get an insight into the community's views regarding the changes in urban green systems and their consequences on access to ecosystem services so as to come out with an appropriate solution.

2. Location of the study area and method

The study focuses on the two green systems neighbouring communities of Mbweni and Kijichi in Dar es Salaam City. Kijichi and Mbweni form a system of lower streams connected to rivers originating from the Kazimzumbwi forest, where some like the Kizinga River pass through the Buyuni ward. Thus, Kazimzumbwi forest forms the catchment areas that connect green systems found in Kijichi and Mbweni through Kizinga and Mpiji rivers (Figure 1). These green systems are composed of an essential ecological ecosystem with potential ecosystem services. Both Mbweni and Kijichi have a substantial portion of land covered by mangrove forests. These forests have been documented to provide ecological and socio-economic systems supporting different species and preventing the coast from erosion (Mabula et al., 2017; Samoilys et al., 2013; Boussougou et al., 2018). Therefore, the three green systems were among the essential study areas because of these characteristics that contribute to the existence of the green system in Dar es Salaam.

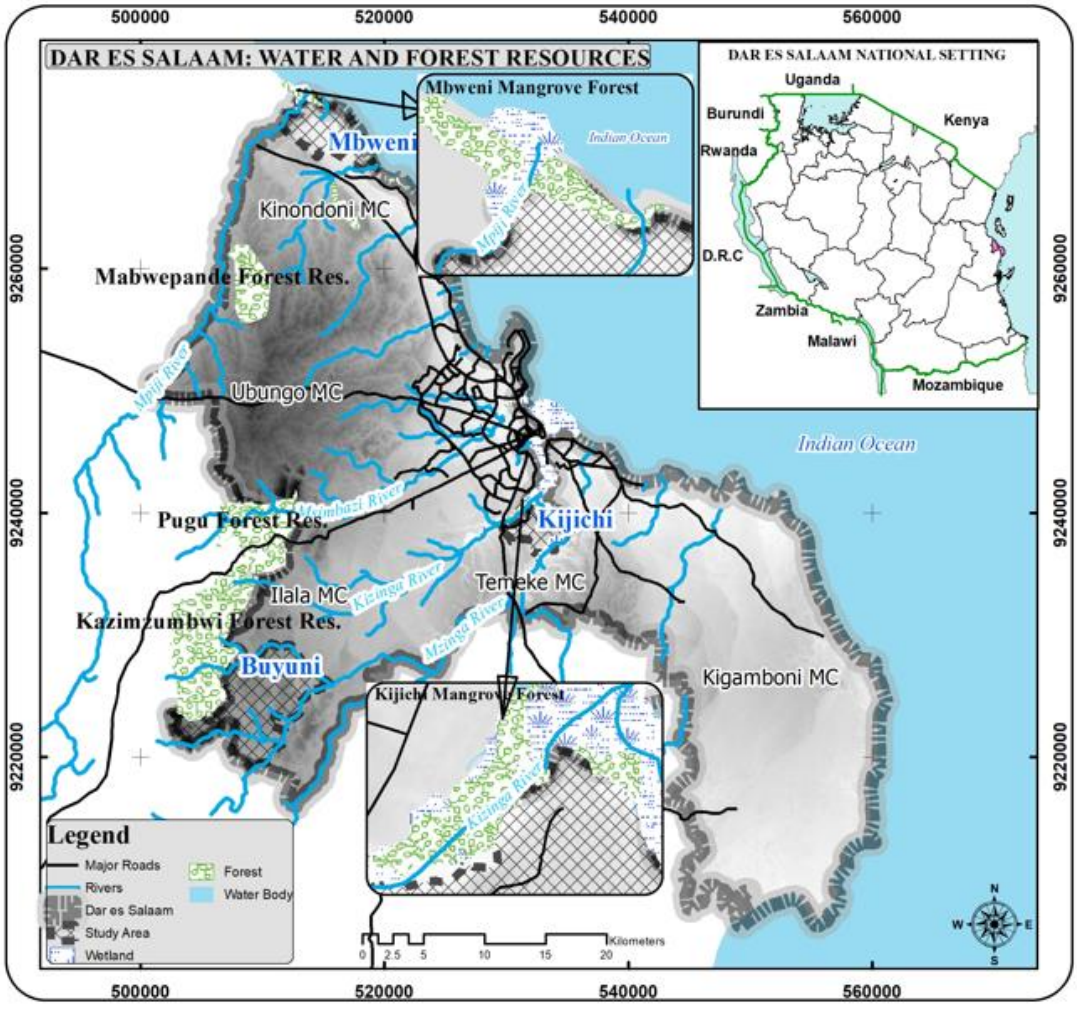

Figure 2. Location of the study area and studied green systems (Source: Author's processing of Digital Elevation Model and Landsat imagery of 2018)

The 30 resolution Landsat imagery (combined bands) of June 2000, July 2012, and July 2018 were used as input for developing changes in the two urban green systems of Mbweni and Kijichi. June is normally the last month of rainy season in Dar es Salaam. The third case Buyuni no classification was done because the site cannot allow concentration of water to replace the vegetation due to its landform. Four community members who represented each study area were selected to determine the boundary of the green systems. They were chosen based on their experience in the area and their engagement in the maintenance of the green system. For classification, the Earth Explorer Platform, and the boundaries of the area obtained from the National Bureau of Statistics (NBS) census data of 2012 were used. Before determining the land cover classes, Environment for Visualizing Images (ENVI) software was used to clear the cloud cover and scan line errors in some Landsat 7 images at preprocessing stage. In addition, area covered by vegetation, water, and bare land for each year was determined using ArcGIS Software. However, Normalized Difference Vegetation Index (NDVI) and Normalized Difference Water Index (NDWI) were used to analyze vegetation cover and vegetation water content respectively from a 30m Resolution Landsat (combined bands) imagery of 2000, 2012, and 2018. Furthermore, the Landsat 7 band combination technique helped to identify the area covered by soil which was classified as bare land and finally the images were vectorized to vector maps. Spatial data analysis technique was used to determine the differences in vegetation cover, water, and bare land in 2000, 2012 and 2018 imagery. The differences in vegetation cover and water concentration in such imageries are as indicated in Figures 2 and 3 were determined.

Qualitative data were collected through Focus Group Discussions (FGDs), meeting with local leaders, and in-depth interviews with key informants. The interviews were conducted with key informants from two national-level agencies [National Environmental Management Council (NEMC) and Tanzania Forest Services (TFS)], three municipal-level actors from Kinondoni, Temeke, and Ilala, and community leaders and conservation groups. These were chosen because they have experience in the area and could provide information on the situation and effects of the changes on green systems. This choice is in line with Hennink (2013) and Cossham and Johanson (2019) notion that key informants are chosen based on their knowledge and experience in the area. Four FGDs, two from each case study were conducted with selected members from conservation groups and community members. The FGDs included 6 to 11 representatives (both men and women), except one FGD with a conservation group that comprised of only women.

Collected data were recorded using smartphone recorder. Data related to the consequences on access to firewood, charcoal, foods, and effects related to heat and runoff were labeled. Categories with the same codes were linked to provide meaning, and after that, a single core category was identified for content analysis.

3. Results

This section presents findings related to changes in vegetation cover, followed by the associated effects and the community's views on the changes in access to ecosystem services. Additionally, the findings of this paper are discussed to reflect the contribution of this study to academic and research works before concluding.

3.1. Changes in urban green systems

Changes in vegetation cover, water, and bare land were observed. The result in Figure 2 indicates a decrease in vegetation cover from 67.9%, to 25.8% and 23.9% in 2000, 2012, and 2018 consecutively in Kijichi green system. Similarly, the water coverage area increased from 16.6% to 43% between 2000 and 2018. However, in Figure 3 the vegetation cover fluctuated where; in 2000, the area covered by vegetation at Mbweni was 26.8%, in 2012 declined to 19.4%, while in 2018 it increased to 31.4%. In contrast, the water coverage area increased from 36.7% in 2000 to 45.9% in 2012, while in 2018 it decreased to 28.8% (Table 1). The decrease in vegetation cover was due to the extraction of resources and farming activities (Mabula et al., 2017; Kideghesho, 2015), which made the wetland more visible hence an increase in the area covered by water during the rainy season. In Mbweni vegetation cover increased in 2018 because of the initiatives taken by the government to rehabilitate the degraded part of the vegetation cover. Furthermore, the bare land increased due to the clearance of vegetation for different reasons such as access to firewood and farming activities. Moreover, the increase in vegetation cover in Mbweni was due to rehabilitation efforts carried out in the area.

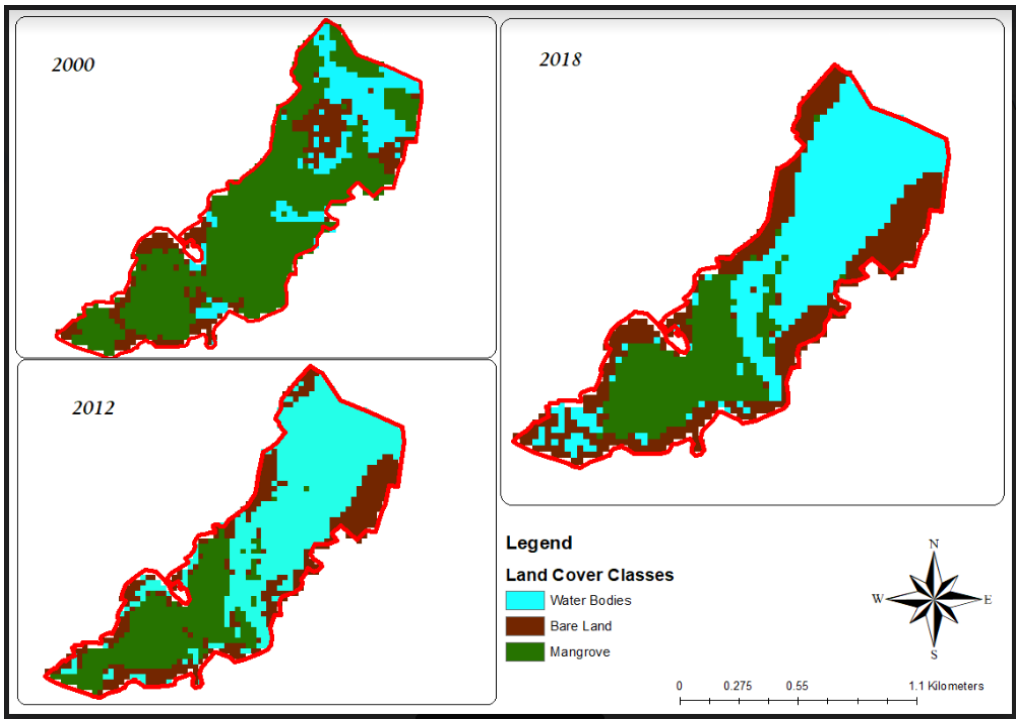

Figure 2. Kijichi site: changes in vegetation and water in 2000, 2012 and 2018

Figures 2 and 3 show the changes in vegetation cover, water, and bare land, resulting from human activities. Table 1 reflected the changes shown in Figures 2 and 3 presenting the coverage of the land classes in m2 and the changes in percentage.

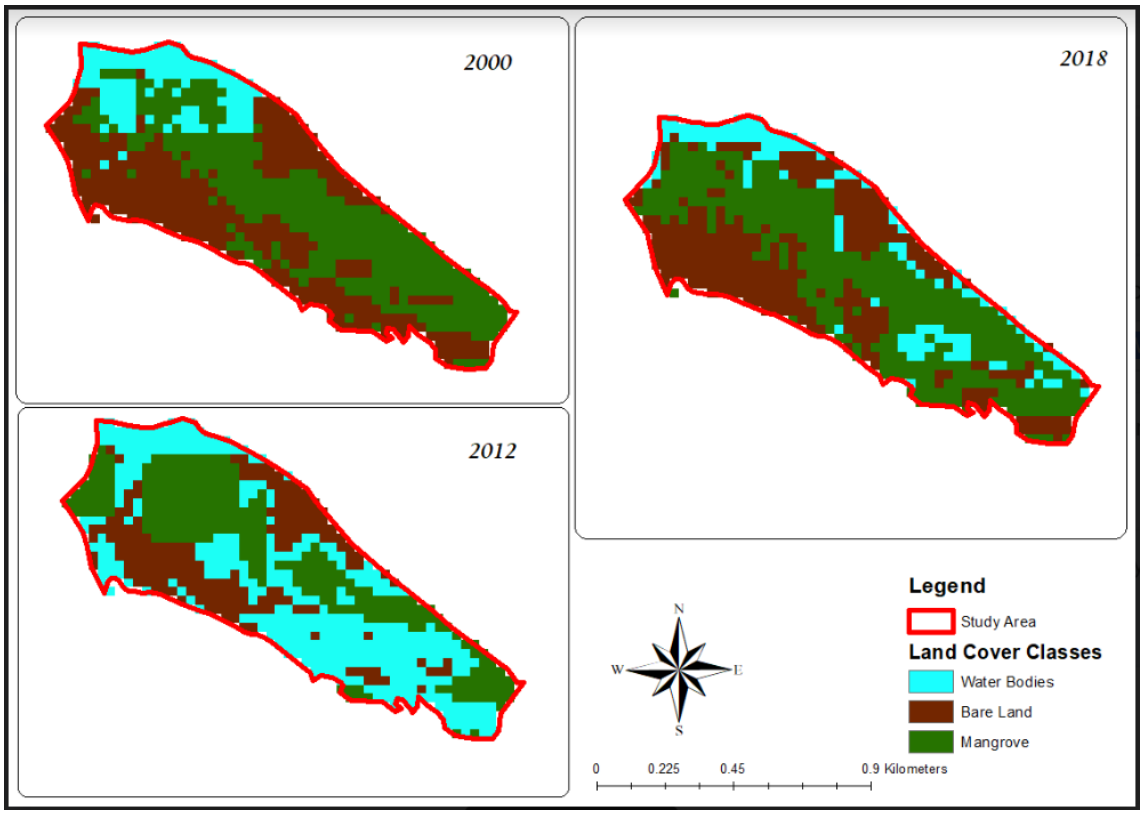

Figure 3. Mbweni site: Changes in vegetation and water in 2000, 2012 and 2018

Table 1. Changes in urban green systems

Year						
	2000		**2012**		**2018**	
Land classes	**Area (m²)**	**Percentage**	**Area (m²)**	**Percentage**	**Area(m²)**	**Percentage**
Vegetation cover	910800	67.9	345600	25.8	321300	23.9
Water bodies	222300	16.6	661500	49.3	576900	43.0
Bare land	208800	15.6	334800	24.9	443700	33.1
Total	1341900	100.0	1341900	100.0	1341900	100.0
Mbweni green system						
Land classes	**Area (m²)**	**Percentage**	**Area (m²)**	**Percentage**	**Area(m²)**	**Percentage**
Vegetation cover	192600	26.8	141300	19.4	225900	31.4
Water bodies	263700	36.7	330300	45.9	207000	28.8
Bare land	262800	36.5	247500	34.4	286200	39.8
Total	719100	100.0	719100	100.0	719100	100.0

Source: Extracted after the analysis of green system changes in Figures 2 and 3, 2022

Table 1 indicates the changes in vegetation cover, water, and bare land in 2000, 2012, and 2018 where the vegetation cover and water changed.

3.2. The associated effects of the changes in urban green systems

Green systems provide different services necessary to meet day-to-day needs. Findings from the Focus Group Discussions, interviews with key informants, and meetings with local leaders revealed several ecosystem services provided by the nearby green systems such as fish, firewood, vegetables, charcoal, wild animals (bush meat), water, fresh air, and herbal plants. Interviews and discussions with FGDs and local leaders were shown that the loss of vegetation cover in Mbweni and Kijichi has led to a shortage of ecosystem services. Most of the participants (40) from (FGDs, local leaders, and Key informants) noted scarcity of fish and charcoal as among the effects caused by a decrease in vegetation cover. Vegetation such as mangrove trees provides potential fish spawning areas. However, their loss affects the habitats for fish and other living organisms necessary for ecosystem services.

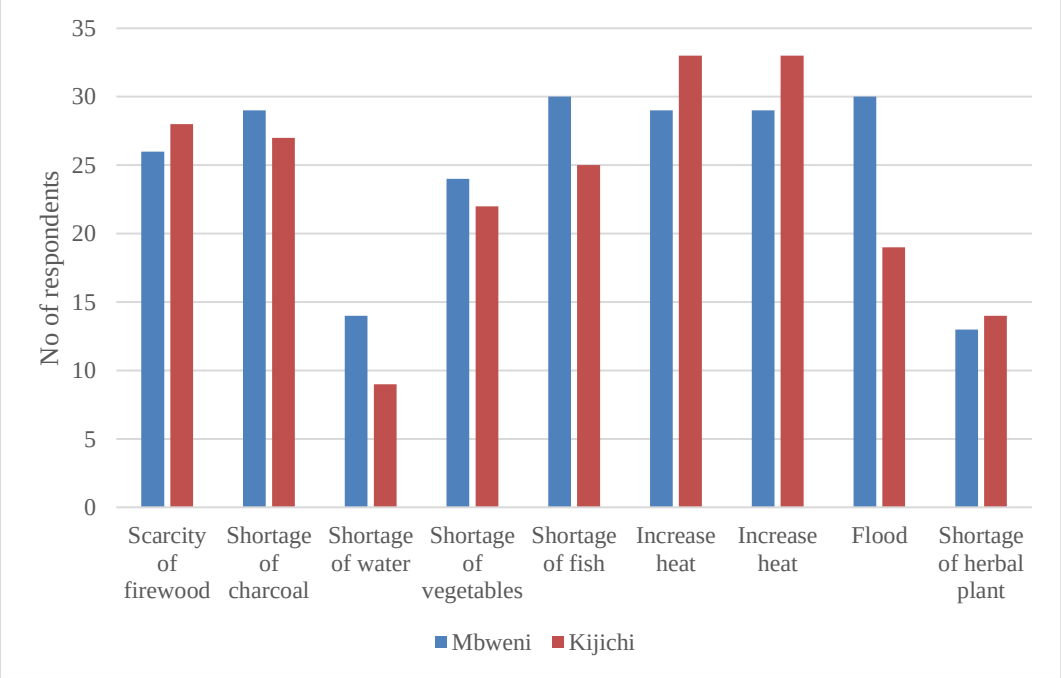

Figure 4. The effect related to change in vegetation cover on access to ecosystem services (Source: Field data, 2019)

Figure 4 indicates responses of the community members regarding shortage in the supply of ecosystem services and the impacts associated with the loss of getation cover that the nearby communities to the studied green systems encounter.

3.3. Views of the community on the impact of the loss of vegetation cover

The findings from qualitative interviews revealed concerns on the rise in temperature which was associated with the eruption of diseases such as scabies, rushes, and fever. The rise in temperature is what is classified in literature as heat islands and its effect. Interviews with key informants from the community level showed that these diseases were not experienced in the past as one respondent said:

> *"Back in the 1980s and 1990s we were not as affected by heat as in recent years. Temperature has risen and caused diseases such as rushes, scabies and fever" (R1 6th June 2019).*

Results in the quotation affirmed that in the past communities were not exposed to diseases such as rushes, scabies, and fever because of the presence of vegetation cover with a favorable environment including fresh air. Figure 4 demonstrates that 28 and 34 respondents in Mbweni and Kijichi respectively revealed that temperature has increased in recent days. Participants associated heat islands' effect with increased stress as in the FDG with the women group at Mbweni who confirmed that an increase in heat affects many people as quoted:

> *"In recent years, we are more exposed to heat stress that makes us suffer from headache and other abnormalities" (Focus Group Discussion, 11th June 2019).*

Results indicate that loss of vegetation cover has exposed some people to stress and problems due to limited fresh air circulation resulting from a loss of vegetation cover.

Flooding is another challenge in Dar es Salaam City which happens during rainy seasons. Thirty (30) and nineteen (19) participants from Mbweni and Kijichi respectively indicated the occurrence of flood caused by runoff during rainy seasons (Figure 4). In addition, results from Focus Group Discussions, key informant interviews, and observation indicated that flooding was common in the study areas during rainy seasons. It causes soil erosion and adversely affects properties such as houses (Plate 1) besides claiming people's life as one of the interviewees noted to have witnessed a person drowning in flooding waters at Mzinga River in January 2022. Meetings held with local leaders linked the occurrence of floods with the removal of vegetation cover, as one said:

> *"Before the year 2000, we never had floods of this magnitude because the dense vegetation cover played a significant role in reducing runoff" (FGD June 2019).*

Vegetation cover reduces the erosive potential of runoff and enhances water percolation to the soil. Therefore, any reduction in the urban green system would exacerbate the negative consequences accompanied by the flood (Plate 1). Furthermore, the interview with Ward Executive Officer (WEO) at Kijichi Ward, revealed that flooding happens during the rainy season, and houses in many parts of Dar es Salaam City get flooded (Plate 2).

Plates 1. Effect of the runoff at the upper and lower stream in Dar es Salaam (*Source: Field data 2019*)

Plate 2. Flooded house during rainy seasons (Source: *The Presidents' Office-Regional (PO-RALG), 2020)*

Access to ecosystem services by neighbouring communities continue to be difficult at different times. Findings revealed that fish supply was common in 1985 to 1995, and community members obtained it within 20 minutes' walk from their premises. However, between 2016 and 2020, neighbouring communities accessed fish beyond 5km in both Kijichi and Mbweni. In contrast, some community members from Buyuni travel more than 30km to the Ferry Fish Market as rivers traverse the area no longer contain fish. The destruction of fish spawning areas along the river course and increased demand for fish due to population growth has affected the availability of fish as one of the respondents said:

> *"Population has indeed increased, but if the fish habitats had not been disturbed, the shortage would not be as is experienced todays" (R12 11th June 2019).*

The FGDs and "Mtaa" chairpersons revealed that the shortage of fish supply has contributed to increase in prices, as the price for fish has increased over time. Mtaa is the lowest administrative unit in urban local government authorities. FGDs with community members showed that from 1985 to 1996 a bundle of 5 fish was sold between 50-200/Tshs (2-9$ cent). However, the same bundle increased to 1,000 and 10,000/Tshs (4 cent and 4$) between 2016 to date, depending on the size of the fish. At the same time, a bucket full of fish was sold from 10,000/ to 20,000/Tshs (4 to 8$) but, the same bucket was sold between Tshs 40,000/= equivalent to 17$ and 120,000/= equivalent to (51.4$) from 2006 to 2020.

Moreover, vegetation cover provides a variety of ecosystem services including energy services such as charcoal and firewood. Findings in Figure 4 indicate shortage of firewood and charcoal due to loss of vegetation cover, as participants revealed that from 1985 to 1995 community members accessed trees for making charcoal within 20 minutes. However, from 2015 onward, one of the key informants who used to make charcoal said that they spend 2 to 6hrs to get trees suitable for making charcoal from the outskirt of Dar es

Salaam City. Likewise, the price for charcoal has increased to more than 50,000/Tshs per sack (21.4$). Overdependence on charcoal as a source of cooking energy has exacerbated cutting down trees hence affecting the presence of green systems and provision of services as one of the officials from the TFS said:

> *"More than 90% of Dar es Salaam residents rely on charcoal for cooking that made wood to be cleared in large parts of the region (R26 8th November 2019).*

Loss of vegetation cover also affected the availability of firewood. Findings revealed that from 1985 to 1995, community members in the study areas used to collect firewood within 20 minutes for free. However, from 2015 to date, there has been a rapid increase in prices for a bundle of 15 pieces of firewood from 40,000-45,000/Tshs (17.2-19.3$). The price has been affected by factors such as cleared vegetation cover and the increase in distance to collect firewood. Due to the price increase, some people opt for other means, such as charcoal and gas. However, alternative sources of energy such as gas is not affordable for the majority of the urban poor who earn less than 1.5$ per day.

Some vegetation in all the study areas showed to provide different medicinal plants, but their disappearance led to difficulty in accessing herbal medicine. During the interview, it was shown that some traditional healers walked for more than two hours searching for herbal plants. Findings demonstrated that medicinal plants were commonly available until early 2000. However, from late 2000 to date, plants such as Dalbergia-melanoxylon (local name mpingo), Melicia exelsa (Mvule), Zanthoxylom challybeum (Mnangunangu), etc. are difficult to be found within Dar es Salam City as One respondent aged 77 said:

> *"My child, since I was born, I have never used contemporary medicines…. I only rely upon traditional ones; in 1985, I could walk for 10 to 20 minutes and collect it, but they are not easily found these days" (R2, 6th June 2019).*

A decline in natural vegetation has reportedly caused shortages of traditional medicine. However, it was revealed that these days few people rely on traditional medicine because of the availability of complementary medicine services.

Vegetables in Dar es Salaam is plenty except for few months in the dry season (September and October). The shortage of wild vegetables in those months was associated with changes in weather patterns which led to a decrease in the river volumes thus limiting water for irrigation and therefore negatively affecting availability as one said:

> *"Loss of water-conserving trees caused a decline in river volumes in dry season hence affected the production of wild vegetables" (Meeting with local leaders on 4th June 2019).*

Community members revealed that before 1995 they could get vegetables within their neighbourhood because of the presence of vegetation cover. However, from 1996 onward it is not easy to obtain such supply within their premises.

3.4. Initiatives to overcome the loss of vegetation cover

Following loss of vegetation cover and its subsequent effects to the community several efforts are being taken by government and non-government actors. Such efforts are like restoration of mangrove forests; restricting human activities around the mangrove forests; formation of Beach Management Units (BMU) and conservation groups. Both BMU and other conservation groups are recognized in the Tanzania Forest Policy, 1998. Also, the Forest Policy, of 1998 in section 4.1.1 (3) encourages formation of conservation groups such as Joint Forest Management (JFM), and Community Based Natural Resources Management (CBNRM) to support green systems including forests. BMU is the community organ formed by community members who are willing to support maintenance of beach areas including the rehabilitation of mangrove trees, patrolling, and protecting green systems from degradation. There are also conservation groups such as Women Mazingira na Mikoko Mbweni (Women group), Mazingira Maputo at Mbweni and SUMAWA group, and Upendo from Kijichi all dealing with rehabilitation of mangrove forest, cleanness and conducting regular patrol. However, majority of these groups are not yet registered except SUMAWA.

In 2018 TFS involved different actors from Rotary club, Aquar-farms and BMU in planting trees to recover the degraded areas of Mbweni and other areas in Dar es Salaam City (Plate 3). TFS occasionally involves BMU in supporting maintenance of green systems. It was the expectation of the BMU to get much support from TFS such as tree seedlings and other motivations; however, support is minimal and below their expectations. Likewise, conservation groups in both Kijichi and Mbweni revealed that TFS seldomly interacts with them in the rehabilitation of the green systems; something that makes other interested groups in maintenance of urban green systems lose hope due to minimal support from government authorities. During interview, TFS officials acknowledged community's efforts towards maintenance of the green systems and promised to cooperate with them and support their efforts.

The Forest Act of 2002 recommends preparing a management plan (forest Management plan) to enhance the management of the green systems. Findings revealed that every district along the coastline, including those in Dar es Salaam, have launched a program to prepare its Mangrove Management Plan since 2017 and are at different stages of preparation.

4. Discussion

The 30 resolution Landsat imagery (combined bands) of June 2000, July 2012, and July 2018 were used to formulate NDVI and NDWI in analysing changes in the green systems using ArcGIS software tool. Moreover, community views on the effects of changes and the impacts were explored. As evidenced in Figures 2 and 3, vegetation cover has decrease in Kijichi and Mbweni, although there was an increase in vegetation cover in 2012 and 2018 in Mbweni. The loss of vegetation cover is associated with various aspects such as urban expansion and other anthropogenic activities just as observed in other studies (Wu et al., 2020; Brown and Mijic, 2019). Other aspects like farming practices and illegal extraction of resources negatively affected the supply of ecosystem services. Farming and illegal extraction of natural resources including vegetation cover is not only happening in Tanzania but also in other counties in Southeast Asia (Lourdes et al., 2021). The effects include the destruction of fish spawning areas and an increase in runoff and floods during rainy seasons. The

government's efforts to protect the green system are dwindling due to inadequate support from the nearby communities because they also depend on green systems to support their livelihood that led to encroachment.

The disappearance of vegetation cover is linked to the increase in heat islands' effect and eruption of diseases. Loss of vegetation cover reduces fresh air necessary for human health as vegetation cover contributes to microclimate moderation which reduces the impact of hot weather (Ruskule et al., 2018; Baskent, 2020). Vegetation cover is essential in supporting the provision of ecosystem services linked to fresh air and conducive environment for people. Limited fresh air is accompanied with diseases that affect the health of people (Kabisch and Bosch, 2017). A study by Walf et al. (2020), showed that the presence of vegetation cover helps to improve health of people and contributes to improved socio-economic benefits among them.

The loss of vegetation cover is linked to the loss of livelihoods in these communities depending on natural resources. Similar to this study, Doggart et al. (2020); Kideghesho, (2015) found that disappearance of vegetation cover affects communities that depend on ecosystem services for sustaining day-to-day needs. The dependence on natural resources increases the loss of vegetation cover, thus the use of alternative sources of energy needs to be emphasized, and costs associated with alternative energy services such as gas and solar be reduced so as to reduce dependence on firewood and charcoal. The use of alternative sources of energy can enhance achievement of the Sustainable Development Goals especially Goal 15.

Dependence on natural resources including green systems is connected to poverty and has consistently been linked to environmental degradation. Communities living nearby green systems have been accessing ecosystem services to meet their well-being without taking precautions on the future of ecosystem systems; thus, resulting into their degradation (Gordon et al., 2000; Minja et al., 2022). Communities may play a vital role in supporting green systems when they are supported with feasible maintenance projects such as beekeeping and cultural tourism.

The loss of vegetation cover has been acknowledged by both the government and community level actors. The government is taking some initiative to address the loss of vegetation cover, and the community level actors are willing to get engaged. Unfortunately, institutional actors are not providing effective support and space to do that. The institutional structure for such actions does exist albeit not fully developed. According to Buijs et al. (2016) engaging citizens including community-level actors can result to positive outcomes to green systems, social and institutional resilience of cities, as they can utilize their resources and knowledge in supporting sustainability of cities.

5. Conclusions

The study employed ArcGIS to determine the changes in vegetation cover in Kijichi and Mbweni Green systems in Dar es Salaam City. The study analysis indicates loss of vegetation cover in Kijichi green system while there was an increase in vegetation cover in Mbweni green systems. There is an increase of water coverage in both study areas especially during rainy seasons that lead to decrease in bare land as some parts of land are occupied with water. The decline of vegetation cover contributes to an increase in urban heat islands' effect that were less felt by neighboring communities in the past. It has also resulted in the occurrence of diseases and stress among urban residents. The disappearance of vegetation cover has contributed to increased runoff and floods during the rainy season, affecting lives and loss of property, thus, affecting resilience of urban communities. Maintenance of urban green systems is important in supporting the provision of important

ecosystem services and enhancing the resilience of cities. This is also one of the priorities of the global agenda such as the Sustainable Development Goals, for example, Goal 15 requires the protection of the green systems to enhance sustainability (United Nations, 2017).

Government's efforts to maintain green systems should go hand in hand with improving the people's well-being and creating awareness on the importance of the green system besides introducing alternative and sustainable projects like beekeeping, poultry and fish farming. Responsible authorities need to cooperate with the neighboring communities in determining appropriate projects that can enable them to meet their needs and engage in maintenance of urban green systems so as to overcome challenges associated with loss of ecosystem services. Furthermore, the paper proposes a critical analysis of the roles of each actor and how each contributes to the sustainability of urban green systems. Key to this study is the issue of recognition of the role of actors and how they might be coordinated to enhance maintenance of urban green systems. Various roles undertaken by different actors need to be determined and be monitored by the respective authority. Coordination of various roles would be possible by establishing clear arrangements for engaging actors both government and non-government actors in promoting urban green systems.

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Conflict of interest

The authors declare no conflict of interest

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