REPORT ON TANZANIA CRITICALLY ENDANGERED ALOES

TaCEA-PROJECT

Aloe flexilifolia

Aloe dorotheae

Background Information

Tanzania is home to a diverse range of plant species, including several endemic and endangered species, such as *Aloe dorotheae* and *Aloe flexilifolia*. These species are primarily found in the Eastern Arc Mountains and selected regions like the Handeni District in the Tanga Region (Burgess et al., 2007). The Eastern Arc Mountains, known for their high biodiversity and endemism, provide critical habitat for numerous rare plant species. However, despite their ecological importance, the population sizes and distributions of *A. dorotheae* and *A. flexilifolia* remain poorly documented, posing challenges for conservation efforts (Schmelzer & Gurib-Fakim, 2008). Comprehensive data on these species is essential to guide effective management strategies and ensure their long-term survival. *Aloe dorotheae* has been classified as a critically endangered species due to habitat loss, climate change, and human-induced threats such as agricultural expansion, deforestation, and land degradation (CITES, 2020). Studies indicate that its natural populations have significantly declined in recent years, necessitating urgent conservation interventions (Grace et al., 2011). *Aloe flexilifolia*, although also facing environmental pressures, has not been as extensively studied, leading to a lack of detailed knowledge regarding its current conservation status and distribution (Newton, 2004). The absence of reliable population assessments and spatial distribution data makes it difficult to develop targeted conservation measures.

Accurate mapping and population assessments of *A. dorotheae* and *A. flexilifolia* are essential for their conservation. Recent advancements in Geographic Information Systems (GIS) and remote sensing provide effective tools for evaluating species distributions and monitoring changes over time (Boko et al., 2021). By conducting a detailed evaluation of the population sizes and distribution patterns of these species in the Handeni District, this study aims to provide valuable data for conservation planning. The findings will contribute to the development of evidence-based strategies for habitat protection, restoration, and policy interventions that ensure the sustainability of these threatened Aloe species.

1: Raising community awareness to promote conservation of Tanzania Critically Endangered Aloe (TaCEA)

Between March and May 2025, we conducted a series of conservation education sessions in the Lushoto, and Handeni districts of Tanga Region, aiming to raise awareness about the protection of critically endangered aloe species (*A. dorotheae* and *A. flexilifolia*). With support from village leaders and an officer from the Tanzania Forest Services (TFS), we organized community meetings in seven villages where these threatened aloe species are either known to exist or have been previously recorded. Although community turnout was modest, we engaged a total of 123 local residents: 76 from five villages in Handeni, and 47 from two villages in Lushoto. Each session primarily focused on the importance of conserving critically endangered aloe species, but we also addressed broader topics, including biodiversity conservation and the impacts of human activities on the environment.

Each meeting included a two-hour interactive discussion on the conservation of Critically Endangered Species (*A. dorotheae* and *A. flexilifolia*) and biodiversity. We shared insights on aloe conservation more generally, discussing both global opportunities and challenges, and examined the drivers of local extinction for endangered species. All sessions were officially organized by village leaders and took place within the respective communities. An important part of the meetings involved assessing local awareness about critically endangered aloe species. Nearly all participants (approximately 100%) were unfamiliar with the existence of these specific aloe plants in their villages. However, they demonstrated general knowledge about aloe plants and their traditional medicinal uses. This lack of species-specific knowledge presents a challenge for conservation efforts.

Despite these obstacles, the project significantly increased local awareness and inspired community interest in protecting endangered aloe species. During discussions, community

members also identified key barriers to their involvement in conservation, including limited education and awareness, as well as poverty. In response, the project team proposed supporting future community-based initiatives—such as beekeeping—to enhance local livelihoods while promoting sustainable conservation practices. These activities are expected to reduce pressures from illegal harvesting and strengthen local commitment to protecting endangered aloes and other vulnerable species.

Figure1: Meetings with local people during awareness raising to promote TaCEA

2: Assessment of current population and distribution status of TaCEA

This research was conducted in Handeni District, located in the Tanga Region of Tanzania. Handeni is known to support populations of *A. dorotheae* and *A. flexilifolia*, making it an ideal location for assessing their distribution and population size. The district features a range of elevations and diverse ecosystems, including rocky outcrops, dry woodlands, and semi-arid landscapes, which provided suitable habitats for these species. The study area was systematically surveyed to identify the locations and environmental conditions that support these endangered Aloe species. A mixed-method approach combining field surveys, Geographic Information Systems (GIS) mapping, and statistical analyses was employed. Fieldwork focused on direct population assessment through sampling techniques, while GIS mapping and remote sensing provided spatial insights into species distribution patterns. Statistical tools were used to analyse population densities, habitat preferences, and environmental threats.

3: Methods used

Both random and systematic sampling methods were applied to locate and document populations of *A. dorotheae* and *A. flexilifolia* across various sites in Handeni District.

- GPS coordinates were recorded for every identified population to ensure accurate geospatial mapping.

- Key environmental variables, such as soil type, altitude, slope, and vegetation cover, were noted to assess habitat preferences and ecological conditions. Individual plants were counted at each surveyed site to determine population size and density.

- The health condition of each plant was assessed, including signs of stress, disease, or habitat disturbance.

- Threats such as overgrazing, land-use changes, deforestation, and climate-related impacts were documented to understand the risks affecting population sustainability. Satellite imagery was utilized to map the spatial distribution of *Aloe dorotheae* and *Aloe flexilifolia* across Handeni District.

- Land cover classification and habitat suitability analysis were conducted using GIS software (such as ArcGIS or QGIS).

- Remote sensing data helped track historical changes in vegetation and assess potential shifts in species distribution over time.

- Descriptive statistics were used to summarize population size, density, and habitat characteristics.

- Spatial analysis using GIS was conducted to identify species distribution patterns, habitat suitability, and environmental correlations.

- Comparative analysis was carried out to assess variations in population sizes across different sites and environmental conditions.

- Statistical software (such as SPSS or R) was used for correlation analysis to examine the relationship between population trends and habitat factors.

4: Results

A field survey was carried out across 11 distinct sites in Handeni District to investigate the distribution patterns of two critically endangered Aloe species: *A. dorotheae* and *A. flexilifolia*.

The results revealed that *A. dorotheae* was present in 7 of the surveyed sites, representing approximately 63.64% of the total locations. In contrast, *A. flexilifolia* was identified in 4 sites, accounting for 36.36% of the surveyed area. These findings suggest that *A. dorotheae* has a broader distribution and may be more resilient or better adapted to the environmental conditions found in this region compared to *A. flexilifolia*, which appears to have a more restricted range. The observed differences in site occupancy may reflect variations in habitat preferences, ecological tolerances, or levels of anthropogenic pressure affecting each species. These preliminary insights are crucial for guiding future conservation planning, especially in identifying priority areas for protection and restoration efforts. Table 1 provides a summary of the number of sites where each species was recorded, the corresponding percentage of total sites, and the overall number of sites surveyed. This information contributes to a clearer understanding of species distribution within the study area and supports evidence-based conservation strategies.

Table 1: Distribution of *A. dorotheae* and *A. flexilifolia* across surveyed sites, showing the number of sites and percentage occurrence for each species.

Species	Number of sites	Percentage
Aloe dorotheae	7	63.64
Aloe flexilifolia	4	36.36
Total	11	100

4.1. Number of Individuals Counted and Documented

Aloe dorotheae

The survey documented a total of 244 individuals of *A. dorotheae* across 7 sites. The distribution and count of individuals per site are illustrated in Figure 2 and summarized in Table 2 below. A bar graph is provided to visually represent the number of *A. dorotheae* individuals documented and counted at each site. The highest number of individuals was recorded at MADEBE (90 individuals), while the lowest was at MSASA (4 individuals).

Table 2: Number of *Aloe dorotheae* individuals documented per site

Site Name	Number of Individuals
Bangu	40

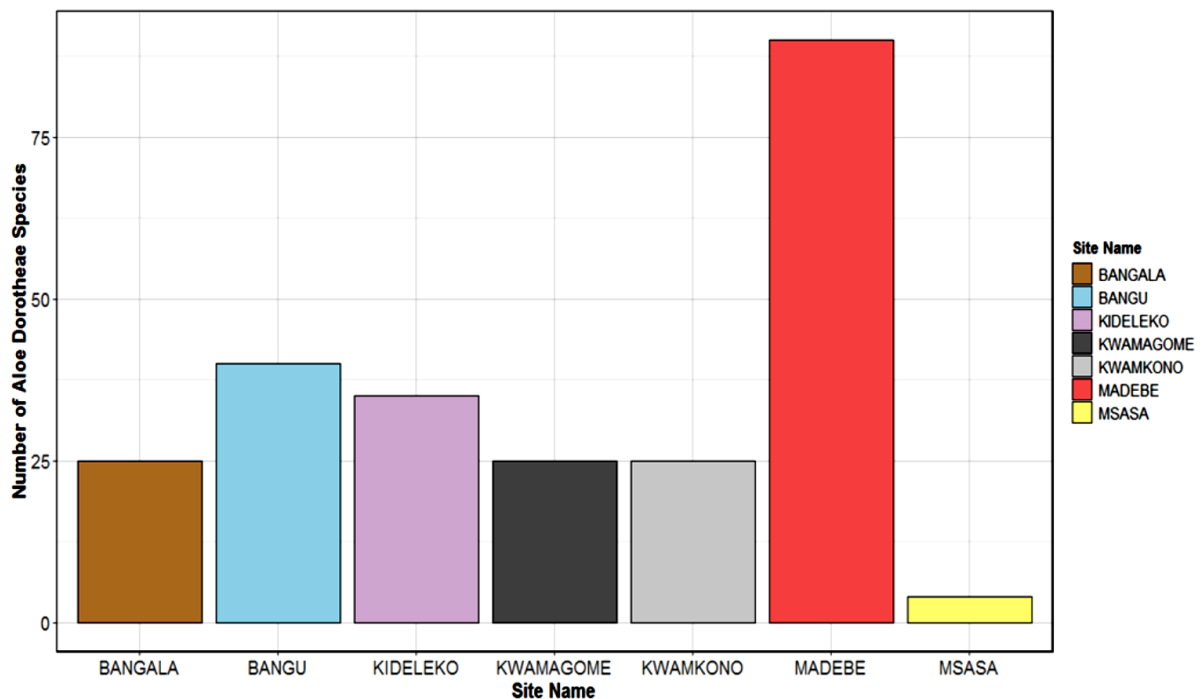|	
Kideleko	35
Kwamagome	25
Kwamkono	25
Msasa	4
Bangala	25
Madebe	90
Total	244

Figure 2: Bar graph showing the number of *Aloe dorotheae* individuals documented and counted across the 7 surveyed sites.

Aloe flexilifolia

A total of 56 individuals of *A. flexilifolia* were documented across 4 sites. The distribution of individuals per site is summarized in Table 3 and illustrated in Figure 3. The highest number of individuals was recorded at SONI (20 individuals), while the lowest was at MAWENI (8 individuals).

Table 3: Number of *Aloe flexilifolia* individuals documented per site

Site Name	Number of Individuals

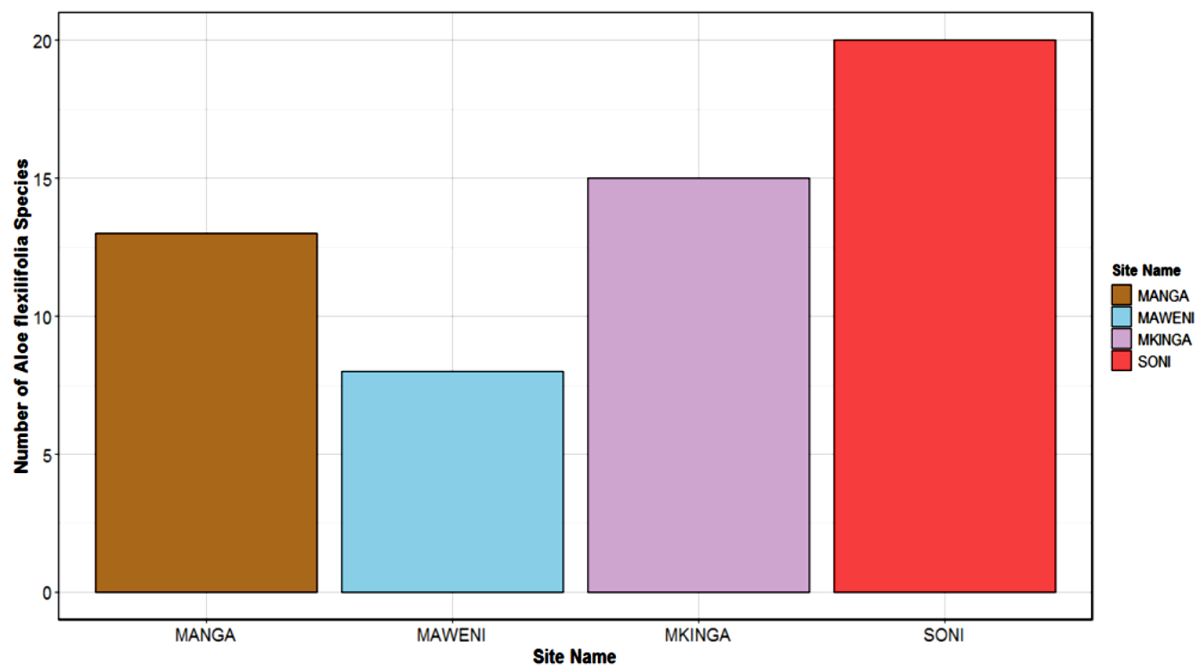|	
Soni	20
Manga	13
Mkinga	15
Maweni	8
Total	**56**

Figure 3: Bar graph showing the number of *Aloe flexilifolia* individuals documented and counted across the 4 surveyed sites.

4.2. Geographical distribution of *Aloe dorotheae*

The geographical distribution map (Figure 4) shows that *A. dorotheae* is distributed across a wide area, with the highest concentration of individuals observed at MADEBE (90 individuals), followed by BANGU (40 individuals). The species was also recorded at KIDELEKO (35 individuals), KWAMAGOME (25 individuals), KWAMKONO (25 individuals), BANGALA (25 individuals), and MSASA (4 individuals).
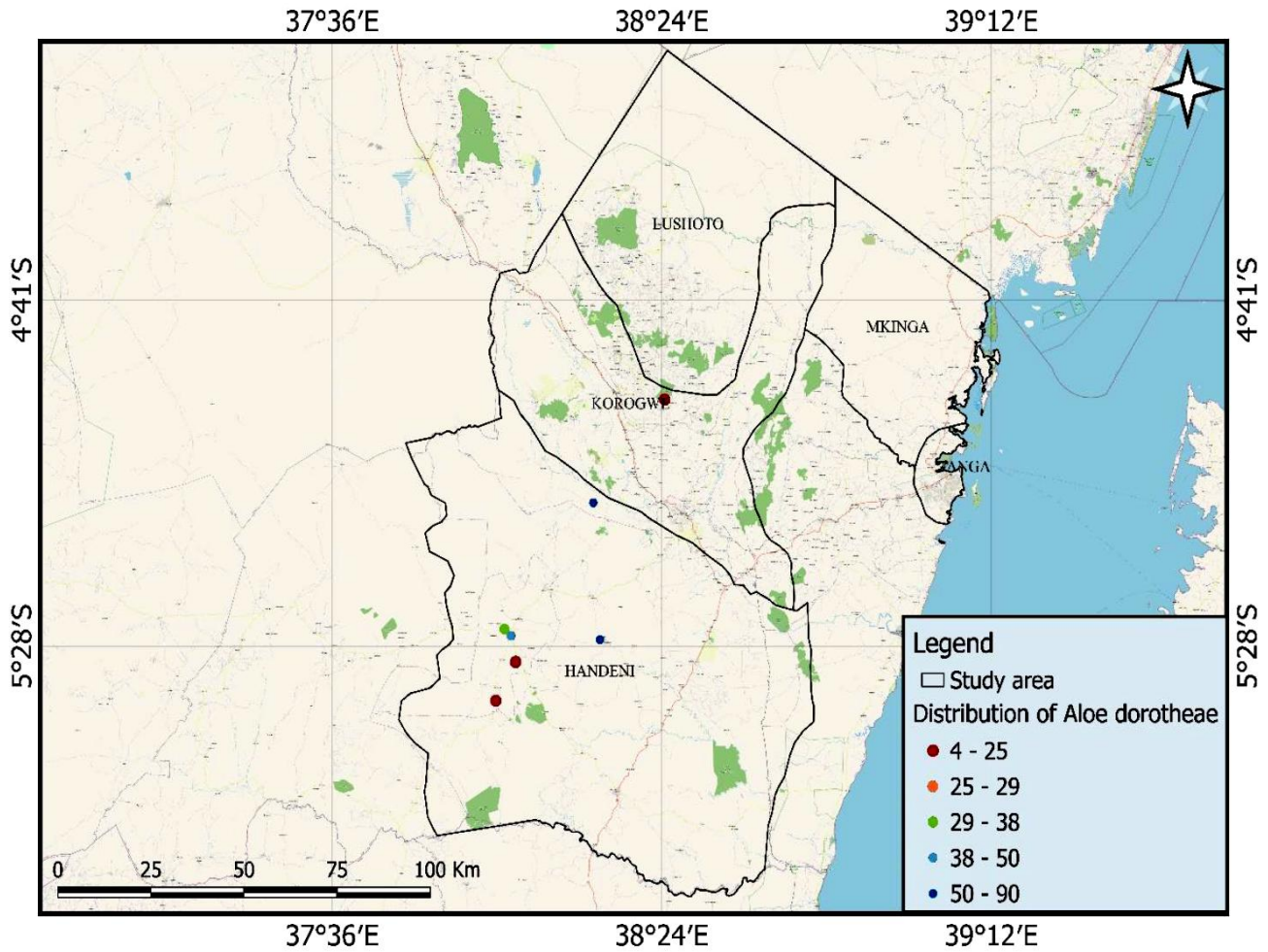
Figure 4: Map showing the geographical distribution of *Aloe dorotheae* across the surveyed sites.

4.3 Geographical Distribution of *Aloe flexilifolia*

The geographical distribution map (Figure 5) shows that *A. flexilifolia* is distributed across a smaller area compared to *A. dorotheae*, with the highest concentration of individuals observed at SONI (20 individuals), followed by MKINGA (15 individuals), MANGA (13 individuals), and MAWENI (8 individuals).
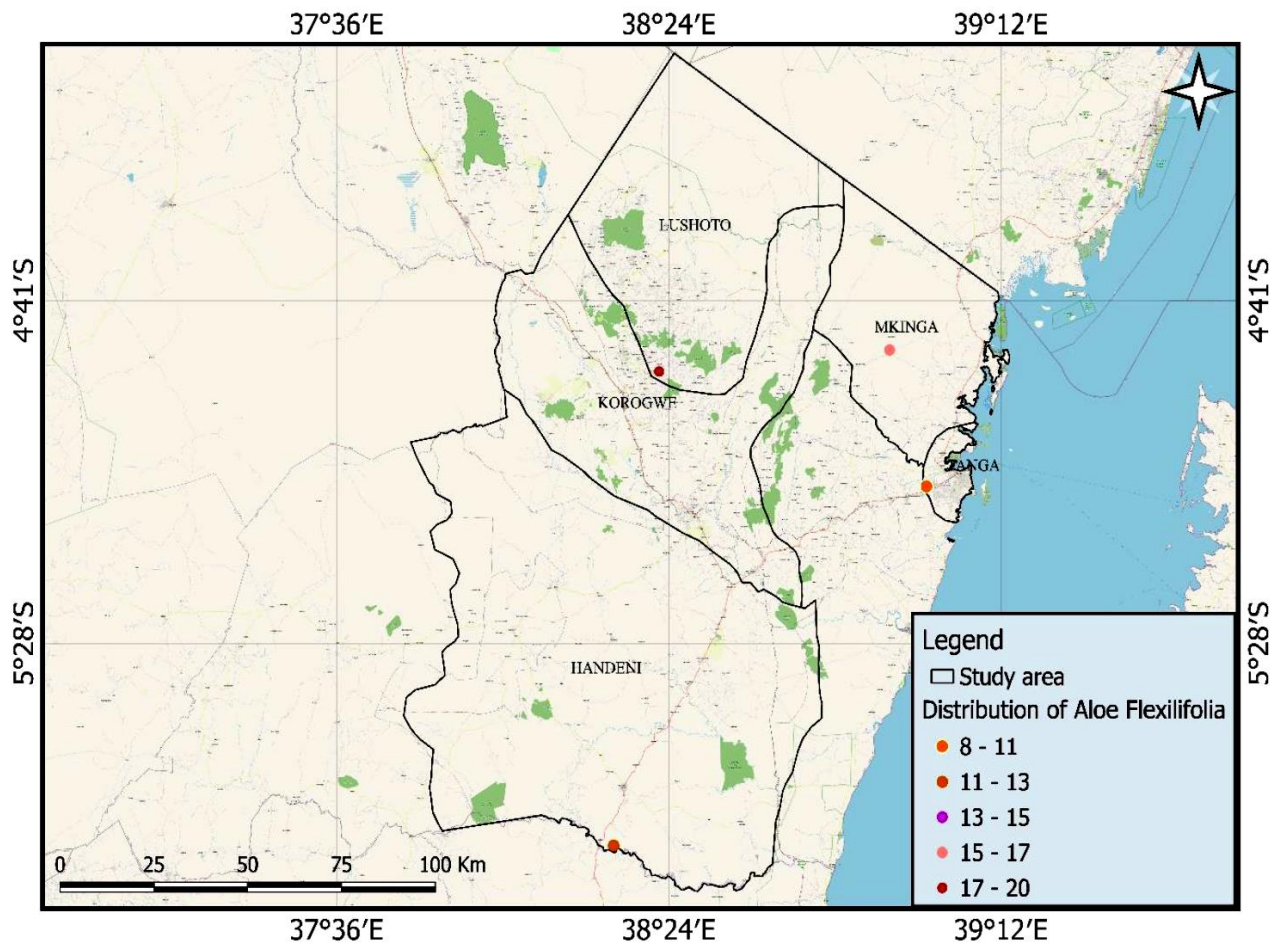
Figure 5: Map showing the geographical distribution of *Aloe flexilifolia* across the surveyed sites.

5. Threats and their proximity to TaCEA populations

5.1. Agricultural expansion

Agricultural activities, including smallholder farming and large-scale sisal plantations, are among the most significant threats to aloe populations in Handeni District. The conversion of natural habitats into farmland leads to habitat fragmentation and loss. According to Burgess et al. (2007), agricultural expansion in the Eastern Arc Mountains and surrounding areas has resulted in the degradation of critical habitats for endemic species, including aloes. In Handeni, the proximity of farmland to aloe populations exacerbates the risk of habitat destruction.

5.2. Deforestation and charcoal production

Deforestation for timber and charcoal production is a major driver of habitat loss in Tanzania. Handeni District has experienced significant forest loss due to the high demand for charcoal as

a source of energy. Blomley et al. (2008) report that unsustainable logging and charcoal production have degraded woodland habitats, which are critical for the survival of *A. dorotheae* and *A. flexilifolia*. These activities often occur in close proximity to aloe populations, increasing the risk of habitat destruction.

5.3. Overharvesting for medicinal use

Aloe species are highly valued for their medicinal properties, and overharvesting poses a significant threat to their survival. Local communities in Handeni District harvest A. dorotheae and *A. flexilifolia* for traditional medicine and commercial purposes. Carter et al. (2011) highlight that overharvesting has led to population declines in several aloe species across East Africa. The proximity of harvesting activities to aloe populations increases the pressure on these species, particularly in areas with limited enforcement of conservation regulations.

5.4. Mining activities

Mining for gemstones and other minerals is an emerging threat in Handeni District. Mining activities often result in habitat destruction and soil erosion, which can directly impact aloe populations. The Tanzania Minerals Audit Agency (TMAA, 2020) reports that small-scale mining in the region has led to the destruction of vegetation and alteration of ecosystems. Aloe species, which often grow in rocky and mineral-rich soils, are particularly vulnerable to mining activities.

5.5. Climate change

Climate change is a long-term threat that exacerbates the impacts of other stressors, such as habitat loss and overharvesting. Changes in rainfall patterns and increased temperatures can alter the ecological conditions required for the survival of *Aloe dorotheae* and *Aloe flexilifolia*. Marchant et al. (2007) suggest that arid and semi-arid regions, such as Handeni District, are likely to experience increased environmental stress, further threatening aloe populations.

5.6. Urbanization

Urban expansion and infrastructure development in Handeni District contribute to habitat loss and fragmentation. As human settlements grow, natural habitats are converted into residential and commercial areas. This threat is particularly significant in areas close to towns and major roads, where aloe populations are at risk of being displaced or destroyed.

5.7. Livestock grazing

Livestock grazing is a common practice in Handeni District and can lead to habitat degradation. Overgrazing reduces vegetation cover, increases soil erosion, and directly damages aloe plants. Livestock often graze in areas where aloe populations grow, particularly in dryland habitats, further threatening these species.

6. Conclusion

The comprehensive assessment of *A. dorotheae* and *A. flexilifolia* populations in Handeni District, Tanga Region, Tanzania, has provided critical insights into their distribution, population size, and the threats they face. The study revealed that *A. dorotheae* is more widely distributed, occurring in 63.64% of the surveyed sites, while *A. flexilifolia* was found in 36.36% of the sites. A total of 244 individuals of *A. dorotheae* and 56 individuals of *A. flexilifolia* were documented, with significant variations in population densities across sites. The highest concentrations of *A. dorotheae* were observed at MADEBE (90 individuals) and BANGU (40 individuals), while *A. flexilifolia* was most abundant at SONI (20 individuals) and MKINGA (15 individuals). The study also highlighted the severe threats to these species, including agricultural expansion, deforestation, overharvesting for medicinal use, mining activities, climate change, urbanization, and livestock grazing. Agricultural expansion and deforestation were identified as the most significant threats, accounting for 25-30% and 20-25% of habitat destruction, respectively. Overharvesting and mining activities also pose considerable risks, particularly in areas where aloe populations are concentrated. Climate change, urbanization, and livestock grazing, while less immediate, contribute to long-term habitat degradation and population decline.