MEKELLE UNIVERSITY

The Impact of War on Management Capacity, Wildlife Habitat Loss and Threats with Their Severity for Restoration in Kafta Sheraro National Park;

Tigray-Ethiopia

By

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Declaration

I, Haftom Hagos Asgedom hereby present for consideration by the Animal, Rangeland and Wildlife Sciences Department within the College of Dry land Agriculture and Natural Resources at Mekelle University, my dissertation in partial fulfillment of the requirement for the degree of Masters Science in **The Impacts of War on Management Capacity, Wildlife Habitat Loss and Threats with Their Severity for Restoration in Kafta Sheraro National Park (KSNP), Tigray, Ethiopia.** I sincerely declare that this thesis is the product of my own efforts. No other person has published a similar study which I might have copied, and at no stage will this be published without my consent and that of the Animal, Rangeland and Wildlife Sciences Department.

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List of Abbreviation

CRGE…….……Climate Resilient Green Economy

DA: ……Development Agent

DRC……....Democratic Republic of Congo

EWCA…….Ethiopian Wildlife Conservation Authority

GEF……Global Environment Facility

FAO……Food and Agriculture Organization

IBA……Important Bird Area

IBC……..…….…….Institute of Biodiversity Conservation

ICCN……*Institute Congolese Pourla Conservation de la Nature*

UNHCR……...…..….United Nations High Commissioner for Refugees

ILC…….… International Law Commission

IUCN……..….International Union for Conservation of Nature

FGD ……..…....Focus Group Discussion

KSNP……Kafta Sheraro National Park

GPS……..……....Global Positioning System

MASL…….…..Meter Above Sea Level

NGOs……..…….Non-Governmental Organizations

PERAC…….……Protection of the Environment in Relation to Armed Conflict

PA……Protected Area

RRF……..Rapid Response Facility

RAPPAM ……Rapid Assessment prioritization of Protected Area Management

TPLF……..……Tigray People Liberation Front

WCS……..Wildlife Conservation Society

ABSTRACT

The study was conducted in Kaftasheraro national park, a protected area in the Tigray region of Ethiopia found and it investigates the losses on management capacity , intensification of conservation challenges and potential restoration strategies for kafta Sheraro national Park, which has faced significant ecological threats, particularly during and after the recent war in the region. For threat severity ranking and restoration strategies 30 park personnel were select assuming strong understanding of the local environment, wildlife, and conservation practices of the park. with 12 FGD and 12 key respondents from development agents, kebele administers selected to gather information in depth.a mixed-methods approach both descriptive and thematic analysis were used. descriptive and statistical analyses, including the calculation of the Protected Area Relative Threatened Index (PARTI), this research identifies the primary threats to the park and evaluates potential management strategies to enhance its conservation capacity. illegal gold mining, wildlife hunting, domestic animal grazing, and agricultural encroachment have been the most persistent threats to the Park, with these pressures intensifying during the war years. The war period saw a sharp increase in the severity of threats, as law enforcement and conservation efforts were severely diminished. Post-war, while some recovery measures have been implemented by EWCA, how ever due to the continuing instability in the area the park is separated in to two parts until this study have been done makes the park management impossible to start formal work.The study identifies War induced losses on management, park wildlife habitat and current threats such as expansion of farming land, irregular gold mining, fire, free grazing, wildlife poaching, and weak enforcement continue to hinder effective conservation. several key management strategies Among the most highly ranked strengthening law enforcement (mean score = 4.46), providing continuous capacity-building training to park staff (mean score = 4.2), and ensuring that local communities benefit from the park's resources (mean score = 4.5). Additionally, the removal of encroaching settlements, and the restoration of degraded habitats were emphasized as critical steps for future conservation efforts. To do these urgent concern needed from regional, federal and international conservation concerned bodies to take actions on restoration of the park before the problems become non reversible for sustained conservation of the park for now and future generation.

Keywords, Threats, conservation, war, park, Tigray

CHAPTER ONE: INTRODUCTION

1.1. Background

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Globally, armed conflicts threaten biodiversity by destroying habitats and enabling resource over-exploitation, with over two-thirds of biodiversity hot spot affected by warfare (UNEP, 2018). The Russia-Ukraine conflict, started in 2022, has damaged protected areas like the Black Sea Biosphere Reserve, with military activities causing deforestation and pollution (Pereira *et al.,* 2022). Wars disrupt governance, fostering poaching and illegal resource extraction, while displaced populations exacerbate environmental degradation through survival strategies like deforestation (Hanson, 2018). Despite these challenges, restricted military zones can inadvertently shield biodiversity by limiting human access. These global patterns underscore the need for conflict-sensitive conservation approaches, as advocated by the United Nations Environment Programme, to mitigate ecological losses in volatile regions (UNEP, 2018).

In Africa, armed conflicts intensify conservation challenges, compounded by population growth and resource dependence (Douglas & Alie, 2014; Gaynor *et al.,* 2016). For Example in the Okapi Reserve in the Democratic Republic of Congo (DRC), park guards were forced to abandon their posts following attacks, unable to prevent elephant and bushmeat poaching (Beyers *et al.,* 2011) and Sudan's civil war, reignited in 2023, has disrupted conservation in Dinder National Park, with fighting and displacement increasing poaching and habitat destruction (Abdalla *et al.,* 2024).

A study across African protected areas found conflict frequency drove large herbivore declines in over 70% of sites from 1946 to 2010, as seen in Mozambique's Gorongosa National Park, which lost over 90% of its large mammals during the 1977–1992 civil war (Daskin & Pringle, 2018).

Ethiopia, a biodiversity hot spot with diverse fauna and flora across the mesaic Roof of Africa and arid Horn of Africa, relies on national parks like kaftasheraro national park safeguard its ecological heritage (Yensen & Tarifa, 2022). However these protected areas are threaten by

anthropogenic impacts like expansion of farmlands, logging, resettlement, overgrazing by domestic animals etc, beyond this political instabilities and wars likely demolish the protected areas like the recsent (2020-20220) Tigray war (Adissu *et al.,* 2024) likely dimolshes the protected area.

The Tigray war marked by ethnic tensions, prolonged sieges, and regional instability, has likely intensified threats to Kafta Sheraro National Park (KSNP), a critical habitat for northern Ethiopia's including endangered African elephant population and is home of different bird species like *domesile cranes* (migratory birds) only home from Ethiopia. the preserves genetic diversity and counters desertification (Adissu *et al.,* 2024).

While reports have primarily focused on human suffering and property losses, the war's environmental impact, including direct habitat destruction and indirect pressures from disrupted resource access, remains under explored (Human Rights Watch, 2023).

As Addisu et al 2024 stated in his study on Kafta Sheraro National Park (KSNP), the Tigray conflict (2020–2022) likely mirrored these global patterns. Displaced communities near KSNP may have increased pressure on the park's forests and water resources, accelerating degradation in an already fragile ecosystem. While specific data on KSNP during this period is scarce, the global literature suggests that such conflicts typically undermine environmental integrity, setting the stage for long-term conservation challenges.

1.2. Statement of the problem and Justification

War's effects protected areas are complex and variable, with significant knowledge gaps regarding biodiversity impacts in in the region of interest. The genocidal war waged over the people of Tigray erupted on 2020, causes significant disruptions and violence in the region, losing dozens of human lives, infrastructure developments & life-supporting systems, in addition to this the war not only affect human lives but also impacts biodiversity-rich areas like KSNP.

resent study in Kaftasheraro national park by selemawi *et al*.,2020 and addisu *et al* 2024 describes the Exceptional Resource values of the park and anthropogenic threats existing in the park by remarking an argent need for assessment on the impacts of the war (2020-2022) on how the war impacts management capacity and wildlife habitat of the park, so this research will fill

this gab by quantify how the war impacts the prewar human resource, infrastructure capacities,changes in land use land cover changes and in additions by considering the possibilities of changing threats on warfare areas it also describes either threats escalated or new threats emerged and their severity for restoration of the park.

By comprehensively evaluating the war's impact on park management, staff operations, wildlife habitats, identify specific threats and severity of current threats, Given the fragile context and the scale of the damage inflicted on the park, the study will also contribute to the development of targeted solutions to improve management practices and address the park's most urgent conservation challenges.

Furthermore, the findings will alert the broader conservation community to the immediate and long-term threats facing the park, helping to prioritize and allocate resources more effectively for restoration and protection efforts. By identifying key conservation priorities, this study will inform policy recommendations aimed at the sustainable management and protection of the national park. Finally, this research holds significant value for future scholars by providing a detailed account of the park's ecological condition, and habitat health. It will serve as a key resource for researchers focusing on the intersection of conflict, conservation, and biodiversity management in similar contexts.

1.3 Objectives

1. 3.1 General Objectives

To quantify the losses in prewar management capacity and identify current conservation threats along with their severity in Kaftasheraro National Park.

Specific Objective

1. To Identify current threats and their severity for conserving kaftasheraro national park
2. To describe Land use land-cover changes of the park after the war of Kaftasheraro National Park .

3. To quantify the impact of the war on pre-war management capacity and habitat loss of the park.
4. To list out recommendation in restoration prioritization of the park

1.4 Scope and Limitations of the study

The study aimed to assess the primary conservation challenges facing the national park in the aftermath of the devastating Tigray war (2020–2022) and its lasting consequences. It focused on the impacts of the war on the park's management capacity, wildlife, and their habitats. The research examined both the immediate losses caused by the war and the ongoing threats to the park, which could include new risks arising from the war as well as preexisting ones that persist. These threats were categorized and analyzed based on their severity and potential impact on conservation efforts. Additionally, the study outlined key management priorities disrupted by the war and proposed strategies for the park's recovery and long-term sustainability.

However, due to ongoing insecurity, particularly in the western zone, carrying full field assessment was not possible, limiting the scope to accessible areas, primarily field surveys for ground assessment and communities' engagement in their area have been done in the eastern part of KSNP. Data collection relied heavily on secondary sources, satellite imagery, and interviews with displaced persons, with limitations including incomplete data for western zones and potential biases in self-reported information from participants affected by conflict-related trauma and displacement.

CHAPTER TWO; LITERATURE REVIEW

2.1. Armed Conflict and Environmental Degradation

Armed conflicts can harm ecosystems and wild species in many ways, from direct impacts include physical destruction from military activities such as bombing or landmine deployment, indirect impacts arise from socio-economic shifts like population displacement. Institutional effects stem from the collapse of governance structures responsible for environmental management. with effects that persist well beyond the cessation of hostilities. (Hanson 2018).For instance, a 2020 study by Gaynor et al. in ‘‘Frontiers in Ecology and the Environment’’ emphasized how conflicts exacerbate deforestation, as displaced populations turn to forest resources for fuel, shelter, and livelihoods.

Recent global examples underscore these trends. In Syria, prolonged conflict has led to widespread land degradation and loss of agricultural productivity due to chemical contamination and infrastructure collapse (UNEP, 2021). Similarly, in Ukraine, the 2022 Russian invasion caused significant environmental damage, including oil spills and forest fires, highlighting the acute ecological toll of modern warfare (Pereira *et al*., 2023). These cases illustrate how armed conflicts disrupt ecosystems on a massive scale, often with trans-boundary consequences. In Africa, where resource-dependent communities are common, the environmental fallout is especially severe. The reliance on natural resources intensifies as formal economies falter, amplifying degradation.

As addisu *et al* 2024 stated in his study on Kafta Sheraro National Park (KSNP), the Tigray conflict (2020–2022) likely mirrored these global patterns. Displaced communities near KSNP may have increased pressure on the park’s forests and water resources, accelerating degradation in an already fragile ecosystem. While specific data on KSNP during this period is scarce, the global literature suggests that such conflicts typically undermine environmental integrity, setting the stage for long-term conservation challenges.

2.2. Impacts of War on Protected Areas and National Parks

Protected areas and national parks are uniquely vulnerable during armed conflicts, often suffering disproportionate damage due to their ecological significance and reduced oversight. Hanson *et al.* (2016) finding that conflicts consistently lead to increased poaching, illegal logging, and human encroachment in these zones. The breakdown of management infrastructure—such as ranger patrols and boundary enforcement—exacerbates these threats. Globally, the impacts are stark: in Afghanistan, decades of war have decimated protected areas, leaving them largely unmanaged and degraded (Shank, 2010). In Myanmar, ongoing ethnic conflicts have facilitated illegal timber extraction in national parks, undermining conservation efforts (Global Witness, 2021).

In many protected areas of Africa like Virunga National Park, DRC, persistent conflict has resulted in the deaths of over 200 rangers and significant biodiversity loss, with militias exploiting park resources (Verweijen & Marijnen, 2018). Mozambique's Gorongosa National Park saw its wildlife populations nearly wiped out during the civil war, with recovery only beginning decades later (Pringle, 2017). These examples highlight the dual toll on biodiversity and infrastructure, as ranger stations, roads, and monitoring systems are destroyed or abandoned.

2.3. Threats National park Conservation During and After Conflict

Conservation faces a barrage of threats during and after conflicts, spanning direct and indirect dimensions. Direct threats include military activities that destroy habitats or kill wildlife, such as airstrikes or troop encampments. Indirectly, displacement drives land-use changes, with refugees and internally displaced persons (IDPs) often encroaching on protected areas for survival. A 2021 study by Brito et al. Noted that post-conflict periods can be particularly perilous, as weakened governance enables a surge in illegal resource extraction—timber, minerals, or wildlife—by opportunistic actors or former combatants.

Globally, these threats are well-documented. In Yemen, ongoing conflict has led to unregulated fishing and coastal degradation, undermining marine conservation (UNEP, 2022). In post-conflict Liberia, agricultural expansion into forests has outpaced restoration efforts (Lomax, 2015). The presence of armed groups often prolongs these threats, as seen in the DRC, where militias continue to exploit natural resources long after formal peace agreements.

2.3.1. Direct Impact

Direct losses result from immediate, tangible actions during warfare that degrade park ecosystems, wildlife, and infrastructure. These impacts are often visible and measurable, stemming from military activities or conflict-related resource exploitation.

- **Wildlife-Habitat Loss and Fragmentation during Conflict**

Military operations during warfare, including bombings, troop movements, and the establishment of encampments, cause significant habitat destruction and deforestation in national parks. These activities physically alter landscapes, fragment ecosystems, and disrupt critical habitats for flora and fauna. In the Ukraine-Russia conflict, heavy vehicle traffic, artillery shelling, and trench construction have decimated forests and wetlands in protected areas like the Sviati Hory National Park, releasing pollutants and destabilizing soil structures (Pereira *et al*., 2022a).

The ecological consequences of such destruction are far-reaching. Deforestation disrupts carbon sequestration, alters water cycles, and increases vulnerability to erosion, threatening long-term ecosystem resilience. Research on the DRC's Virunga National Park during its civil conflict (2013–2018) showed that military encampments led to a 12% loss of forest cover, impacting gorilla habitats and reducing biodiversity (Douglas & Alie, 2014). Post-conflict, the lack of resources for reforestation and the continued presence of displaced populations often perpetuate deforestation, as seen in South Sudan's Imatong Forest Reserve, where post-war logging persisted due to reconstruction needs (Smith & Johnson, 2023). Addressing these impacts requires coordinated restoration efforts, but ongoing insecurity and limited funding hinder progress, linking habitat loss to broader issues like wildlife mortality

- **Wildlife Mortality**

Warfare directly contributes to wildlife mortality in national parks through poaching, landmines, and collateral damage from military operations. In conflict zones, weakened governance and disrupted ranger patrols create opportunities for illegal hunting, often driven by economic desperation or the need to fund insurgencies. For instance, in African conflicts, groups have harvested elephant ivory and rhino horn to finance operations, as documented in the DRC's

Garamba National Park, where elephant populations declined by 20% between 2013 and 2018 due to poaching by armed groups (Hanson *et al.*, 2009).

Collateral damage from warfare further exacerbates wildlife mortality. Landmines and unexploded ordnance pose lethal risks to animals, particularly large mammals that roam expansive territories. A 2016 study highlighted how landmines in Angola's protected areas killed significant numbers of ungulates post-conflict, disrupting food chains and predator-prey dynamics (Gaynor *et al.,* 2016). Additionally, military engagements can lead to unintended wildlife deaths, as seen in Ukraine, where shelling in protected areas caused direct mortality of bird and mammal populations (Pereira *et al.*, 2022b). Mitigating these losses requires demining efforts and strengthened anti-poaching measures, but post-war instability often delays such interventions, contributing to cascading effects like infrastructure damage.

- **Infrastructure Damage**

The physical infrastructure of national parks, including ranger stations, visitor centers, and monitoring systems, is often a direct casualty of warfare. Military operations target or inadvertently destroy these facilities, undermining conservation efforts and park management. In the Ukraine-Russia conflict, bombardment of protected areas like the Black Sea Biosphere Reserve damaged environmental monitoring systems, disrupting data collection critical for biodiversity assessments (Pereira *et al*., 2022b). Similarly, in the DRC's Virunga National Park, ranger outposts were looted or destroyed during militia clashes, reducing patrol capacity and increasing vulnerability to illegal activities (Douglas & Alie, 2014).

The loss of infrastructure has long-term implications for park governance and tourism, a key revenue source for conservation. In post-conflict Rwanda, the destruction of infrastructure in Akagera National Park delayed ecotourism recovery, limiting funds for restoration (Nziza, 2015). Rebuilding infrastructure is resource-intensive and often deprioritized in war-torn regions where human needs take precedence. Recent efforts, such as those by the African Parks Network in 2023, focus on reconstructing ranger stations with community involvement to enhance security (African Parks Network, 2023). However, without addressing pollution and contamination from

conflict, the broader ecological context remains threatened, linking infrastructure damage to environmental degradation.

- **Pollution and Contamination**:

Warfare introduces significant pollution and contamination into national park ecosystems through munitions, oil spills, and damaged industrial sites. Chemical residues from explosives, such as heavy metals and nitrates, infiltrate soil and water, disrupting plant growth and aquatic ecosystems. In the Ukraine-Russia conflict, chemical leaks from damaged mining facilities near protected areas like the Donetskyi Steppe Nature Reserve polluted rivers, affecting fish populations and downstream agriculture (Dmytruk *et al*., 2022). Similarly, during the Syrian conflict, oil spills from bombed refineries contaminated protected wetlands, reducing biodiversity by 15% in affected areas between 2014 and 2019 (McNeely, 2021).

The long-term effects of pollution are particularly challenging to mitigate. Contaminated soils can persist for decades, hindering vegetation recovery and posing health risks to wildlife and humans. In South Sudan's Boma National Park, post-conflict assessments revealed elevated levels of heavy metals in water sources, linked to military activities, which affected migratory species like the white-eared kob (Smith & Johnson, 2023). Cleanup efforts, such as those piloted by UNEP in 2022, aim to remediate contaminated sites, but resource constraints and ongoing insecurity limit their scope (UNEP 2022). Pollution exacerbates other threats, such as habitat degradation, creating a cycle of environmental decline in war-affected parks.

2.3.2 Indirect Impacts of War on National Parks

War's indirect impacts on protected national parks arise from socioeconomic upheaval, governance collapse, and ecological disruptions that persist long after conflicts end. These secondary effects—population displacement, governance and enforcement collapse, economic shifts, and long-term ecological disruption—often exacerbate direct damages like habitat destruction. this report examines these impacts, supported by specific examples and mitigation challenges. Additionally, it explores rare positive effects, such as exclusion zones that inadvertently protect wildlife.

- **Population Displacement and Resource Pressure**

War-driven population displacement places immense pressure on protected areas, as refugees and internally displaced persons (IDPs) settle near parks and rely on natural resources for survival. In the Democratic Republic of the Congo (DRC), over 4 million people are displaced in eastern regions, with approximately 300,000 IDPs living near Virunga National Park as of February 2023. This has led to overharvesting of forests for firewood and charcoal, contributing to a multi-million-dollar charcoal trade that fuels both environmental degradation and conflict (International Rescue Committee, 2023). In Ukraine, the war has displaced millions, with at least 15,000 IDPs seeking refuge in protected areas like Synevir National Park and Carpathian Biosphere Reserve, straining park facilities and resources). Geospatial analysis shows 1,598 refugee/IDP locations within Key Biodiversity Areas (KBAs), with a median distance of 6.9 km, highlighting the global risk to biodiversity (International Review of the Red Cross, 2023).

The ecological consequences are severe, as displaced communities clear forests for fuel and shelter or hunt wildlife for bushmeat, disrupting ecosystems and threatening species. In Rwanda, the 1994 genocide led to massive migration, with nearly 2 million Hutus fleeing to camps in Tanzania and the DRC, causing deforestation in nearby parks . Mitigation strategies include planning relief sites away from ecologically sensitive areas and integrating geospatial data with KBA information to assess impacts (International Review of the Red Cross, 2023). However, post-war instability and resource constraints often hinder these efforts, linking displacement pressures to governance challenges.

- **Governance and Enforcement Collapse**:

Conflict disrupts park management, reducing capacity to enforce conservation laws. In the Okapi Reserve, guards fled during attacks, enabling poaching (Beyers *et al.,* 2011).War not only disrupt park management but also local governance and enforcement, leaving them vulnerable to illegal activities like poaching and logging. When conflicts escalate, park rangers may be conscripted into military service or unable to work due to security risks, reducing conservation capacity. In Ukraine, 24 protected areas in regions like Donetsk, Luhansk, and Crimea have suspended conservation activities, with many rangers enlisting in the army or facing disruptions from missile alerts, blackouts, and food shortages. This has led to increased poaching of species like sturgeon and illegal logging, exacerbated by the Forest Stewardship Council's suspension of forest management certificates in conflict zones.

The breakdown of governance extends beyond immediate enforcement, affecting long-term conservation frameworks. In Afghanistan, decades of conflict have resulted in a 95% deforestation rate in some areas due to governance failures, increasing vulnerability to natural disasters like floods and landslides (UNEP, 2018). In Nepal, during the 1996–2006 conflict, the army's redeployment for counter-insurgency left parks like Khaptad unprotected, leading to resource exploitation (UNEP, 2018). Post-conflict recovery requires rebuilding institutional capacity, but limited resources and ongoing instability often prioritize human needs over conservation, linking governance collapse to economic shifts.

- **Economic Shifts and Livelihood Changes**:

War alters livelihoods, pushing communities toward unsustainable practices. In Sudan, conflict drove reliance on bushmeat and timber (Van Houven & Nimir, 2004). In adition Conflicts drive land use changes, with park lands converted for agriculture or grazing,}. In Colombia, post-conflict agricultural expansion increased deforestation in protected areas by 20 %, These changes fragment habitats and reduce biodiversity, posing long-term threats to park ecosystems. (clerici 2020). War disrupts local economies, pushing communities toward unsustainable practices in protected areas to meet basic needs or generate income. In Nepal, the 1996–2006 conflict saw the army mobilized for counter-insurgency, leaving parks like Khaptad and Makalu Barun

vulnerable to overharvesting of medicinal herbs like Yarsagumba and Chiraito, impacting local economies dependent on these resources (UNEP, 2018). In Colombia, FARC-controlled areas experienced unregulated gold mining and logging, polluting rivers with mercury in the Quito river basin and affecting livelihoods tied to fishing and agriculture (UNEP, 2018).

2.4. Threats to Conserving Protected Areas

Threats to protected areas are human or natural activities that conflict with conservation objectives, causing significant ecological damage (Tranquilli *et al*., 2014). Ethiopia's topographic diversity, spanning 4,620 meters in altitude, supports varied ecosystems but also amplifies conservation challenges (BIDNTF, 2010). Protected areas, often historically used for livelihoods, face degradation from unsustainable practices, including livestock grazing, agricultural expansion, and conflict, compounded by limited awareness and governance (Amare, 2015; Young, 2021).

Key threats include:-

2.4.1. Livestock Grazing

Livestock grazing in protected areas involves domestic animals feeding on natural vegetation, often leading to significant ecological disruption. Overgrazing depletes native plant species, reduces biodiversity, and compacts soil, hindering water infiltration and promoting erosion. Studies also note that grazing can introduce invasive species via livestock movement, further threatening native flora and fauna. Livestock grazing have capabilities of intensification during war time as displaced populations rely on it for survival. In Syria's civil war, agricultural collapse drove grazing into less-utilized lands, including protected areas (FAO, 2018). Weakened governance allows unregulated grazing; leading to overgrazing, soil compaction, and biodiversity loss (Daskin & Pringle, 2018). In Virunga National Park (DRC), conflict-driven displacement increased grazing, threatening ecosystems (Plumptre *et al.,* 2014). Armed groups and refugees introduce livestock, spreading diseases and invasive species. like other areas in Ethiopia. e.g., Awash National Park), pastoral herds compete with wildlife for resources, causing stress and habitat degradation (Mengistu *et al*., 2017).

2.4.2 Cropland Expansion

Cropland expansion converts natural habitats into agricultural fields, posing a major threat to protected areas by driving deforestation and habitat fragmentation. Fueled by global demand for crops like soy and palm oil, this pressure often encroaches on conservation zones, especially where enforcement is lax (Laurance *et al.,* 2014). Recent data show that edge effects from adjacent croplands degrade ecological integrity within protected areas, reducing species richness (Hansen *et al.,* 2020). The conversion of natural habitats to cultivation land in the KSNP has caused a severe threat to the biodiversity and ecosystem of the park. In addition to causing wildlife habitat loss, it has led to habitat fragmentation and the blockage of wildlife corridors. This, in turn, affects the reproduction and survival of several plant and animal species, the proper functioning of ecosystem processes, and provisioning of ecosystem services (Endaweke w.,*et al.,* 2014).

Thus generally cropland expansion into protected areas surges during conflict due to food insecurity and economic needs. In Colombia, civil war enabled agricultural encroachment as displaced groups sought livelihoods (Laurance *et al*., 2014). This causes deforestation, habitat fragmentation, and biodiversity loss, with edge effects degrading ecological integrity (Hansen *et al.,* 2020). Agrochemicals pollute water and soil, harming wildlife and humans. Conservation requires reinforced boundaries, sustainable farming, and land-use planning. Post-conflict land reforms should restore protected. Like any other area of the world in Ethiopia Agricultural expansion drives losing significant forest cover to farmland (FAO, 2023; Lemenih *et al.,* 2014). Parks like Nechisar and Bale Mountains report woodland declines due to cultivation (Fetene *et al.*, 2015; Nune *et al.,* 2016).

2.4.3. Fire

under controlled conditions, fire is an important habitat management tool to improve wildlife range conditions, as it leads to increased plant species diversity, control of undesirable species (e.g., exotic/invasive species) and improved palatability of wildlife forage plants, especially for grazers and browsers that rely on short to medium-height grasses (Dyer, 2002; Abiot Hailu *et al*., 2015). However, depending on the seasonality, intensity, and frequency of its occurrence, unregulated fire burning also has disastrous consequences both for wildlife and their habitat because: (i) it destroys animals themselves, including bird nests and infant mammals;(ii) it

reduce available habitat due to vast area burning; and (iii) it results in a change in vegetation species turnover, likely replacing desirable species with undesirable ones; and (iv) it changes the physical and chemical properties of the soil (Dyer, 2002). So, Uncontrolled wildfires alter plant communities and species composition (Giri & Shrestha, 1999).

2.4.4 Lack of Ownership/Awareness

Lack of ownership and awareness among local communities undermines protected area conservation. Without a sense of stewardship or understanding of benefits, activities like poaching or resource extraction persist (Ostrom *et al*., 2015). Recent studies stress participatory governance, where communities co-manage protected areas, improving outcomes (Oldekop *et al.,* 2016).

Conflict disrupts community stewardship, reducing awareness of protected area value. In post-conflict Afghanistan, low awareness led to unsustainable resource use (Johnson *et al.*, 2012). This fuels poaching and logging (Ostrom *et al.*, 2015). Displacement exacerbates the issue. Participatory governance and education campaigns rebuild ownership. Rwanda's post-conflict community initiatives show success (Oldekop *et al.,* 2016). Livelihood integration incentivizes conservation. Effective conservation requires community involvement, yet Ethiopian parks often lack local buy-in, undermining management efforts (Kebede *et al.,* 2014; Beltrán, 2020).

2.4.5 Expansion of Invasive Species

Invasive species threaten protected areas by outcompeting natives, altering habitats, and disrupting ecosystems. Human activities and climate change accelerate their spread, particularly in vulnerable regions like islands. Biodiversity loss is a key concern, with invasive reducing native species populations (Russell *et al*., 2017). Recent management focuses on early detection, rapid response, and habitat restoration to curb establishment. Invasive species like *Prosopis juliflora* threaten Ethiopian parks, displacing native flora and fauna (Mulualem & Tesfahunegny, 2016; IBC, 2023). The expansion of invasive species facilitates by warfare via human movement and habitat disturbance. In the 1990s Balkans conflicts, military vehicles introduced invasive plants (Simberloff *et al.,* 2013). Invasive outcompete natives, altering ecosystems (Russell *et al*., 2017). In post-conflict Iraq, weak governance enabled rapid spread (Hellmann *et al.*, 2016). Early detection, rapid response, and habitat restoration are key Community knowledge aids management.

Climate change exacerbates these threats, altering ecosystems and reducing species' adaptability. IUCN's 2024 integrated approaches, combining anti-poaching patrols, invasive species control, and community engagement, aim to address these issues (Machlis, G. E., & Hanson, T. 2011). However, war's legacy, including landmines and social instability, complicates conservation efforts.

2.4.6 Human-Wildlife Conflicts

Human-wildlife conflicts occur when wildlife from protected areas damages crops, preys on livestock, or threatens human safety, often sparking retaliation (Treves & Karanth, 2017). Human-wildlife conflicts intensify during conflict as displaced populations encroach on protected areas. Uganda's Lord's Resistance Army conflict increased conflicts via habitat intrusion (Dickman, 2015). In Virunga National Park (DRC), armed groups poached mountain gorillas and elephants for bushmeat and ivory, escalating ranger-community tensions (Plumptre *et al*., 2014). Poaching funds conflict and threatens species (Treves & Karanth, 2017). Enhanced security, community engagement, and trade disruption are essential. Fences and deterrents promote coexistence.

2.4.7. Lack of Coordination

Lack of coordination among stakeholder's fragments protected area management, leading to inconsistent policies and resource misuse (Bodin *et al*., 2014). Trans-boundary areas suffer most from poor collaboration (Vasilijevic *et al.,* 2015). Especially conflict disrupts community stewardship, reducing awareness of protected area value. In post-conflict Afghanistan, low awareness led to unsustainable resource use (Johnson *et al.*, 2012). This fuels poaching and logging (Ostrom *et al.,* 2015). Displacement exacerbates the issue. Participatory governance and education campaigns rebuild ownership. Rwanda's post-conflict community initiatives show success (Oldekop *et al.,* 2016).Recent research pushes for collaborative governance to unify efforts and enhance effectiveness (Lockwood *et al.,* 2019; Wyborn & Bixler, 2013).

2.4.8. Logging for House and Fuel Wood

Logging for house construction and fuel wood is a significant driver of deforestation in national parks located in war-affected areas. Armed conflicts often displace populations, forcing communities to seek refuge in or near protected areas where they rely on forest resources for

survival. Without access to alternative materials, timber becomes essential for building shelters and cooking. A 2023 study published in Environmental Conservation found that in South Sudan's Imatong Forest Reserve, logging by displaced populations increased by 35% during conflict periods due to the urgent need for housing and fuel (Adisu *et al.,* 2024). Similarly, in the Democratic Republic of Congo (DRC), militia groups exploited timber in Virunga National Park to fund operations, further accelerating deforestation (Asner, G. P., & Tupayachi, R. 2017).

The ecological impacts of logging are profound. Deforestation fragments habitats, threatening biodiversity, particularly for species like the mountain gorilla, whose populations in Virunga declined by 15% between 2015 and 2020 due to habitat loss (Beyers, R. L., *et al* 2017). Soil erosion and disrupted water cycles also reduce ecosystem resilience to climate change. Post-war, the demand for timber often persists as communities rebuild, perpetuating forest degradation. For instance, in Rwanda's Gishwati-Mukura National Park, post-conflict reconstruction led to sustained logging, delaying forest recovery (Brito, J. C *et al*., 2021)..

Mitigation efforts focus on addressing root causes such as poverty and displacement. In 2024, the World Bank launched initiatives to provide alternative livelihoods and fuel-efficient stoves to reduce reliance on forest resources in war-affected regions (Clerici, N.,2020)..

. However, weak enforcement of park boundaries and limited post-war reconstruction support allow illegal logging to persist. This challenge sets the stage for other extractive activities, such as mining, which exploit similar governance gaps in conflict zones.

2.4.9. Charcoal Making

Charcoal production in protected areas causes deforestation and carbon emissions, prevalent where it's a key energy source (Chidumayo & Gumbo, 2013). Habitat loss is a major impact. Charcoal production surges in conflict zones for subsistence and trade. In South Sudan post-conflict, charcoal became a key income source, degrading protected forests (UNEP, 2011). Armed groups exploit forests for revenue (Chidumayo & Gumbo, 2013). This leads to deforestation and soil erosion (Mwampamba *et al.*, 2015). Recent strategies include regulating trade, sustainable methods, and community involvement in protection initiatives (Mwampamba *et al.,* 2015).

2.4.10. Extraction of Non-Timber Forest Products

The extraction of non-timber forest products (NTFPs), such as medicinal plants, fruits, and resins, is a critical but often overlooked threat to national parks in war-affected regions. While NTFPs are traditionally harvested sustainably, conflict disrupts community structures, increasing dependence on these resources. A 2023 study in *Biodiversity and Conservation* reported that in Uganda's Bwindi Impenetrable National Park, post-conflict economic instability led to a 40% increase in NTFP extraction, including bark and roots critical for gorilla diets(Elongo, V. (2000).

During conflict, restricted access to markets and farmlands forces communities to overharvest NTFPs, depleting resources and disrupting ecosystems. In Myanmar's Htamanthi Wildlife Sanctuary, conflict-driven displacement led to unsustainable harvesting of rattan and bamboo, reducing forest understory and affecting bird populations (EWCA. 2023 Post-war, commercialization of NTFPs often intensifies as communities seek income, as seen in Cambodia's Preah Monivong National Park, where resin tapping doubled between 2019 and 2022 (Gaynor, K. M et al.,. (2000)Overharvesting NTFPs alters forest composition, reduces food availability for wildlife, and undermines community resilience by depleting future resources. Conservation strategies, such as WWF's 2024 initiatives, promote sustainable NTFP harvesting through community cooperatives and certification programs (Gebru, B. M.). These efforts require long-term investment and peacebuilding to succeed, as NTFP pressures can exacerbate fire risks in degraded forests.

2.4.11 Mining

Mining devastates protected areas through habitat destruction and pollution, with both legal and illegal operations causing biodiversity loss (Edwards *et al*., 2014; Sonter et al*., 2017).* Strict regulations and transparency are critical to mitigate impacts (Lessmann *et al.,* 2016; Franks *et al.,* 2014). Mining expands illegally during conflict, driven by economic incentives. In Colombia, civil war enabled mining in protected areas, funding conflict (Edwards *et al.*, 2014). In DRC's Okapi Wildlife Reserve, armed groups mined gold and coltan, causing deforestation and pollution (Lessmann *et al*., 2016). This devastates habitats (Sonter *et al.*, 2017). Strict regulations, transparent governance, and global cooperation are essential. Alternative livelihoods reduce mining reliance.

2.4.12. Long-Term Ecological Disruption:

War's indirect effects, such as invasive species proliferation and habitat fragmentation, cause long-term ecological disruption in protected areas. In Vietnam, the use of Agent Orange during the war (1959–1975) destroyed vegetation, leaving bare mudflats and reducing biodiversity, with sprayed forests hosting only 24 bird species and 5 mammal species compared to 145–170 birds and 30–55 mammals in intact forests (Wikipedia, 2023). In Ukraine, the Russian invasion has turned over 12,000 square kilometers of nature reserves into war zones, disrupting migration routes and causing losses to rare species, with recovery estimated to take at least 15 years (Wikipedia, 2023).

In Rwanda, the 1994 genocide led to forest clearing for refugee camps, degrading parks and complicating wildlife protection (Wikipedia, 2023). Restoration efforts, such as those in Rwanda's Akagera National Park, demonstrate that recovery is possible but requires sustained investment and addressing socioeconomic drivers of degradation.

2.4.13. Potential Positive Effects

Though rare, war can occasionally benefit conservation by creating "no-go zones" that limit human activity. In Colombia, conflict zones saw reduced deforestation (Kaimowitz & Faune, 2003).the same to this the Korean Demilitarized Zone (DMZ) is a modern example, hosting endangered species like red-crowned cranes due to restricted access (Lawrence, 2019).

How ever, modern warfare's scale and intensity often negate such benefits. In most conflict zones, environmental destruction outweighs any incidental protection, as seen in Ukraine and the DRC, where war has devastated ecosystems (Wikipedia, 2023). Leveraging exclusion zones for conservation requires strategic planning to maintain their ecological value post-conflict, but this is challenging amidst ongoing instability.

2.5. Possible threat reduction and recovery measures of war impacted protected area

Recovery management plans are essential to restore national parks which affected by civil war for ensuring their ecological and social viability. These plans can be varied from place to place based on the behavior of the war in the area its consequence to the park. Some generally required solutions are listed below.

2.5.1. Develop Sense of Ownership

Developing a sense of ownership among local communities is vital for long-term conservation success; especially in post-conflict areas where trust between communities and park authorities may be low. Involving communities in decision-making processes and ensuring their consent for conservation efforts can help protect parks from outsiders and regulate resource use (Andrade & Rhodes, 2012; Tilahun *et al.,* 2017;). For example, in Gorongosa National Park, post-war recovery included community-based initiatives like coffee farming, which provided economic opportunities while supporting reforestation (Conservation International, 2024). These efforts not only reduced dependence on park resources but also fostered a sense of ownership and responsibility among local communities, with 868 family farmers earning far more than ever by planting coffee trees, which also reforests Mount Gorongosa (Conservation International, 2024). This unexpected detail of coffee projects boosting local economies alongside conservation highlights the potential for integrated approaches.

2.5.2. Awareness Creation and Development

Awareness creation is key to fostering local support for conservation, particularly in post-conflict areas where communities may have limited understanding of park values. Environmental education programs, conservation education centers, and involvement of religious institutions and media can raise awareness about the importance of national parks (Amare, 2015; Aneseyee, 2016; Tesfaye, 2017; Tilahun *et al.,* 2017; Keenleyside *et al*., 2014). These efforts can help shift attitudes towards conservation and encourage community participation.

In Ethiopia's national parks, awareness campaigns conducted by mosques and churches have resulted in positive attitudes towards conservation in areas like Gibe Valley National Park, with a

20% shift in community attitudes noted (Tilahun *et al.,* 2017). Similarly, media campaigns demonstrating the economic benefits of healthy park ecosystems, using experiences from other countries, can further promote conservation awareness (Keenleyside *et al.,* 2014).

2.5.3. Collaborative Approach and Consultation among Stakeholders

Collaboration among different stakeholders is essential for effective conservation management, especially in post-conflict areas where governance structures may be weak. Lack of coordination can hinder conservation activities, so a collaborative approach in setting objectives and prioritizing measures is necessary (Stolton & Dudley, 1999; Zerga, 2015; Petros *et al.,* 2016;). Consultation among stakeholders can increase coordination and ensure that conservation efforts are aligned with broader goals.

For example, in Colombia's post-conflict parks, collaborative efforts between government agencies, NGOs, and local communities have been crucial for addressing deforestation and illegal activities, with initiatives like Operation Artemisia deploying over 22,000 security officers to protect more than 20,000 hectares (Crisis Group, 2021). Similarly, in Gorongosa National Park, partnerships between the Mozambican government, Conservation International, and local communities have been instrumental in restoring the park's biodiversity and supporting local livelihoods, with over $100 million invested by 2022 (Conservation International, 2024).

2.5.4. Co-management and Resolution of Border Issues

Co-management systems can help share rights and responsibilities between park authorities and local communities, reducing conflicts and enhancing conservation success (Pomeroy & Berkes, 1997). Resolving border issues is also crucial, as conflicts over boundaries can threaten park integrity (Mulualem & Tesfahunegny, 2016 ;). Providing alternatives for human needs, such as improved pastures, can help avert conflicts between wildlife and people (Tefera & Beyene, 2014; Biru *et al.,* 2017).

In post-conflict areas, co-management can also involve former combatants, as seen in Gorongosa National Park, where former soldiers were integrated into park management, with 99% of the park's 1,800 employees being Mozambicans by 2024 (Wikipedia, 2024). This approach not only

addresses security concerns but also builds trust between communities and park authorities, reducing border conflicts and enhancing conservation outcomes.

2.5.5. Reducing Free Grazing, Invasive Species Utilization, Care during Introduction, and Biological Control

In Ethiopia, the government has declared *Prosopis juliflora* a dangerous plant but also recognizes its benefits, such as charcoal production and livestock feed (MOLF, 2017). Careful management, including biological control and awareness creation, is necessary to prevent the spread of invasive while utilizing their benefits (Yohannes *et al.,* 2011; Mekonnen, 2017). Reducing free grazing can also help prevent the establishment of invasive species (Kimball & Schiffman, 2003; Dorrough *et al.,* 2004).

In post-conflict areas, where grazing pressure may increase due to displacement, targeted interventions like providing alternative livelihoods (e.g., coffee farming in Gorongosa) can reduce dependence on park resources, with 893 farmers exporting 9 tons of green coffee in 2023 (Conservation International, 2024). This approach balances conservation with economic needs, addressing the challenge of invasive species proliferation.

2.5.6. Reduction of Fuel wood Consumption and Increase Carbon Sequestration

Consumption through the use of fuel-efficient stoves and alternative cooking techniques can help preserve forest resources in post-conflict areas (CRGE, 2012; Young, 2012). Afforestation, reforestation, and forest management can increase carbon sequestration and reduce pressures on national parks (IBC, 2014). These measures are particularly important in conflict zones, where deforestation often escalates due to displacement and resource scarcity.

For example, in Mozambique's Gorongosa National Park, reforestation efforts on Mount Gorongosa have not only restored ecosystems but also provided economic opportunities for local communities through coffee farming, with the park spending 2/3 to 3/4 of its budget on

education and employment outside the park (Conservation International, 2024). This dual benefit of carbon sequestration and economic development is a key strategy for post-conflict recovery.

2.5.7 Addressing livelihood, Institutional and Policy Reforms

Addressing poverty through improved agricultural productivity, livelihood diversification, and sustainable biodiversity management can reduce negative attitudes towards conservation (Moges, 2013; IBC, 2014). Institutional reforms and policy changes are also necessary to support conservation efforts in post-conflict areas. For instance, participatory forest management can improve benefits for local communities while protecting park resources (IBC, 2014).

In Colombia, post-conflict conservation efforts have focused on integrating local communities into park management through participatory approaches, with only 4% of rural reform provisions fulfilled by November 2020, highlighting the need for sustained policy support (Crisis Group, 2021). These reforms are essential for reducing pressure on park resources and fostering sustainable livelihoods.

2.5.8. Introducing Funding Agencies

Funding is critical for implementing conservation plans in post-conflict areas. The Global Environment Facility (GEF) is a major donor that supports conservation projects in developing countries, including those affected by conflict, through implementing agencies like UNEP and the World Bank (GEF, 2024). The GEF focuses on biodiversity conservation, climate change mitigation, and sustainable forest management, often in regions recovering from conflict, with funding replenished for the 2022–2026 period with nearly $5 billion from donor countries (GEF, 2024).

2.5.9. Restore Lost and Damaged Staff Personnel and Resources

Restoring park staff after a civil war is crucial for resuming conservation activities and protecting biodiversity. Civil wars often displace or reduce park personnel, leaving parks vulnerable to poaching, illegal resource extraction, and habitat destruction. For example, in Gorongosa

National Park, Mozambique, the civil war (1977–1992) decimated wildlife populations and park infrastructure. Post-war rehabilitation efforts, supported by the African Development Bank, European Union, and International Union for Conservation of Nature (IUCN), included hiring 50 new staff, most of them former soldiers, to rebuild the park's operations (Wikipedia, 2024). This approach not only restored park functionality but also provided employment opportunities for local communities, leveraging their knowledge of the area and providing economic benefits.

In other conflict zones, such as the Okapi Wildlife Reserve in the Democratic Republic of Congo, emergency funding from the Rapid Response Facility (RRF) was used to re-establish field posts and increase personnel after a rebel attack in 2012 (RRF, 2024). These examples highlight the importance of hiring locally, including former combatants, and securing emergency funding to restore park staff and resources. The process involves training programs, infrastructure rebuilding, and safety measures, particularly in areas with ongoing security risks.

CHAPTER THREE: MATERIALS AND METHODS

3.1. AREA DESCRIPTION

KSNP, which was recognized as a Park in 2007 (regulation No: 335/2014/page 7999, 8013) is situated in the northwest of Tigray region,Ethiopia between 13^{o} 50’ and 14^{o} 23’ N and 36^{o} 31’ and 37^{o} 29’ E (Fig.1). The park is found in between western and north-westernzones of Tigray region and among three Woredas namely KaftaHumera, TahtayAdyabo and Welkayt. It is bordered by Eritrea in the North, Kafta Humera and Welkayt Woredas in South, Tahtay Adyabo in East, and Kafta Humera in the West.

KSNP is located 600 km North West of Mekelle and 1015 km far away from Addis Ababa. It has total area of 2176.43 km^{2}. The elevation of the park varies from 539 to 1130 meters above sea level (m.a.s.l). The landform of the areas are heterogeneous in nature and consist of flat plain, undulating to rolling, some isolated hills and ridges, chain of mountains and valleys (Fitsum and Bikila, 2020)

The Park is home to many ungulates, predators and other wild animal species. The presence of some mega wild animals such as the African elephant, Roan antelope and the cranes migratory birds found only in this site from Ethiopia wintering site) and other migratory birds make the park and its environs a significant conservation site (Addisu *et al.,*2024).

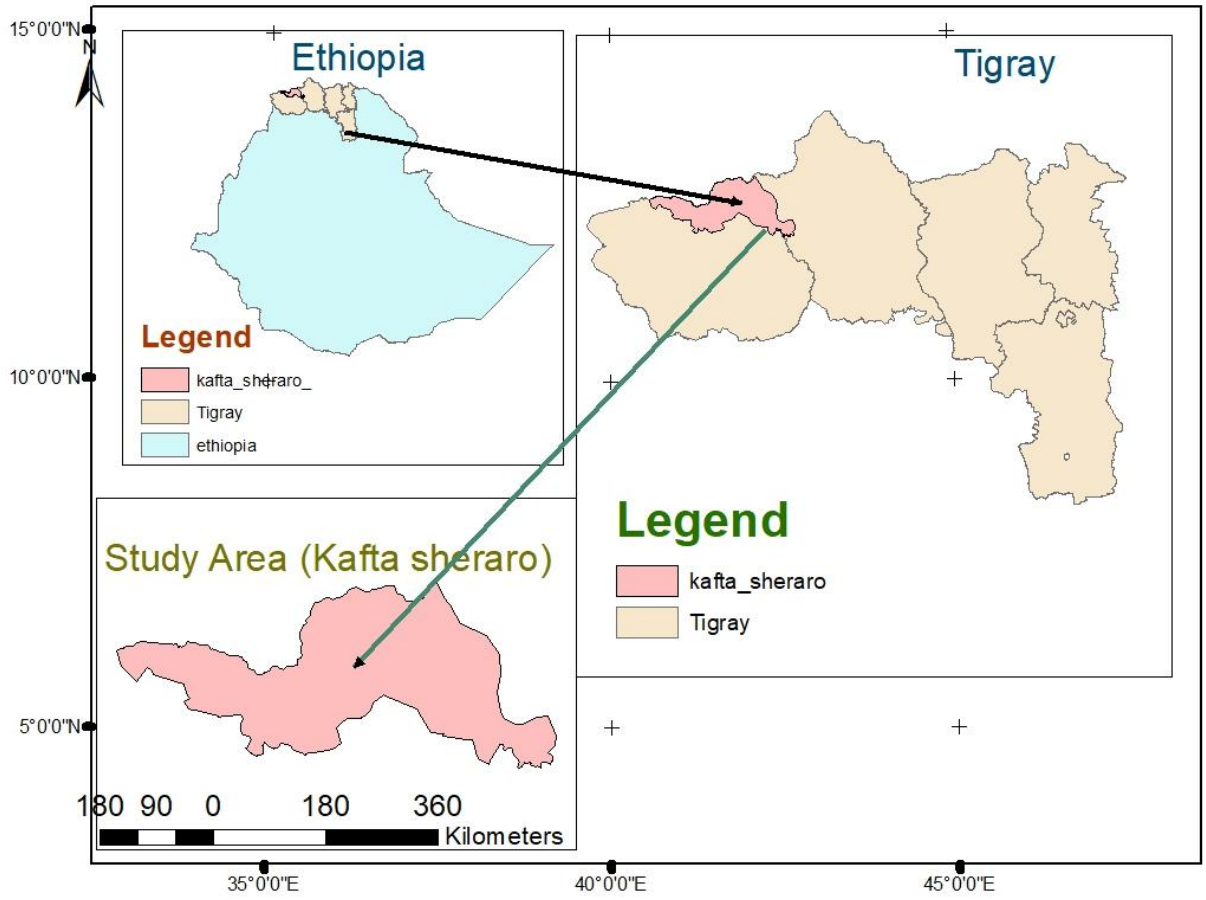

FIGURE 1 MAP OF KAFTASHERARO NATIONAL PARK

3.1.1. Population

Due to the political insecurity of the country in 1970s and 1990s and living tendencies of people in the kola areas in general and both the Kafta Sheraro areas as a whole had been very limited due to the insecurity and continuous war in the area. The zone was under Tigray Peoples Liberation Front (TPLF) guerilla fighters selected by its dense forest where a frequent armed-war was occurring between them and the Ethiopian government (or the "Derg regime", 1974-1991). As a result, socio-economic activities in the area and human disturbances to the environment were at low level until late 1990s, after which the area has been rapidly occupied and populated

as result of the volunteer resettlement program launched by the regional government in late 2003. Human population size in and around the KSNP area was estimated 64,000 in 2015 (KSNP office, 2016).

3.1.2. Flora and Fauna

KSNP is one of the most important conservation areas in Ethiopia; it hosts several conservation concern and economically important faunal and floral species (Kiros *et al,* 2014).

- **Flora**

The KSNP harbored more than 70 woody species, (46 trees, 18 shrubs, and 6 tree/shrubs) (Temesgen and Warkineh, 2020). The most dominant and frequent tree species in the park are *Acacia mellifera*, *Combretum hartmannianum*, *Terminalia brownii, Balanites aegyptiaca*, *Dicrostachy scinerea*, *Acacia senegal, Acacia oerfota, Boswellia papyrifera, Ziziphus spina-christi, and Anogeissus leiocarpus* (Temesgen and Warkineh, 2020). Generally four major types of vegetation were identified; these are *Acacia Commiphora* woodland with dominant *Acacia mellifera* and *Balanites aegyptiaca* species, *Combretum-Terminalia* Woodland with *Terminalia brownii* and *Boswellia papyrifera* as frequent species; Dry-evergreen montane woodland and riverine woodland *Hyphenet thebica* as dominant species (EWCA, 2018).

FIGURE 2 LANDSCAPE AND PLANTS TYPES OF THE PARK.

- **Fauna**

The park had 42 species of mammals, 163 species of birds, 9 species of reptiles, including the greatest terrestrial mammal African elephant(*Loxodonta africana*) which is the icon of the park , Greater kudu (*Tragelaphus strepsiceros*), Eland (*Tragelaphus oryx*), Klipspringer (*Oreotragus oreotragus*), Oribi (*Ourebia oureb*i), Anabis Baboon (*Papio Anubi*s), Vervet Monkey (*Cercopithecus aethiops*) Serval cat (*Flis serval*), Leopard (*Panthera pardus*), Cheetah (*Acinonyx jubatus*), Common bushbuck (*Traglaphus scriptu*s), and Common Warthog (*Phacochoerus africanus*) are among them, fish species and several migratory bird species including, the only known population of Demoiselle crane (wintering migratory bird) along the Tekeze River in the country make the park and its environs a significant conservation site for the national as well as international communities. (Zenebe & Adissu, 2019; Zegeye 2020)

3.1.3. Climate

The climate of the area is semiarid receiving mono-modal rain fall, with the long rains occurring from middle of May to beginning of September nonetheless, short rains occasionally occur from late September through November with an annual average precipitation of about 600 mm. The average monthly temperature of the area varies between 15.2^{o}C and 37.5 ^{o}C with the warmest period being occurs from April to May while the coldest period from July to August (Zenebe & Addisu, 2019).

3.2. METHODOLOGY

3.2.1. Research Design

This study employed a mixed-methods approach, combining quantitative and qualitative data collection methods to assess the impacts of war on perceived conservation capacity, wildlife habitat loss, and threat severity within Kafta Sheraro National Park (KSNP). This mixed-methods descriptive for the quantitative data and thematic analysis for the qualitative data narratives, stories,and detailed observations that capture the complexity of impacts of the war.

A reconnaissance survey was first conducted in November 2023 a year after the Pretoria agreement to tahtay adiyabo part of kaftasheraro national park to

identify the main threatening factors of the park and communicate with woreda agriculture office and security administration assess security conditions and feasibility to do fieldwork. The threats identification were done by listing out literature based threats along with previously identified threat factors in the study area

. Then the key threatening factors were sorted for ranking of the level of severity.
The park rangers/officers was asked independent of each other according to Kiringe and Okello, (2007) to rank the identified threats from one lowest threat level to five highest threat level on the sorted key threat factors.thirty park rangers/officers were participated. Scoring for each threat factor on ordinal scale by protected area officers was assumed to be adequate for the purpose of assessing status and threat index of the park.
The same to threat ranking Possible recovery solution were also filled by park rangers/officers also done by combining from identified war impacted protected area literature and local inputs. These recovery solutions also filled by the park personnel by giving their agreement 1 disagree up to 5 highly agreed on the importance of the recovery solution. This helps in giving priorities to which problem needs first to resolve on prioritizing resource allocation

3.2.2. Sampling Technique

A. Threat Severity and Recovery Solutions

Purposive sampling was chosen for its suitability in conflict zones (Maxwell, 1996), park rangers who were interviewed through the questionnaire were considered knowledgeable in view of their involvemen in the area over the three time periods (before, during, and after the war) and protecting the park over time. Due to their cloth attachment with the park and the communities surrounding the area these have better understanding both on the threats and possible recovery solutions.

B. War-Induced Losses

Twelve key informants these are kebele administrators, and development agents and park wardens who have first hand knowledge on the park conditions were chosen based on their

present in the area during the war. Seventy participants were involved in twelve FGDs, including three community-level and two Woreda-level FGDs from the eastern part, and seven FGDs of displaced persons from IDP camps selected by IDP coordinators as individuals present during the war in the area. Each FGD had 5–8 members, including Woreda administration workers selected for their proximity and knowledge of park conditions, ensuring relevant insights despite security constraints.

3.2.3. Data Collection Methods

Data collection involved multiple sources and methods to ensure triangulation and validity of findings.

A. **Threats and Recovery Solutions**

Data on threats and recovery strategies were collected via semi-structured questionnaires administered to thirty park workers, who ranked the severity of the previously identified threats from previously identified threats of the park and integrated from preliminary survey for newly emerged threats as the consequence of the war,based on this twenty-one identified threats were identified and ranked their severity using a five-point scale (1 = least severe, 5 = most severe). The Mean Threat Factor Score (MSTF) was calculated for each threat across periods, and recovery measures were rated for agreement on the importance of the identified solutions on their urgency and importance by giving liker scale of agreement from 1 up-to 5 (1 = disagree, 5 = highly agree) with percentages of agreement calculated from total respondents to guide prioritization based on the frequencies and percents of agreement given bay the park personnel.

B. Land use land cover change

Before LULC classification and detection of changes, p reprocessing of satellite images is an imperative process to develop an inline association between biophysical phenomena on the ground and acquired data (Coppin et al., 2004).

Before any activities, Landsat images were geometrically rectified (Geo coded) to the World Geodetic System 1984 (WGS 84) and set a projection to Universal Traverse Mercator (UTM)

zone 37 N specific to Ethiopia.And finally,each of the stacked satellite images was clipped to polygon shape file of the KSNP in ERDAS Imagine 9.2 software.

Satellite Image Acquisition and Preparation

Two types of satellite images, all with spatial resolution of 30m and three band combinations, were downloaded from the USGS from the USGS online data provision interface (http://edc.usgs.gov/products/satellite/raster.html) and used for the study: Land Sat8 (acquisition date: Land Sat8 (18/06/2019) and Land Sat8 (20/06/2024) for the year 2019 and 2024, respectively). based in the war erupted in 2020, Therefore, the study years of 2019 and 2024 were purposive selected to assess the land use and land cover changes before and after the war). The month of June was selected for each study year since this month is the switch on/off time for low lands, which shows a clear spectral reflectance on the different land use/cover (FAO, 2005). Prior to analyses the satellite images were pre-processed in order to enhance efficiency, harmonize data and to reduce errors (Jensen, 1996). Firstly, the satellite images were stacked to produce a multi-spectral image from each of the panchromatic bands provided per image. Secondly, the satellite images were Geo-rectified using the geometric registration strategy, where images are rectified with ground features to reduce positional inaccuracies which stem from geometric instability of the satellites during the data acquisition (Jensen, 1996). And finally, each of the stacked satellite images was clipped to polygon shape file of the KSNP in ERDAS Imagine.

C. War induced losses

Twelve FGDs (three community-level, two Woreda-level, and seven with IDP displaced persons).Twelve key informant interviews with stakeholders (e.g., administrators, agricultural experts).

Field observations in accessible areas

Pre-war and post-war satellite imagery supported data collection for inaccessible areas. This was especially used see infrastructural damage /rangers out post/ using google earth maps attaching

the park shape file on the google then identifying the outpost areas then observing using time series to find the changes of the building before and after the war.

The insecure western part was avoided from field survey due to safety concerns. Photo and video data from media sources, such as VOA Amharic documentary, provided visual context on habitat and community impacts, triangulated with GIS analysis imagery and secondary sources (journals, NGO reports) for consistency and accuracy.

3.3. Data Analysis

Data analysis was tailored to address the study's objectives.based on the objectives the analysis methods used were listed below

3.3.1. Threat Severity Ranking:

According to Kiringe and Okello, (2007) the existing threat factors of the park were calculated as indicators of how serious a threat factor was during the three time period in the national park and vulnerability of the park to these threats:

- **Mean Score of each Threat Factor (MSTF)** = (Sum of all the scores for that particular threat factor) / (the total number of respondents, 30 respondents). During analysis of MSTF each of the 30 park staff independently scored each threat's severity at one time by remembering the past based on their understanding for three periods before ,during and after the war , based on recall and observation. Scores were summed and averaged per threat per period using SPSS (Version 20).It quantifies the average perceived rank of each threat providing a starting point for comparison.

- **Relative Threat Factor Severity Index (RTFSI)**

RTFSI was derived by normalizing MSTF against the maximum possible score (5), enabling comparison across threats and period

RTFSI= (The mean score for a particular threat factor (MSTF)) / (The maximum possible Score, 5). *Example*: For "poaching" with MSTF = 3.0, RTFSI = 3.0 ÷ 5 = 0.6 (60% of maximum severity).

MSTF values were normalized against the highest possible score (5) to create a relative index, computed in SPSS for each threat across periods. RTFSI standardizes severity (0–1 range), enabling comparison across threats and periods (e.g., poaching at 0.6 vs. grazing at 0.8).Higher RTFSI values signal urgent threats, informing resource allocation (e.g., anti-poaching patrols). It also indicates Trend Analysis, Tracks changes (e.g., wartime RTFSI spike), and revealing conflict's peak impact.

- **Protected Area Relative Threatened Index**

PARTI is most time used for comparison of different protected areas to know the overall vulnerability of a protected area of the identified threats . Aims in order to decide which park or protected area is highly threatened and needs prioritization than the other. In this study since it is for one park KSNP it sees the condition of the park during the three time before during and after the war how individual threat is severe during these period and also to know in which time the national park is threatened to the commutative threats existed.

(PARTI)= (Total score of the 21 threat factors from the interviewed officers) / (Total responses, 90). *Example*: If total scores across 21 threats for wartime = 1890 (e.g., 90 per threat × 21), PARTI = 1890 ÷ (Number of respondents (30) × possibility of highest score (5) × total identified threats (21) = 1890 ÷ 3150= 0.6.

PARTI measures KSNP's aggregate threat level per period, indicating overall conservation stress (e.g., 0.6 = moderate threat).it also Compares periods (e.g., pre-war 0.4 vs. wartime 0.6), pinpointing war's broad impact.

Spearman Rank Correlation: Used to test associations between RTFSI and PARTI across periods, identifying which threats drive vulnerability (e.g., poaching correlating with wartime PARTI). **Example**: If "poaching" MSTF rises from 2.5 (pre-war) to 4.0 (wartime), RTFSI shifts from 0.5 to 0.8, and PARTI reflects a broader wartime increase in poaching.

3.3.2. Ranking of Recovery Strategies

The 30 Park rangers/staff rated the 21 proposed strategies of restoration after the devastating war (e.g., reforestation, ranger training), based on agreement in the importance of the identified

strategies as 1 disagree and 5 for highly agreed. With percentages and frequencies highlighting consensus, guiding recovery priorities.

3.3.3. Land-use land cover change analysis

Image Classification

Unsupervised classification method was applied first to identify land cover types. The outputs from this unsupervised classification were checked against local knowledge of the study area and easily distinguishable land cover of the study area from high-resolution Google earth. Accordingly, five land cover types were defined and used for further analyses: woodland, bush land/shrub land, grassland, agricultural (cultivation) land and bare land. Then ground truthing points were taken at 300 randomly generated points in the study area. This number of points is well above the recommended number for the Maximum Likelihood Classifier Technique, which is a minimum of 250 points for total study area (Eyob Teshome et al., 2011). Ground truthing points were located from google earth pro in the inaccessible areas due to insecurity and by hand-held GPS 72H and the were recorded. These ground-truthing points were used to make the training areas around which polygons for each class were drawn to define the digital signature. Finally, a supervised classification method was applied using the signatures defined for the training areas (LEICA Geo systems, 2003). Supervised classifications of all images were carried out using the Maximum Likelihood Classifier Technique in ERDAS Imagine software version 9.2. This method is the most preferred as it takes into account the most variables by using a covariance matrix.

3.3.3. Analysis of Losses Due to War

Thematic Analysis: Corbin and Strauss (2008) guided coding of qualitative data into 3 themes. Those are park management resource loss, human personnel crisis, and park wildlife and their habitats loss collected FGDs, key informant interviews, and field observations.datas from recording,field observations were arranged in to themes then interpreted Findings were cross-checked with satellite imagery this satellite image were basically used to see the land-use land-cover changes before and after the wars. And reports for consistency. Audio visual data, sound

records from remote interview and FGD records translated to word by arranging to their familiarization of data.

CHAPTER FOUR: RESULTS

The result and discussion session elaborates the results and interpretations of all the objectives in this study. Hence, the objectives are put in order to make it clear for readers and other scholars who may use this thesis as a reference material.

4.1 Demographic characteristics of respondents

4.1.1. Service Years of Respondents

TABLE 1 SERVICE YEARS OF RESPONDENTS

Service years	Frequency	Valid Percent
3	5	16.7
5	4	13.3
6	3	10.0
7	2	6.7
8	8	26.7
9	2	6.7
10	3	10.0
11	1	3.3
13	1	3.3
19	1	3.3
Total	30	100.0

Source: Own survey result, 2023/2024

4.1.2. Work Areas of Respondents

Table 2 Work area of respondents

Work area	Frequency	Percent
Kafta	**12**	**32.5**
Sheraro	**18**	**97.5**
Total	**30**	**100**

Source: Own survey result, 2023/2024

4.1.3. Age of Respondents

The data presented in Table 3 provides insights into the age distribution of the respondents in the study. The age of the respondents ranges from 30 to 60 years, with the majority (50%) falling within the 41 to 50 years age.

Table 3 Ages of respondents

Age of respondents	Frequency	Percent
30-40	**13**	**43.3**
41-50	**15**	**50**
51-60	**2**	**6.7**
Total	**30**	**100**

Source: Own survey result, 2023/2024

4.1.4. Sex of Respondents

Table 4: Sex category of respondents

Sex of respondents	Frequency	Percent
Male	29	94.6
Female	1	5.4
Total	30	100

Source: Own survey result, 2023/2024

4.1.5. Education Level of Respondents

Table 5 Education levels of respondents

Educational level of respondents	Frequency	Percent
Primary school	12	41.9
Secondary school	12	41.9
Certificate	1	2.7
Diploma	2	5.4
Degree	2	5.4
Masters	1	2.7
Total	30	100

4.1.6. Positions of Respondents

Table 6 Positions held by respondents

Positions	Frequency	Percent
Expert	**2**	**5.4**
Chief scout	**2**	**5.4**
Scout	**26**	**89.2**
Total	**30**	**100**

Source: Own survey result, 2023/2024

4.2. **Land Use and Land Cover Classification**

Land cover classes in the study area for the each year of 219 and 2024 were shown in figure

. The maps clearly show persistent dominance of wooded grass land with an increasement after the war. Which covers 38-60 % of the total area and water body being the rarest land cover class, covering a mere 0.32-0.80% over the study period (Table 1). Classification accuracy assessment made, based on the 2024 image, showed that overall accuracy was 94%. Of the land cover classes water body (100% accuracy) appeared to be the most accurately classified, followed by wood land grass land (both 95%), cultivation land (89%) and wooded grassland (93%). These results suggest that the land cover classification has acceptable level of accuracy; thus valid conclusions could be made.

Land Use and Land Cover Changes

Results showed that all land cover classes exhibited some degree of change over the study period

(Table 1). Wooded grassland changed the most (an increase from 38.18 % of total park coverage in 2019 to 59.73 % in 2024), followed by grassland (a decrease from 30.95 % in 2019 to 9. 66% in 2024).

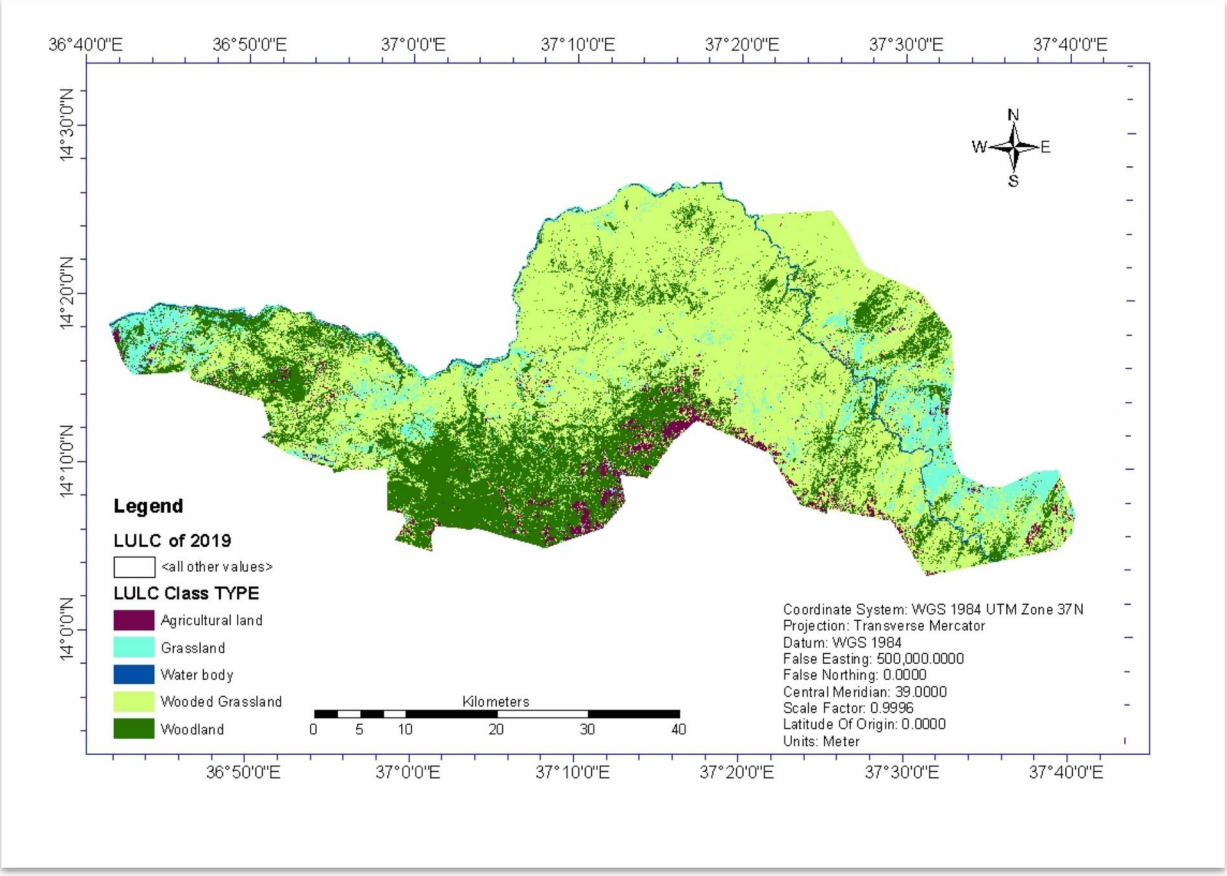

FIGURE 3 LAND USE LAND COVER TYPE OF KSNP BEFORE WAR IN 2019

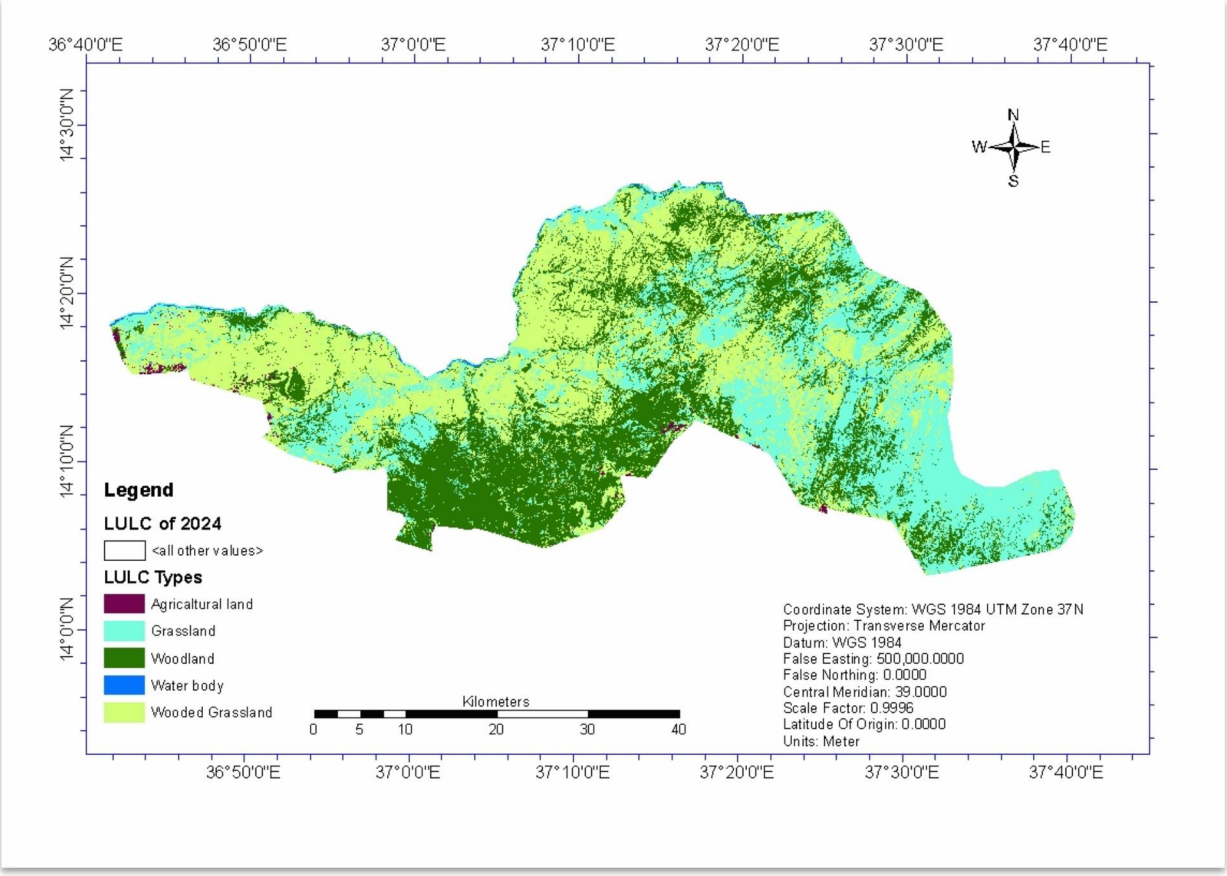

FIGURE 4 LANDUSE LAND COVER TYPE OF KAFTASHERARO NATIONAL PARK AFTER WAR IN 2024

TABLE 7 **TOTAL AREA AND PERCENTAGE COVER OF EACH LAND COVER CLASS BEFORE AND AFTER THE WAR YEARS USED IN THIS STUDY.**

No.	Landcover type	2019		2024	
		Area in KM^2	Area in %	Area in KM^2	Area in %
1	Agricultural land	10.785	0.5	79.630	3.69
2	Grass –land	668.446	30.95	208.617	9.66
3	Water body	6.859	0.32	17.446	0.81
4	wooded Grassland	824.547	38.18	1289.903	59.73
5	Woodland	648.800	30.04	563.856	26.11
	Total park area	**2159.48**	**100**	**2159.45**	**100**

TABLE 8 **CHANGE IN LAND COVER IN KAFTA-SHERARO NATIONAL PARK IN EACH TIME PERIOD INTERVAL;**

changes expressed in percentage and rate (change per year).

No	Land cover type	Changes in land cover from 2019 to 2024		
		Total area change in **KM²**	**Percent change**	**Change per year (km2)**
1	Agricultural land	68.85	86.46	13.77
2	Grass land	-459.83	-68.78	91.97
3	Water body	10.59	154.4	2.118
4	wooded Grassland	465.36	56.43	93.072
5	Woodland	84.944	13.09	16.98

4.2. Losses on existing management capacity and wildlife habitat due to war

4.2.1. Breakdown of Park Management

Almost all of the equipment and infrastructure of the park office was looted directly and indirectly as a result of the war. Scout residences in three different areas of the park were also burned and looted. The ranger's camp sites were first used as camp site for the military and when they left the area these sites looted by the irregularities and burned by uncontrolled fire arise in the areas duo to different conditions. The facilities in the park office were purchased directly from the headquarters and from the budget sent by the park management they have been presented.

When the fighting started, on November 2020 the employee fled to save their life. The situation was sudden and unexpected and there was no opportunity for employees to seize any belongings in their offices or homes. Various small equipment stationary used for park activities in the office, guide books, binoculars, digital cameras from small to large, office chairs and tables were looted and broken. The main staff materials of the park management are listed in the following table.

TABLE 9 STAFF PROPERTY DAMAGE AND LOOTING

No	the type of property that was existed before war	number	Looted by different actors	Existed after war	Percent looted
1	Being a patrol & management car.	4	4	**-**	**100**
2	Desktop computer	12	13	**-**	**100**
3	Laptop	7	5	**2**	**71**
4	Lighting Generator	1 new	1	**-**	**100**
5	Suzuki motorbike	1	1	**-**	**100**
6	Camera	3	28	**-**	**100**
7	Radio operators	28	4	**-**	**100**
8	binoculars	4	1	**-**	**100**
9	Out posts(scout residents in the park)	**3**	3	**-**	**100**
10	Office electric transformer	**1**	**1**	**-**	**100**

Source: Own survey result, 2023/2024

4.2.2. Damage to the park personnel

The war displaced 85% of KSNP's personnel (61 out of 72 employees), with seven deaths and one unaccounted for, as per survey results from 2023–2024. This loss of manpower, detailed in Table 8, severely hampered park management and protection capabilities. The park office ceased

operations, and even after the Pretoria Agreement in November 2022, instability persisted, with personnel reassigned temporarily to other parks by Federal head office of the park Ethiopian wildlife conservation authority /EWCA/ due to the instabilities continued in the area.

TABLE 10 DAMAGE TO THE PARKS MANPOWER

S.N	Total former park employees before war			Displaced by the war				who died during the war due to various reasons				Employees who do not know where they are		
	Male	Female	Total	Male	Female	Total	%	Male	Female	Total	%	Male	Female	Total
1	59	13	72	49	12	61	85	7	-	7	10	1	-	1

Source: Own survey result, 2023

4.2.3. Damage to wildlife and their habitats

A. Wildlife killing

The war facilitated increased wildlife hunting by militants for food and market purposes. Species such as greater kudu (*Tragelaphus strepsiceros*), eland (*Taurotragus oryx*), red-fronted gazelle (*Eudorcas rufifrons*), orbi (*Ourebia ourebi*), common bushbuck (*Tragelaphus scriptus*), warthog (*Phacochoerus africanus*), and waterbuck (*Kobus ellipsiprymnus*) were heavily targeted, particularly in the first year (2020–2021). Greater kudu, due to their slower movement high in their number, were especially vulnerable, with meat sold at border stations like Adigoshu and Adebay. Poaching for non-food items, such as Elephant ivory, also surged, with reports of elephants killed in Adi Goshu using poisoning chemicals and near the Eritrean border in the eastern part of the park, and ivory seized by Commission Police Tigray in 2023. Before the war, park rangers and government agencies coordinated to control such activities especially ivory trafficking, but the conflict's collapse of management enabled widespread poaching.

FIGURE 5 GROUP OF GREATER KUDU BEFORE THE WAR 2019 (PHOTO FROM KSNP ,2019)

The photo in the right side implies greater kudu near to the road are staying and watching to a car arriving to them, this implies they did not move to hide makes them more susceptible for hunting.

FIGURE 6 HUNTED MALE GREATER KUDU INSIDE KSNP DURING WAR (PHOTO FROM KEY RESPONDENT, 2023)

This was widespread in the first year of the war. In the second year, the number of wildlife decreased due to hunting there were many wildlife like Greater kudu, Eland , red fronted gazelle, Orbi, Common bush-buck, warthog and water buck were haunted for their meat. and especially greater kudu were easily found in various parts of the park before but after war they severally haunted and observing becomes difficult Tatek shawol park representative interview with VOA, 2023.

In addition to being used for meat and market use, they are also killed for selling parts of their bodies to non-food wild animals and other traditional uses such as tiger skin and ivory. there was also a group of elephant poachers moving inside the villages of Adigoshu with their poisoning material during the war time. As a result the respondents observed in the Adi Goshu Park area two Elephant and in eastern parts to the Eritrean border Aditsetser site three elephants. killed by poachers after a year in 2023 ivory has been seized from illegal traffickers at both ends of the park's western in the Humera-Gonder line and eastern boundaries via Sheraro to Mekelle. The members of discussion group 4 indicated that they have killed the elephants by mixing various deadly poison chemicals by mixing with elephant favoured fruits and goes to the elephants area and kill them to use their tusks (ivory).

Before the war, illegal ivory trafficking was limited and park guards and controls were coordinated with the relevant government agencies of security intelligence workers surrounding the park. A year before the war started there were elephant poachers entering the park and caught by the rangers with their poisonous chemicals before giving to elephant moving here and there inside the park to find elephants and were arrested and prosecuted for poisoning in the park for elephant.

Therefore, the main ivory movement is not directly caused by the war but indirectly caused by the collapse of the park management and stakeholder government structures caused by the war.

FIGURE 7 ELEPHANT IVORY CATCHES BY COMMISSION POLICE TIGRAY ON 2023(PHOTO FROM FACE BOOK PAGE OF COMMISSION POLICE

B. Expansion of Agriculture

The collapse of state administration and park management forced local communities to rely on KSNP's resources for livelihood. Agricultural expansion into park lands for cash crops like sesame *(Sesamum indicum)* intensified throughout the park.

The farming is extremely expanded after war even in the areas there was no farming activities and used as core area for mega animals like elephant in which having campsites for tourists staying for weeks there before the war but now irregular farmers are cultivated these lands.

The farming expansion in western part of the park is not only subsistence farming by small farmers but also mechanized using tractors and involving communities from distant areas, disregarded sustainable management practices, exacerbating habitat degradation.

FIGURE 8 FARM EXPANSION IN THE PARK DISCUSSION WITH "*WOFER ZEMET*" JULY 2024 MYKUHLI (EASTERN PART OF KSNP)

C. FIRE

It is reported that fire occurs throughout the park every year, often in October, burning over 60% of the park area each year (KSNP, 2016). Although the nature and extent of the impacts on biodiversity and ecosystems have not been examined, this uncontrolled fire is now thought to represent one of the most serious threats to KSNP's.

These uncontrolled fire before the war were either during honey harvesting or livestock owners during during cooking they left fire and it can burn avast area of the park. But after the eruption of the war the causes of uncontrolled fire increase due to different actors with different

interest in the park. These are (i) irregular gold miners deliberately introduce fire to make free their area because the gold detector machinery works when the area become free of grass cover, second (ii)the intensified farming expansion also causes fire because the farmers first done forest clearing for land preparation which follows firing of the cleared land in which have the capabilities of causing a vast land to be burned by fire.(iii) Military engagements within KSNP, given its remote location and dense vegetation, led to fires from weapon use and deliberate burning to clear strategic areas.

These fires destroyed large swathes of tree and grass cover, severely impacting herbivorous wildlife reliant on vegetation for survival. The uncontrolled nature of these fires exacerbated habitat loss, with long-term implications for ecosystem recovery. Whilst acknowledging the role that fire has in ecosystem functioning.

FIGURE 9 BURNED LAND ALONG TEKEZE RIVER IN KAFTASHERARO NATIONAL PARK DURING WAR

D. Livestock Grazing

Overgrazing by the livestock is a serious problem during the rainy season when the lands outside the park are covered by crops. It is estimated that about 520,000-530,000 heads of livestock from the surrounding areas and other parts of Tigray, as well as from Eritrea, use the park for grazing during the wet season (KSNP, 2016). But when the war started majority residence of surrounding

area of western part of KSNP were displaced some with their animals and majority ignoring their animals and displaced to save their life. Unlike before the war there is no introduction of animals from parts of the region to the park especially to western part because due to the insecurity condition movement of people and animal were blocked in Tekeze , but from Eritrea and surrounding western zone Woredas many heads of animals were crossing Tekeze river and distributed though out the park in the western part, due to no park management to protect them the area is highly over grazed with a collateral damage to herbivore wildlife due to feed competitions and disturbance. In the eastern part animals from displaced peoples from western zone, and from surrounding Kebeles live in the park causing over grazing. Community's surrounding the park in the eastern part also compute with the displaced communities in the park intensifies the impact of grazing and browsing. Communities cut tree to feed their animal especially during dry season. Such unregulated livestock grazing/browsing activities have several undesirable ecosystem consequences.

E. Non Timber Forest Product (NTFP)

Non timber forest product (NTFPs), particularly from *Boswellia papyrifera* along western part of the park sites Whdet, Mayweyni, Adigoshu upto Mykeyh (bordering the eastern part of the park by Tekeze river) was with high cover of *Boswalia paplifera* with no extraction of gum resin from it before the war. This is especially due to collapse of park management, because to get a resin it takes months and if there is patrolling the irregular producers can simply catch. the NTFP extraction from *Boswallia papillifera* is severely damaging this endangered plant spices due to harvesting without regular management system only considering how much they get from it, the extraction is also expand to the eastern part of the park area.in addition to lawlessness of the area the highly increased price of the plant product at after the war makes it to suffer from mass irregular producers in the area.

F. Illegal gold mining

Mining was existed even before the war, being carried out in two district of the park, namely Adebay and Adi Goshu sites. In contrast, although area coverage of gold mining done in small part comparing with invading by cultivation and livestock grazing is limited but, its impact deforestation in the park is very high. Trees are cut down extensively, the land is heavily dug and

exposed to heavy erosion, and large pits are created so that wildlife can easily fall into the pits in the in night time and die. Moreover, it is also a cause of fire burns. When a gold miners move with a machine to search for a gold area, they deliberately set fire to the park because the ground must be free of grass to detect the gold machine either the gold is exist or not in the area even if the gold miners want to burn the gold expected small area but they did not control the fire then it expands large area of the park. During that time, the wildlife in the area some of them will hunt by the peoples in the mining and some escape from the area and the area become disturbed. in addition to gold finder machine, large stone grinding creatures used to grind the collected stones are interred in both sites in the park and they placed it in a convenient place to grind stones which have small particle gold in side them. These creatures have heavy sounds, which disturb the wild animals and maximize the destruction of the park and making soil pollution in the area. In addition to this these goldsmiths operate in groups and have a large number of illegal weapons because they own large capital from the mining and the materials used are expensive requires to have militarized personnel to save their wealth and life as well because there is no bylaw to save them, their life is survival of the fittest.

The militarized personals in addition to guarding of their mining groups they also go heavy hunting activities. Therefore, gold mining has caused many legacies such as heavy landslides uncontrolled fires, heavy noise of creatures, hunting wild animals, deforestation for housing etc., these threats were generally escalated by the collapse of the park office and the local government administration due to the war. After the war began, the park completely stops its work until the war cool down more than a year, then after headquarters deployed coordinating chief wardens, vehicles and new scouts in the areas. To restart the activities some patrols and condition checks of the park were conducted. However, this lacks coordination and sustainability of stakeholders has not saved the park from the above mentioned hazards.

Even after the peace agreement between the central and regional governments most of the park remained unsettled for two years until this study done. The western part when the irregular mining is happening is unstable and using mining freely.

G. Internal Displacement of population and its Impact on the Park

The war displaced over two million people, with many settling near KSNP's eastern borders (UNHCR, 2024). These internally displaced persons (IDPs) goes to different IDP areas of the region and part live in IDP's around the park resorted to cutting down forests for fuel wood, shelter, and agricultural expansion, leading to significant habitat loss. Satellite imagery from 2018 to 2023 reveals extensive deforestation and agricultural encroachment in areas like Mykuhli, and Adiaser (eastern part of KSNP) with private fences and farm expansion observed during field survey.

The pressure by IDP on the park compounded by conflicts between displaced communities and local residents saying we have land ownership (land tenure) the condition in the area have likely further complicating the restoration efforts. This condition gathered from FGD and key respondents was supported by field surveys to the areas of Mykuhli and Adiaser supports the condition seen by satellite image the impact of displaced people and surrounding kebeles to the park is very severe areas can be cultivated are all cultivated, peoples constructed houses for them and for their Animals which causes high deforestation. Beyond the destruction of the park by farming expansion the local community who is their permanent settlement enamoring this part of the park claimed ownership of the farm land and receives farm rent by seining this is my certified land to those displaced persons. But these peoples did not have regular certificate and take out during the demarcation of the park. And want to cultivate in the area from the farmers from different areas.

During the field visit to eastern part of the park the researcher got farmers and livestock herders, the farmers are not only the displaced but also peoples migrate from central part of the region to get new productive land and these are come after the ceasefire agreement when the area become sustainable from suffer of eruption of war, these farmers called locally *"wefer zemet"* in Tigrigna meaning farmers migrate from their settlement and cultivate government owned lands either protected areas or others not privately owned lands.

These farmers take into conflict with surrounding communities in the park when the neighbor communities ask them to pay land rent so beyond its damage the park becomes source of instabilities due to common resource use conflict between the users. *wofer zeme*t farming is known even before the war high land peoples migrate during raining season to the hot lowlands in searching of cultivating land and was a problem to park conservation. After the peace

agreement, destruction and agriculture have worsened since the war. Because people become free of suffer of war. And no organization was responsible to ask them.

FIGURE 10 DISPLACED PEOPLE HOUSES AND SESAME CROP AGRICULTURAL ACTIVITIES CUT DOWN FROM LARGE TREES INSIDE THE PARK PHOTO BY RESEARCHER JULY 2024 (CENTER LIVESTOCK KEEPERS WITH SCOUT, RIGHT RESEARCHER)

Interestingly, some displaced individuals expressed gratitude for the park's role in protecting their livestock during displacement, highlighting a complex community-park relationship.

H. Long-term Park Ecological Disturbance

The cumulative effects of these activities have weakened KSNP's ecosystems, increasing susceptibility to invasive species like *Prosopis juliflora* (mesquite), already present in limited areas. Resent studies, such as Schulte Bühne *et al.* (2024), indicate conflict-related woody vegetation loss across 930 km² in Tigray, highlighting long-term ecological threats.

Broader research indicates that conflicts cause significant biodiversity loss and ecosystem disruption. Daskin and Pringle (2018) found that high-conflict frequency led to population growth rates decreasing, with no significant effect from species body mass, protected-area size, or conflict intensity (human fatalities), emphasizing the long-term ecological disturbance caused by sustained conflict. Hanson (2018) further notes that recovery is often slow and dependent on post-conflict management, with potential for scientific and conservation engagement to mitigate

negative impacts in war zones. These findings align with KSNP's challenges, where cumulative impacts threaten ecosystem resilience

4.2.4. Positive Situation as a Consequence of the War

As detailed above, this war has severely damaged the park. Pre-war problems such as illegal agriculture, gold mining, arson and poaching increased dramatically after the war began.

Meanwhile, one of the 11 zones in the park, Adi Tsetser in the eastern part of the park becomes free from anthropogenic impacts of free grazing and expansion of farm land makes it rehabilitated than before the war having better forest cover as it is almost completely free from agriculture and free grazing in general.this is due to the existence of Eritrian forces camping there makes human activities are blocked, no livestock grazing , no cultivation or other human activities are allowed there makes to rehablitate the plant cover of the area.

FIGURE 11 SATELLITE IMAGE PARTS OF PARK IN ADITSETSER BEFORE WAR IN2018 UPPER AND 2023 AFTER WAR IN THE BOTTOM

As we see from fig 14 the upper satellite image in 2018 is less plant coverage when compared to the lower area satellite image taken on 2023, this is due to Eritrean military around the area makes free of community interference, even if there is logging of large trees for military purpose but the area becomes free from irregular introduction of communities for cultivation, animal grazing and other activities, which was high interference before the war and conflicts between park personnel and the local communities.

Secondly, the vast irrigation systems in Tekeze river in the park have become free of irrigation due to the displacement of irrigates due to the war to save their life.

As a positive consequence elephants were move to this eastern part of the park due to the existence of disturbance free palatable forage resource of the irrigation, the neighboring communities of the eastern part of the park sow a group of elephant in this area.

There are many reasons for the movement of these elephants to the area, one of which is the free availability of undisturbed forests in the area and or their former habitat area may be disturbed (western part of the park) generally they use this irrigated area in the first years but after the irrigation area also dried because without management the fruits cannot sustain during the dry season. See the satellite image of the irrigation how it dries during the war time.

FIGURE 12 IRRIGATION BEFORE THE WAR ON 2018 ALONG TEKEZE RIVER LEFT AND AFTER WAR ON 2023 RIGHT.

So generally even if existence of irrigation in the park is one of the main threats of the park but exclusion of the users during war time did not sustain the park since these people were irrigated before the park was established and could not be removed from the area. The irrigation, which was temporarily suspended, was resumed from 2023 after the Pretoria Agreement.

Therefore, the benefits of the positive conditions caused by the war to the park require careful consideration so that they do not pose any multiple risks that are based on their preservation and sustainability in the post-war period. For example, irrigation that had been stopped due to the war needs to be worked harder to prevent it from increasing.

The huge gap here was that when the situation returned to normal, the communities' desire to use the park quickly began to rise but neither the protection and control functions nor the government administration functions were quickly restored to their functions Because it has been dependent on the park, there is a higher chance of parks resource use conflict between community and responsible body for conservation.

4.3. Current Threats and Their Severity for Conservation of the park

The KSNP, faces a variety of threats that impact its biodiversity and conservation efforts (Tables 9, 10,). These threats stem from both natural and human-induced factors, exacerbated by socio-political circumstances. This section outlines the severity and causes of these threats,

highlighting the critical influence of the war and post-war periods on park management and conservation.

TABLE 11 MEAN THREAT FACTOR SCORE AND RELATIVE THREAT FACTOR SEVERITY INDEX

Threat Factors identified by protected area officers	Before war		During war		After war	
	Mean threat factor score (Mean ± SE)	Relative Threat Factor Severity Index (RTFSI)	Mean threat factor score (Mean ± SE)	Relative Threat Factor Severity Index (RTFSI)	Mean threat factor score (Mean ± SE)	Relative Threat Factor Severity Index (RTFSI)
Illegal gold mining	3.8±0.15	0.76	4.00±0.24	0.8	4.3±0.14	0.86
Wildlife Hunting for food and other commercial purposes	2.5±0.16	0.5	4.5±0.14	0.9	3±0.15	0.6
wild fire	4.1±0.11	0.82	4.3±0.14	0.86	3.6±0.16	0.72
Expansion of agriculture in the park and its boundaries	4.5±0.09	0.9	4.1±0.19	0.82	4.5±0.09	0.9
Domestic animal grazing	4.00±0.14	0.8	3.8±0.20	0.76	3.7±0.20	0.74
Illegal logging for house building and other uses	2.00±0.14	0.4	3.1±0.11	0.62	3±0.19	0.6
Destruction of wildlife habitat by cutting down trees for charcoal and wood	2.3±0.12	0.46	2.3±0.29	0.46	2.4±0.11	0.48
Residential expansion within and boundaries of the park	2.9±0.26	0.58	2.4±0.17	0.48	2.7±0.32	0.54

Expansion of new weeds	2.00±0.19	0.4	3.1±0.10	0.62	2.2±0.19	0.44
Existing natural resource protection laws do not save the park from penalties	3.7±0.11	0.74	4.6±0.10	0.92	3.3±0.31	0.66
Lack/low staff and field scout communication hurts the park	1.1±0.10	0.22	4.6±0.15	0.92	4.2±0.15	0.84
Community awareness of the benefits of protecting natural resources and biodiversity is low	3.8±0.14	0.76	3.7±0.09	0.74	4.1±0.14	0.82
Shortage of funding for PA management affects biodiversity conservation	3.7±0.88	0.74	3.6±0.18	0.72	4.3±0.09	0.86
irrigation within national park is a threat to the survival of the park	3.9±0.13	0.78	1.9±0.20	0.38	3.9±0.13	0.78
Military camp in the park	1.6±0.14	0.32	3.5±0.11	0.7	2.3±0.27	0.46
Lack PA impact assessment and monitoring by concerned bodies	2.5±0.16	0.5	4.4±0.06	0.88	3.5±0.10	0.7
Lack of well-organized law enforcement	4.2±0.11	0.84	5.00±0.18	1	3.8±0.10	0.76
Lack of alternative livelihood activities for the people who rely on the park	2.4±0.17	0.48	2.4±0.21	0.48	3.6±0.19	0.72
Relies of pollutants in or around the protected area affects wildlife and their habitat	1.7±0.18	0.34	2.9±0.13	0.58	2.5±0.18	0.5

Lack of integration of protected area conservation policy with local community	3.3±0.11	0.66	4.3±0.11	0.86	4.3±0.13	0.86
Negative altitude of local community towards wild animal in the park	3.9±0.15	0.78	3.8±0.15	0.76	3.8±0.15	0.76
Mean value (± SE)						

Source: Own survey result, 2023/2024.

TABLE 12 PARTI RESULT DURING THE THREE TIME HORIZON

Protected Area	Before war	During war	After war
	Protected Area Relative Threatened Index, PARTI (rank)	Protected Area Relative Threatened Index, PARTI (rank)	Protected Area Relative Threatened Index, PARTI (rank)
Kafta Shiraro Park	0.09(3)	0.12(1)	0.11(2)

Source: Own survey result, 2023/2024

4.4. Results of Descriptive Statistics Showing Possible Recovery Management Plans

The results from this study indicate that there are several potential recovery management plans or strategies that could significantly enhance the management and conservation capacity of Kafta Sheraro National Park, especially in the aftermath of the threats identified during the study period. The mean score and percentage of respondents' agreement with each proposed strategy provide insight into which actions are seen as most important and feasible for improving conservation outcomes. Even if the ware is stopped by the peace agreement but the condition of kaftasheraro is still under insecurity condition with difficulties to return surrounding

communities, surrounding kebele ,woreda and zonal administers. The same park personel also difficult toreturn to park managmnet place. So the the recovery management requires political stability firest to work with the identified and ranked threats based on their urgency for implementations.

Below is a detailed explanation based on the descriptive statistics, including the mean values and the percentage of strong agreement from the respondents

1. Replace Lost and Damaged Manpower (Mean Score = 4.8, 80% highly Agreement)

Replacing lost and damaged manpower is considered the most important and urgent strategy to enhance park management. With a mean score of 4.8, the respondents strongly agree on the necessity of rebuilding the workforce, which likely diminished due to the impacts of war or insufficient staffing prior to and during the conflict. This strategy emphasizes the need to recruit, train, and retain sufficient human resources capable of enforcing park regulations, managing threats, and conducting effective biodiversity monitoring. Restoring manpower ensures that the park is equipped with personnel who can address pressing conservation challenges and continue long-term management efforts (Nash, 2012).

2. Enhance Community Awareness of the Park (Mean Score = 4.5, 50% highly Agreement)

Enhancing community awareness about the park's biodiversity, its benefits, and the importance of conservation was also identified as a crucial strategy, with a mean score of 4.5. Half of the respondents strongly agreed with this solution. Increased community awareness can foster positive relationships between the park and local communities, mitigating conflicts and encouraging sustainable use of natural resources. Gillingham and Lee (2003) suggested that community-based conservation programs, where local populations are educated about the ecological and economic value of conservation, are essential in improving both park protection and local livelihoods.

3. Ensure That the Boundaries of the Community Can Benefit from the Park (Mean Score = 4.5, 56.7% Agreement)

This strategy addresses the need for ensuring that communities around the park's boundaries derive tangible benefits from the park, such as through ecotourism or sustainable resource harvesting. With a mean score of 4.5 and a 56.7% agreement rate, respondents stressed that providing direct benefits to surrounding communities would increase local support for conservation initiatives and reduce encroachment. Brockington *et al*. (2008) highlighted that when communities benefit from parks (e.g., through job creation or sustainable agriculture), they are more likely to support conservation efforts and take part in protecting the area.

5. Strengthen Cooperation with Stakeholders (Mean Score = 4.2, 63.3% Agreement)

Strengthening cooperation with stakeholders, such as local government agencies, NGOs, and international conservation bodies, is another important strategy, with a mean score of 4.2 and 63.3% of respondents in agreement. Collaborative efforts can bring additional resources, expertise, and influence to conservation management. Carter and Schmitz (2008) emphasized that partnerships between different stakeholders are crucial in improving both the management and financial sustainability of protected areas.

6. Compensation for Irrigation in Various Parts of the Park (Mean Score = 4.36, 43.3% Agreement)

Providing compensation to communities for refraining from using irrigation within the park received a mean score of 4.36. This strategy is particularly relevant for mitigating human impacts on water resources and biodiversity. Nagendra (2008) noted that compensation schemes could be effective in reducing unsustainable practices, particularly in areas where local communities rely on park land for farming and irrigation.

7. Provide Continuous Capacity Building Training to Scouts (Mean Score = 4.2, 43.3% Agreement)

Continuous capacity building for scouts is essential to ensure that park staff can effectively manage resources, address threats, and respond to emergencies. With a mean score of4.2, respondents agreed that regular training for park personnel, especially scouts, would improve their skills in biodiversity monitoring, law enforcement, and community engagement. Beyene (2010) found that ongoing training of park personnel significantly increases their capacity to tackle conservation challenges, particularly in post-conflict settings.

8. Making Firebreaks Mandatory (Mean Score = 4.2, 28.6% Agreement)

The creation of firebreaks is crucial to managing the risk of wildfires, especially in regions prone to such events. With a mean score of 4.2, firebreaks are considered an essential preventative measure. Given the frequency of wildfires in the park, as observed during the war period, this strategy would help limit the spread of fires and protect both human settlements and biodiversity.

9. Legal Farms Relocation (Mean Score = 4.2, 30% Agreement)

Relocating legal farms within the park received a mean score of 4.2, with 30% of respondents in agreement. This strategy suggests that agricultural activities, which often lead to deforestation and biodiversity loss, should be relocated outside the park. Schroeder *et al*. (2011) noted that agricultural encroachment is one of the main causes of habitat destruction, and legally relocating farms can help restore ecosystems and prevent further degradation.

10. Prepare an Emergency Response Plan (Mean Score = 4.06, 33.3% Agreement)

An emergency response plan with a mean score of 4.06 emphasizes the importance of being prepared for natural disasters, conflicts, or other sudden threats to the park. Such a plan would outline clear protocols for protecting both the park's resources and the surrounding communities in times of crisis. Nash (2013) found that emergency plans are vital in maintaining the resilience of protected areas during times of political instability or environmental disasters.

11. Amendment of the Protection of Parks Law (Mean Score = 4, 50% Agreement)

Amending the protection laws to strengthen enforcement and penalties received a mean score of 4.0, with 50% agreement from respondents. This strategy seeks to address legal loopholes and ensure stronger penalties for illegal activities within the park. Barrett et al. (2007) emphasized that legal reforms and better enforcement mechanisms are essential in ensuring that conservation laws have the intended effect.

12. Remove Residential Villages in the Park (Mean Score = 3.9, 46.7% Agreement)

The removal of residential villages from within the park received a mean score of 3.9. Although there was significant support for this measure, it highlights the challenge of balancing human needs (compensations required) should consider with conservation goals. Relocating communities is often met with resistance but remains a necessary action to prevent habitat destruction and ensure the long-term protection of biodiversity.

CHAPTER FIVE; Discussion

5.1. Demographic Characteristics of Respondents

The mean service year of respondents /park personnel is 7.4 years indicates the majority of the respondents have substantial work experience in the park, which may enhance their capacity to manage the tasks and responsibilities associated with their roles in addition to this experienced workforce can provide valuable insights of the threats existed before the war by recall their institutional knowledge and to specify parks over all management and conservation requirement and decision-making processes within the park for restoration. The majority of the respondents (67.5%) are from the Sheraro site, this is due their presence The remaining 32.5% of the respondents are from the Kafta Humera branch of the park the less representative from kafta is the workers in the area are displaced due to war and doesn't return due to continuing insecurity in the area.

The inclusion of staff members from both the core study site and the broader park context can provide a more robust and contextualized analysis of the park's comprehensive management and conservation efforts.

- **Age, Educational level and Sex of Respondents**

The age of the respondents ranges from 30 to 60 years, with the majority (50%) falling within the 41 to 50 years age bracket.The data indicates that a significant proportion of the respondents (43.3%) are in the 30 to 40 years age group. This suggests that the study has also captured the perspectives and insights of a younger, yet still experienced, cohort of staff members. The inclusion of this age group is important, as they can provide a fresh and dynamic perspective on the park's management, potentially bringing new ideas, innovative approaches, and a different outlook on the park's challenges and opportunities.the diversified age of respondents is due to the employing new staff members when the park capacity increases and sometimes when some one left their work due to age and getting other opportunities. The experienced senior staff can offer their institutional knowledge and well-established practices, while the younger staff can contribute their innovative thinking and adaptability to changing circumstances. This diversity of

age and experience can foster a more robust and well-rounded analysis of the park's management and conservation efforts.

The majority of the respondents (41.9%) hold primary and secondary school certificates This suggests that a significant portion of the park's staff, likely the front-line workers or "scouts," have relatively lower levels of formal education. This finding is not entirely unexpected, as the nature of the work in the park may not necessarily require advanced academic qualifications, but rather a strong understanding of the local environment, wildlife, and conservation practices.The inclusion of staff members with diverse educational backgrounds is a positive aspect of the study, as it suggests that the park's management team comprises a mix of experienced front-line workers and highly educated professionals . This diverse skill set can be beneficial in addressing the multifaceted challenges of park management, as it allows for the integration of practical, on-the-ground knowledge with more theoretical and analytical approaches. It is important to note that the less number high educational qualification of the staff in these respondents is because of the requirement of the park with high profession how ever due to displacement of experts due to war and doesn't return to their work place . how ever even if large number of fieled scouts required upgrading field skill education and integrating with staff expert data system is mandatory to ensuring the park's successful management and protection.

The sex ratio of respondents is highly represent by male, this is also due to the existence of the park personnel during the study time in the area. In addition to this the work especially rangers work mostly needs physical strength that may challenge women in nature, and majority of the park workers are males.

- **Positions of Respondents**

The results show that the majority of the respondents (89.2%) are scouts. This finding is due to two conditions. First the day-to-day operations and activities in the park are primarily carried out by the scout workforce, who is responsible for on-the-ground monitoring, patrolling, and implementation of conservation measures. Second as indicated in the displacement of personnel during war time the higher stuff members did not stay there displaced to head office and other area far from the park. So this is not saying there is only these staff personnel's working in the area.

5.2. explanations of Threat Index during different time horizon

The findings from the study of KSNP reveal the severity and significance of various threat factors affecting the park's conservation over three distinct periods: before, during, and after the war in Tigray. These periods show the shifting nature of threats to the park, which are influenced by socio-political factors, including the war.

The Protected Area Relative Threatened Index (PARTI), as calculated in the study, was used to assess the relative significance of these threats for considering restoration programme based on their severity. The severity ranks before and during the war is an implication to see how warfare change or escalate threats in protected area for protection concerned bodies and the current existing threat rank is for restoration programme prioritization indication and further studies Below is an explanation of the significant variables identified in each period. Accompanied by relevant scholarly references that support similar findings from other regions or studies.

5.2.1. Expansion of Agriculture in and Around the Park

Agricultural expansion, had a threat index of 0.9 before and after the war and 0.82 during the war indicate it is highest threat of the park scoring greater than 0.8during the three time horizon . This high threat index suggests that farming activities significantly encroach upon the park, affecting its biodiversity. This result matches to different studies done in the park before the war by (Selemawi. A., *et al,* 2020; Adissu. A; et al 2024). they says Agricultural expansion is a major serious threat to the existence of wildlife in the study area., Unless urgent mitigation measures are taken, continued cultivation encroachment in the area will have disastrous consequences for the biodiversity and ecosystem of the park.

5.2.2. Domestic Animal Grazing

Domestic animal grazing was a persistent threat across all periods, with an index of 0.80 before the war, 0.76 during the war, and 0.74 after the war. This threat factor indicates that grazing pressure on the park's resources was strong, particularly before the war, domestic animal grazing declines during war is due to displacement of surrounding communities and their livestock from the area.this makes some decline how ever animals from other areas and even from Eritrea

crossing tekeze river and stayed in the park this was described by VoA amharic in august 14/2022. Studies in other areas such as those by Schroeder *et al.,* (2011) have similarly shown that uncontrolled grazing by domestic animals can severely degrade the vegetation and biodiversity of protected areas.

5.2.3. Wildfires

Wildfires are another significant threat to the park's conservation efforts, with a threat index of 0.82 before the war, 0.60 during the war, and 0.72 after the war. The fluctuations in wildfire severity might be related to shifts in human activity and climate conditions, as noted by Leone *et al.,* (2014), who highlighted the role of fire in ecosystem disruption and its exacerbation during periods of conflict, when fire control and forest management resources are often limited. Although wildfires were a concern throughout the study periods, the war itself seems to have temporarily reduced their occurrence, likely due to a reduced human presence in the area during the conflict

5.2.4. Lack of Well-Organized Law Enforcement

The primary threat factor across the park is the lack of well-organized law enforcement, which consistently recorded the highest threat index values: 0.84 before the war, 1.00 during the war, and 0.76 after the war. This indicates a significant failure in law enforcement, particularly during the war. The government’s focus during the conflict was largely on the war effort, diverting attention from the park and its surrounding communities. This observation supports findings from similar studies, such as those by Barrett *et al.,* (2007), who identified that in conflict zones, national resources often face diminished protection due to competing priorities. The lawlessness during the war period allowed illegal activities such as poaching and deforestation to thrive within protected areas.

5.2.5. **Irrigation within the National Park**

Irrigation activities within the national park also pose a significant threat, with an RTFSI of 0.78 before the war, 0.38 during the war, and 0.78 after the war. This suggests that while irrigation

was less prevalent during the war, it resumed afterward, as the local community sought alternative means to support agriculture in a region with limited arable land. Nagendra (2008) similarly found that irrigation projects within protected areas could degrade ecosystems, especially when water use is not carefully managed.

5.2.6. Low Community Awareness and Illegal Mining

Low community awareness about the importance of protecting natural resources and the prevalence of illegal gold mining were identified as additional threats. The RTFSI for low community awareness was 0.76 before, 0.74 during and 0.82 after the war, while illegal gold mining was 0.76, 0.8, and 0.86 respectively. The significant rise in illegal mining activities, particularly after the war, could be attributed to the collapse of local economies and the desperation of communities trying to recover from the economic strain of conflict. This aligns with findings by Beyene (2010), who reported that economic hardships caused by war often lead to the proliferation of illegal resource extraction as a survival strategy.

5.2.7. Inadequate Natural Resource Protection Laws and Shortage of Funding

The study also revealed two significant institutional issues: the ineffectiveness of existing natural resource protection laws (RTFSI = 0.74 before, 0.92 during, and 0.66 after the war) and a shortage of funding for park management (RTFSI = 0.74 before, 0.72 during, and 0.86 after the war). The main cause of low law enforcement before the war is relating to punishment for those caught committing illegal activities in the park are low. Due to the weakness of the national parks penal code in force in Ethiopia. The failure of natural resource laws during wartime reflects the broader governance challenges by other conditions neglecting park. during periods of instability, as noted by Brockington *et al*. (2008). The post-war funding crisis is also a key issue in many conflict-affected regions, where governments struggle to allocate resources for conservation amid urgent recovery needs.

5.2.8. Lack of Integration of Conservation Policies with Local Communities

Finally, the lack of integration of conservation policies with local community needs was a significant factor, with RTFSI values of 0.66, 0.86, and 0.86 before, during, and after the war.

The disruption caused by the war and the shifting focus of the local community to basic survival made it difficult for conservation policies to be effectively integrated into community practices. This gap in policy integration has been observed in other studies, such as Carter and Schmitz (2008), who emphasized the importance of involving local communities in the design and implementation of conservation strategies

5.2.9. Lack of Alternative Livelihood Activities (r (2) = 0.72, p = 0.000)

The absence of alternative livelihoods for communities dependent on the park worsened the park ecosystem. It is recommended that the government need to establish community livelihood compensating mechanisms to reduce the dependence on the park. This is especially required in identified areas for those having farm lands given before the demarcation of the park in side it and they did not come out, this impacts the park not only by using of their registered land but disturbing starting from the entrance to the farm and making difficulties to make patrolling for irregular introduce merged with them and for their expansion of farm in the park.

5.2.10. Wildlife Hunting for Food (r (3) = 0.5, p = 0.009)

Hunting for food was a significant threat to KSNP during the war indicates high increasment from before the war. This was due to to complete breakdown of the park management and introducing of different actors both to save their life and due to feed access they used wildlife killing as main source of their feed. The result obtained from the respondent agrees with personal communication by tatek shawel VoA Amharic 2023, impacting wildlife populations. Similar studies by Brodie *et al.,* (2015) have shown that hunting is one of the leading threats to biodiversity in protected areas, particularly in regions with weak law enforcement.

5.2.11. Illegal Logging (r (3) = 0.4, p = 0.067)

Illegal logging for construction and other military purposes during the war was an important factor in the park, contributing to deforestation of large tree Ngugi *et al.,* (2021) highlighted that illegal logging is one of the major anthropogenic threats to forests in protected areas, often exacerbated by the lack of effective monitoring systems during conflict.

5.2.12. Residential Expansion Within and Boundaries of the Park (r (3) = 0.58, p = 0.093)

Residential expansion into protected areas is a growing issue, and before the war, it posed a moderate threat to KSNP in.There are two villages inside the park existed before the declaration of the park in the crossing of Tekeze river from Sheraro to Humera especially the communities livelihood aligned with the irrigation in the area along Tekeze river it disturbs the park which requires solution in the long run. But currently as consequence of the war in addition to this residents of internally displaced people are existed in the park causing collateral damages in expansion of farm land and grazing their animals in parts of the park, which requires basic concern to the area and returning of the people to their homeland.this is similar to the impacts of war in ukrain In Ukraine, the war has displaced millions, with at least 15,000 IDPs seeking refuge in protected areas like Synevir National Park and Carpathian Biosphere Reserve, straining park facilities and resources (WWF, 2022).having the same implication to KSNP.

5.2.14. Expansion of New Weeds (r (3) = 0.4, p = 0.001)

Invasive species were also a threat to the park before the war. Weeds can out-compete native species, leading to long-term ecological changes invasive weeds have been seen in different parts, these weeds are not palatable to graze by livestock and the wild animals. Even if they are not as great threat in this time but there is indicators of expansion in the park especially in areas which are overgrazed by livestock because when the indigenous grass species are highly overgrazed and exploited the invasive species get conducive environment. Shackleton *et al.,* (2014) discussed the threat posed by invasive species in protected areas, emphasizing their role in altering ecosystems due to the collapse of responsible bodies in the protecetd areas.

5.2.16. Shortage of Funding for PA Management (r (3) = 0.74, p = 0.061)

The shortage of funding for protected area management was another major concern, affecting conservation efforts. The park requires different funding agencies how ever due to the war the existed funds like GEF-6 on for the park management empowering was stopped due to war which was work protecting Elephants, Similar findings were observed by Brockington *et al.*

(2008), who found that insufficient funding often leads to the deterioration of conservation efforts, especially in post-conflict areas.

5.2.17. Existing Natural Resource Protection Laws Do Not Save the Park (r (1) = 0.92, p = 0.000)

The breakdown of law enforcement during the war was a key factor in the park's vulnerability to different threats.this is due to different condition especially government does not bossier about how can affect the war to protected areas around it, but how to win the war against the opposite forces. In KSNP during war all government functions were displaced and still not in work. How ever the problem of the baylaws is not due to the collapse of the structure but even before the war the Ethiopian protected area by laws have not the capability to save national parks, the punishment given to irregular users of protected areas are very less.and no capabilitie to save the park.Barrett *et al.,* (2007) emphasized that in conflict zones, legal frameworks and conservation laws often become ineffective due to the lack of government control.

5.2.18. Lack/Low Staff and Field Scout Communication (r (1) = 0.92, p = 0.000)

The lack of communication and the reduction of staff during the war severely hindered the park's ability to enforce conservation laws.the park does not only lack communication between staff and field workers/rangers but complete breakdown of communication and displacement of workers highly affectyed the park. A study on protecyed area done by Beyene (2010) highlighted that resource depletion and personnel shortages are common in areas affected by conflict.

5.3.Landuse land cover changes

The park area has been changed its land-use land-cover from 2019 to 2024 both decline and increments have been recorded in different types of land-cover . in the park agricultural land was estimated to 1079 ha in 2019 before the war which increases to 7963 ha in 2024 that is 86.5% increase in five years with an estimated 1377 ha increment each year. Farming was decreased from 2015 to 2019 , that a study by zenebe a and adissu 2019; in kaftasheraro national park says total cultivated land in 2015 was 7024 ha having a decrease from 2009 that was 13810 ha. This was due to the empowering of park management from time to time. This also during this study decreases to 1079 ha in 2019. How ever due to the war farming increases to more than in 2015

cultivated land coverage. The second highest change is decline of woodland to wooded grass land this is due to different factors especially high logging of large trees for housing, and military purposes during the war makes the dense wooded lands to become sparse wood with grasses, the second the continuous fire existence in the park due to different actors tend vast area of the park to change from bushed forests to sparse wooded grass lands.

CHAPTER SIX; CONCLUSION AND RECOMMENDATIONS

5.1. CONCLUSION

The Tigray war significantly diminished the park's conservation capacity, with 85% of staff displaced, critical infrastructure looted or destroyed, intensifying pre-war existing threats and introducing new challenges (like settlement of displaced people and NTFP extraction of the *Boswellia papyrifera)*. The war accelerated habitat loss driven by agricultural expansion, illegal gold mining, and uncontrolled wildfires. Key species, including African elephants and greater kudu, faced heightened poaching, with ivory trafficking and selling of greater kudu meat in surrounding kebele due to collapsed management structures. Despite these adversities, opportunities for recovery exist, such as the rehabilitation of areas like Adi Tsetser, which saw reduced human activity during the war. The research also provides essential baseline data for future ecological studies, emphasizing adaptive management and stakeholder collaboration and Restoring KSNP requires multifaceted approaches that restore habitats, rebuild management capacity, and engage local communities, supported by national and international efforts to ensure the park's long-term sustainability.

5.2. RECOMMENDATIONS

KSNP like any other protected area in Ethiopia face different threats even before the war, highly exacerbated by the Tigray war,which halted management operations and caused operational property losses. To enhance conservation and ensure long-term ecological sustainability, the following streamlined recommendations are written in consideration of political instabilities in the area will become to its normal condition in short time but now the park is separated in two as kafta or western part and the sheraro or eastern parts makes difficult to work with some recommendation given here. In general from the study different recommendations for local and national and international communities for restoration of the park after the devastating war have been described here, these are address staffing, funding, biodiversity recovery, community livelihoods, disaster preparedness, ecological monitoring, and trans-boundary cooperation.

1. **Strengthen Park Management and Resources**

- **Restore Staffing and Infrastructure**: The park remains divided due to ongoing insecurity, with staff reassigned to other parks. The federal government should collaborate with local authorities to reassign adequate personnel to both park sections and restore damaged infrastructure. This will address escalating post-war threats, such as irrigation and non-timber forest product (NTFP) extraction.
- **Secure Diverse Funding**: Develop a sustainable funding strategy involving local government, international donors, and private sector partnerships. Strengthen ties with conservation NGOs and research institutions for technical and financial support. Organize a multi-stakeholder conference (federal, state, local governments, NGOs, and UN bodies) to align on restoration priorities and responsibilities.

2. Implement Recovery Strategies for Biodiversity:

Wildlife Protection and Habitat Restoration: Establish and enforce effective wildlife protection mechanisms, including the removal of illegal settlements, grazing, and other human activities from critical wildlife habitats. Initiate habitat restoration projects where degradation has occurred, focusing on reforestation, and combating invasive species.

- **Wildlife and Habitat Study**

The study reveals there is wild life and habitat losses, which requires a detailed separate studies how the war impacts individual Species Composition and Abundance is lookalikes. Detailed individual surveys should be conducted to document the species present in the Park, including flora, fauna, and any endemic or threatened species by making close integration with national and international research institutions. Regular monitoring should be implemented to track changes in species composition, distribution, and population trends. This will provide an understanding of how ecological conditions evolve following the devastating war. And how is the severity with implication for restoration with individual wildlife is required.

Fire Management Plans: Develop and implement a comprehensive fire management plan to prevent wildfires and minimize their impact on biodiversity. This could include creating firebreaks, establishing early warning systems, and community-based fire control initiatives.

Monitor and Manage Invasive Species: Establish monitoring systems for invasive species and implement eradication or control measures to prevent the further spread of weeds and other non-native species that threaten native biodiversity.

3. **Address Livelihood Needs and Alternative Sources of Income:**

- **Promote Alternative Livelihoods**: Provide sustainable income sources, such as beekeeping, handicrafts, and other alternatives to reduce community dependence on park resources. This is critical for displaced communities reliant on aid and park resources post-war. these displaced communities are lost their properties and still really dependent on international aids with a hand to mouth life with some still attached to park resource to support their life needs. In order to secure their livelihood without harming the national park. These communities still live in IDP's arranging after return their livelihood not only for the short term but also for the long term sustainability is important from both national and international organizations with special emphasis on return time to their resident.
- **Encourage Sustainable Agriculture**: Train local farmers in agroforestry, water conservation, and soil health to minimize agricultural encroachment and land degradation around the park in the long term.

4. **Strengthen Disaster Preparedness and Emergency Response**:

- **Prepare and Implement an Emergency Response Plan**: Given the history of conflict and the impact of disasters like wildfires, it is critical to prepare an emergency response plan for the park. This should include strategies for mitigating fire risks, responding to natural disasters, and managing the impacts of climate change on biodiversity.

5. **Conduct Further Ecological and Socioeconomic Studies**:

- **Long-Term Ecological Monitoring**: Establish long-term ecological monitoring programs to track biodiversity trends, habitat changes, and the effectiveness of conservation strategies. Data from these studies will help in adaptive management and refine recovery efforts over time.

- **Social Impact Assessments**: Regularly assess the social impact of conservation efforts on local communities, including the effectiveness of alternative livelihood programs and the success of community engagement strategies.

6. **Foster Trans-boundary Cooperation**

- **Integrated Plan with Eritrea**: As a trans-boundary park adjacent to Eritrea's Gash-Setit Wildlife Reserve, develop a joint conservation plan for shared species, like the African elephant, to promote sustainability of the wildlife and can be use as making regional peace.
- **Community Engagement Across Borders**: since Eritrean-herders also crossing the border and introducing their animals to the park Communicate park bylaws to livestock herders crossing borders to minimize anthropogenic impacts, fostering mutual understanding of sustained conservation for both protected areas also important in the long-run.

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