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THE ROLE OF SANCTUARY FORESTS AND RIVERS IN CONSERVING GENETIC RESOURCES AND BIODIVERSITY

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Abstract

Sanctuary forests and river systems are critical forms of in situ conservation that safeguard genetic resources and maintain biodiversity. By protecting species within their natural habitats, these ecosystems preserve evolutionary processes, support endemic and threatened taxa, and provide resilience against environmental change. This article examines the mechanisms through which sanctuary forests and rivers contribute to genetic conservation, their complementary roles, and the limitations that affect their effectiveness. The invasion of Christianity on sanctuary forests and rivers is a threat to genetic genome bank and biodiversity. The spread of Christianity becomes a threat when it removes traditional protections without establishing alternative conservation governance. Where religious institutions and traditional authorities collaborate, the outcome is often neutral or positive for biodiversity. The threat happens when Christian conversion leads to abandonment of taboos and no new governance replaces them. Where churches, traditional rulers, and NGOs collaborate—as in Apoi Creek and Opu-Nembe—the outcome is often conservation with local buy-in.

Keywords: In Situ Conservation, Forest Genetic Resources, Biodiversity, Sanctuary Forests, Gene Flow

INTRODUCTION

Biological diversity is maintained at three levels: ecosystem, species, and genetic diversity. Of these, genetic diversity underpins the adaptive potential of species and the long-term stability of ecosystems. Flourizel, defined biodiversity as the biological variation/species types in their ecological environments due to genetic factors over a period of time; it could be genetic

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interactions or environmental changes (natural or man-made) influence/threats that creates their differences/kinds/types (Igbani, 2022). They reported that biodiversity should not be construed as a simple umbrella covering a mosaic of heterogeneous activities but should represent a composite entity 'shaped by the interactions' (Igbani & Uka, 2019; Krishnamurthy, 2003). In situ conservation—protecting species in their natural habitats—is recognized as the preferred approach for maintaining evolutionary processes, as it allows populations to adapt to changing conditions. Sanctuary forests and rivers exemplify this approach, functioning as dynamic reservoirs of genetic resources.

Sanctuary forests and rivers are not just for biodiversity, they serve direct social, cultural, and economic functions for traditional communities and the wider society (FAO, 2002).

Aim and Objectives of the Study

Aim of the Study

The aim of the study is to document the role of sanctuary forests and rivers in conserving genetic resources and biodiversity.

Objectives of the Study

The specific objectives of the study are to:

- Explain the role of sanctuary forests in conserving genetic resources and biodiversity.
- Explain the role of sanctuary rivers in conserving genetic resources and biodiversity.
- Protecting sanctuary forests and rivers for the conservation of genetic resources and biodiversity.

Usefulness of Sanctuary Forests and Rivers to Traditionalists

Traditionalists rely on these areas for cultural identity, spiritual practice, and livelihoods:

Sacred and Cultural Value:

- Sacred groves and fetish forests are often protected by taboos and traditional laws. They house shrines, ancestral sites, and are used for rituals, initiations, and festivals.
- Species like Adansonia digitata (baobab) and Khaya senegalensis (African mahogany) are conserved in these groves for spiritual reasons, even when surrounding forests are cleared.

Traditional Medicine and Food:

- Forests and rivers provide medicinal plants, herbs, fruits, nuts, and game that form the basis of traditional healthcare and diet.
- Rivers supply fish, mollusks, and plants used in traditional cuisine and herbal remedies.

Indigenous knowledge preservation:

- Protecting these ecosystems keeps the knowledge of plant use, animal behavior, and seasonal cycles alive. Elders pass this knowledge to younger generations within the context of the actual ecosystem (FAO, 2002).

Conflict Mitigation and Social Cohesion

- Traditional management of sacred forests often regulates access and use, reducing conflict over resources within communities.

Usefulness of Sanctuary Forests and Rivers to Society at Large

For the broader society, sanctuary forests and rivers provide ecosystem services and development benefits:

- **Ecosystem Services**

Water Regulation: Riparian forests stabilize riverbanks, filter sediments, and maintain water quality for drinking, agriculture, and industry.

Climate Regulation: Forests sequester carbon and moderate local climate. Rivers and wetlands buffer floods and droughts.

Pollination and pest control: Forest populations of bees, birds, and insects support agriculture beyond the protected area.

- **Economic Benefits:**
- Ecotourism and Culture Tourism: Sites like Apoi Creek Forest and Bayelsa's riverine landscapes attract tourists interested in wildlife and culture, creating jobs and revenue.
- Fisheries and Non-timber Forest Products: Healthy rivers sustain fisheries. Forests provide fruits, nuts, honey, and medicinal plants that contribute to rural livelihoods.
- **Health and Education:**
- Clean water and reduced flooding lower disease burden.
- These areas serve as living laboratories for schools and universities studying ecology, genetics, and conservation (FAO, 2002).
- **Genetic Resources for the Future**

Wild populations in sanctuaries maintain genetic diversity that can be used for crop and livestock breeding, disease resistance, and climate adaptation. This benefits agriculture and food security nationwide.

Sanctuary Forests as Genetic Reservoirs

Sanctuary forests are protected areas where logging, agriculture, and hunting are restricted to minimize anthropogenic disturbance. Their contribution to genetic conservation includes:

- Maintenance of Genetic Diversity: Large, undisturbed forests sustain outcrossing between unrelated individuals, thereby preserving high levels of heterozygosity and allelic variation. This reduces the risk of inbreeding depression and genetic drift that occurs in small, fragmented populations.
- Refugia for Endemic and Threatened Species: Sanctuaries provide habitat for species with narrow ecological niches. In Nigeria, the Apoi Creek Forest Ramsar site protects the critically endangered Niger Delta "red colobus monkey" and other endemic taxa. Such sites act as refugia where species persist despite regional habitat loss.
- Source Populations and Ecosystem Resilience: Protected forests serve as source populations for recolonization of degraded areas. Seeds, pollinators, and dispersers migrate outward, supporting landscape-level biodiversity recovery. They also maintain ecosystem processes such as nutrient cycling and climate regulation.
- Cultural and Sacred Groves: Across sub-Saharan Africa, sacred groves and fetish forests have historically protected species like Adansonia digitata and Khaya

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senegalensis for spiritual reasons, resulting in unintentional conservation of forest genetic resources.

- Rivers and Wetlands as Corridors for Genetic Flow: Rivers and associated floodplains link terrestrial and aquatic habitats, facilitating gene flow and maintaining aquatic genetic resources.

Aquatic Genetic Resources

Rivers harbor fish, amphibians, mollusks, and aquatic plants with locally adapted genotypes. The Niger Delta river network supports endemic fish species adapted to unique water chemistry and flow regimes.

Connectivity and Gene Flow

As linear ecosystems, rivers connect fragmented habitats, enabling movement of aquatic organisms and dispersal of riparian plant seeds. This connectivity mitigates genetic isolation and supports metapopulation dynamics.

Climate Resilience

Healthy river systems buffer against droughts and floods, providing refugia during climatic extremes. Floodplain wetlands create heterogeneous microhabitats that sustain high species and genetic diversity.

The Forest-River Nexus

Riparian forests and rivers are ecologically interdependent. Riparian vegetation stabilizes riverbanks, filters sediments, and supplies organic matter that sustains aquatic food webs. Protecting both systems conserves terrestrial genetic resources—trees, mammals, insects—and aquatic genetic resources—fish, invertebrates, macrophytes—while maximizing ecotone diversity at the land-water interface. Integrated management of forest-river mosaics is therefore more effective than isolated conservation efforts.

Limitations and Challenges

The effectiveness of sanctuary forests and rivers depends on several factors:

- Size and Connectivity: Small, isolated forest patches lose genetic diversity rapidly due to drift and inbreeding.
- Human Pressure: Encroachment, illegal logging, and hunting undermine protection goals, particularly in regions with high demographic pressure.
- Water Quality: Pollution from industrial activity and oil spills degrades aquatic habitats and erodes genetic resources, as observed in parts of the Niger Delta (Vanguard News, 2023).
- Management Capacity: Many protected areas lack explicit genetic conservation objectives and monitoring protocols, limiting their contribution to genetic resource management.

Sanctuary Forests and Rivers Aid Animal Genetic Preservation

Sanctuary forests and rivers conserve animal genetic resources by protecting animals in situ in their natural habitats where evolutionary processes continue (FAO, 2002), thus:

- Maintaining Viable Wild Populations: Sanctuary forests and rivers keep populations large enough to avoid inbreeding and genetic drift. Large, undisturbed forests sustain outcrossing between unrelated individuals, preserving heterozygosity and allelic variation in mammals, birds, primates, and insects. For example, the Apoi Creek Forest in Bayelsa protects the critically endangered Niger Delta "red colobus monkey" by maintaining a viable wild population.
- Providing Refugia for Endemic and Threatened Species: Protected habitats act as refugia when surrounding areas are degraded. Species that can not survive in farmland or urban areas persist here, keeping their unique gene pools intact. Sacred groves across sub-Saharan Africa have unintentionally conserved populations of mammals and birds by restricting hunting and clearing.
- Enabling Gene Flow and Connectivity: Rivers and riparian forests function as linear corridors. They connect fragmented forest patches, allowing animals to move, mate, and exchange genes between populations. This prevents genetic isolation in fish, amphibians, and riparian mammals. For fish and amphibians, rivers maintain locally adapted genotypes tied to water chemistry, flow, and temperature.
- Serving as Source Populations for Recolonization: When surrounding areas are disturbed, animals disperse from sanctuaries to recolonize degraded habitats. This spreads genetic diversity back into the landscape and supports recovery of wild populations (FAO, 2002).
- Supporting Climate Resilience: Healthy river systems and forests buffer against droughts and floods, providing refugia during extremes. Floodplain wetlands create microhabitats where species can persist and maintain genetic diversity during climate stress.
- Preserving Co-evolutionary Processes: In situ conservation in sanctuaries lets animals continue evolving with their environment, pathogens, and food sources. This is better than ex situ methods like zoos or gene banks because it maintains the full range of genetic variation linked to local adaptation.

CONCLUSION

Sanctuary forests and rivers are indispensable for in situ conservation of genetic resources and biodiversity. They preserve evolutionary processes, maintain adaptive potential, and provide ecosystem services that support human well-being. To maximize their impact, conservation strategies must integrate forest and river management, ensure adequate protected area size, and incorporate genetic considerations into land-use planning. As global biodiversity declines, strengthening these natural sanctuaries is a priority for sustainable development and climate adaptation.

By protecting habitats, sanctuary forests and rivers prevent loss of animal genetic diversity, maintain adaptive potential, and provide the raw material for natural selection and future breeding programmes. Without these in situ reservoirs, ex situ methods alone can not preserve the genetic variation needed for long-term species survival (FAO, 2002).

For traditionalists, sanctuary forests and rivers are living cultural and spiritual heritage. For society, they are infrastructures providing water, food security, climate resilience, and economic opportunity. Losing them breaks both cultural continuity and the ecosystem services most communities depend on daily (FAO, 2002).

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RECOMMENDATIONS

To strengthen the role of sanctuary forests and rivers in conserving genetic resources and biodiversity, the following actions are recommended:

- Expand and connect protected areas: Designate larger sanctuary forests and riparian corridors to maintain viable population sizes and reduce genetic drift. Where possible, establish ecological corridors between fragmented habitats to restore gene flow. FAO recommends that in situ conservation reserves be large enough to sustain natural evolutionary processes and outcrossing.
- Integrate genetic considerations into management plans: Protected area management should explicitly include genetic conservation objectives, such as monitoring allelic diversity and population structure of priority species. This aligns with FAO guidance on managing forest genetic resources in protected and managed forests.
- Strengthen community-based conservation: Formalize the role of sacred groves and traditional practices in conservation policy. Local communities have historically protected species like Adansonia digitata and Khaya senegalensis through cultural norms. Supporting these systems improves compliance and reduces encroachment.
- Improve water quality and pollution control: Enforce regulations on oil spills, industrial discharge, and agricultural runoff in the Niger Delta and similar regions. Healthy aquatic systems are essential for maintaining aquatic genetic resources and the function of riparian corridors.
- Invest in monitoring and research: Support long-term monitoring of genetic diversity in key sanctuary sites, including Apoi Creek Forest and the Niger Delta river network. Data on population genetics can inform adaptive management and identify populations at risk of loss.
- Link conservation with sustainable use: Promote sustainable harvesting and eco-tourism models that provide local benefits without undermining genetic integrity. As noted by FAO, in situ conservation is most effective when compatible with sustainable resource use.

Implementing these measures will improve the resilience of both terrestrial and aquatic genetic resources, supporting biodiversity conservation and climate adaptation in the long term.

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