Review

The Assessment of the Role of Parks and Botanical Gardens in Ethiopia

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The Assessment of the Role of Parks and Botanical Gardens in Ethiopia

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Abstract: In Ethiopia, there are a lot of national and regional parks and the objective is to conserve wild animals and plants on site. Botanical gardens are essential to the study and preservation of plant biodiversity, both in situ and ex situ. Botanical gardens are vitally essential establishments that protect the environment from ever-increasing environmental concerns, provide recreational possibilities, educate the public about environmental issues, and carry out a variety of conservation and research projects. Their goal is to preserve collections of live plants with documentation for use in scientific study, preservation, exhibition, and teaching. Botanical gardens engage in a wide range of scientific endeavors, including the study of seeds, taxonomy, systematics, genetics, biotechnology, propagation, horticulture, public education, restoration ecology, and many other subjects. The functions of parks and botanical gardens include; scientific research, natural science, Reduction of Wind and Water Loss, shelter for Fish, Wild Habitat, Noise, Pollution Control, and Serving as a Buffer Zone.

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Introduction

Ethiopia is regarded as one of the global centers of biodiversity resources, and part of its richness is thought to be attributed to the country's wide altitudinal range (Tolera, Asfaw, Lemenih, Karltun, & Environment, 2008). The concept of a botanical garden originated in Italy in 1545 (Chen & Sun, 2018). According to studies, the number of botanical gardens in the world is around 2500 (Golding et al., 2010). Botanical gardens are essential to the study and preservation of plant biodiversity worldwide, both in situ and ex-situ (Mounce, Smith, & Brockington, 2017). A goal of the Global Strategy for Plant Conservation is to save 70% of the world's vulnerable plant species ex-situ (Huang, 2018). Additionally, botanical gardens play a significant role in maintaining species that are essential to human usage and welfare (Dunn, 2017). Botanical gardens engage in a wide range of scientific endeavors, including the study of seeds, taxonomy, systematics, genetics, biotechnology, propagation, horticulture, public education, restoration ecology, and many other subjects (Donaldson, 2009). Ecosystem services are declining as a result of the unprecedented loss of plant diversity. As a result of numerous destructive human activities, such as overharvesting, overexploitation through destructive agricultural and forestry practices, urbanization, environmental pollution, changes in land use, exotic invasive species, and global climate change, approximately one-third of the 300,000–450,000 vascular plant species in the world are currently in danger of going extinct (Dunn, 2017). However, plant biodiversity is extremely damaging.

The word "park" implies "enclosure" in Latin. The terms "preservation," "protection," and "conservation" basically mean "keeping certain areas or natural aspects away from the present demand." Similarly, administration refers to specific methods of overseeing the field, often involving the entire spectrum of new organizations, professionals, and procedures, while establishment designates a legal event of bringing into existence. A park in the community symbolizes a variety of cultural, artistic, and spiritual qualities. (Ghimire, 1994).

Parks and forests are examples of important natural resources since they support the livelihoods of a large number of people worldwide and have a positive impact on the ecological balance. However, many ecologically significant regions, such as parks, are severely degraded as a result of rising population growth, decreased agricultural yield, and the rapid extension of farmlands in the

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majority of countries. The primary motivation for this type of natural resource management (Inglis, 2008). Beyond the harmful impacts of environmental pollution, an ecosystem that is well-managed and maintained is also crucial for human health. Humans' physical and emotional well-being are negatively impacted by natural disasters. Exposure to diseases or hazardous substances can harm biodiversity, while biodiversity with ecosystem services can have a positive impact on health-related concerns by altering the aesthetic, cultural, and recreational characteristics of natural ecosystems. By assuming the nativity and threat status of plant species, botanic gardens are currently a good technique for the ex situ conservation of those species (Krishnan & Novy, 2016). Ethiopia's botanic gardens are utilized to protect the rarest plant species in the nation as well as indigenous, endangered, endemic, and commercially significant plant species. The primary goals of botanic garden in Ethiopia are plant conservation, research, education, and ecotourism. Prioritizing native, endangered, endemic, and commercially significant plants together with uncommon species that are unique to the nation is part of the conservation effort. The organization has created a variety of infrastructures to help it carry out its vision and mission in an equitable manner. The garden creates an evolution garden and a themed garden with collections of diverse in situ and ex situ conservation approaches. According to the concepts of ecosystem services, diseases, and natural disasters are partially controlled by the ecosystem, which has negative health (Polisciano & Farina, 2010). In well-known public areas, these activities offer exceptional chances for gardening, conservation biology, and the study of plant biodiversity. Nonetheless, the role of botanica garden and parks remains scarcely explored. The aim of this study are to increase public knowledge of the issues affecting our environment and world to effect significant behavioral changes.

Role of Parks and Botanical garden in Ethiopia

In Ethiopia, nation's plant genetic resources are maintained and preserved in large part by the Botanic Garden. It is presently putting up a lot of effort and being successful in a range of tasks that aid in the achievement of its goal. The organization's primary objectives are study and the preservation of native and different plants, parks mostly serve the purpose of conservation. The main function of botanical garden are; a) To display an extensive assortment of everything deemed ideal from an attractive perspective from the woody plants that can be grown in the region (if a botanical garden, then among the perennials, annuals, and bulbs as well, if an arboretum). b) To serve as a way to introduce new plants, wherever they may have originated, into the region. c) To give botany, horticulture, and natural study students access to a lab. d) To strategically plant areas to boost output, economic significance, and aesthetic appeal; additionally, to introduce novel plants that have not been planted there before. e) To stimulate the public's interest in leisure activities such as drives, walks, breathtaking displays, flower shows (Patzelt & Anderson, 2016). Numerous significant environmental advantages are provided by parks, woods, and other vegetation. In addition to giving all land-dwelling animals a place to live, trees' ability to sequester carbon helps to fend off climate change and global warming. The distribution and intensity of local and regional rainfall are greatly influenced by forests. Not only do plants in parks provide a plentiful supply of food and clean water, but they also provide therapeutic, decorative, and recreational uses for a multitude of individuals. (Mekonnen, 2015). However, the botanical garden’s role is conservation and scientific research, and it can cover all park activities. A botanical garden is the perfect location for a variety of scientific (Novy, 2017). Plant physiology and growth strategies, plant-animal interactions, and phonological indicators of climate change are among the data on plant ecology that are collected from this significant source (Herben, Nováková, Klimešová, & Hrouda, 2012).

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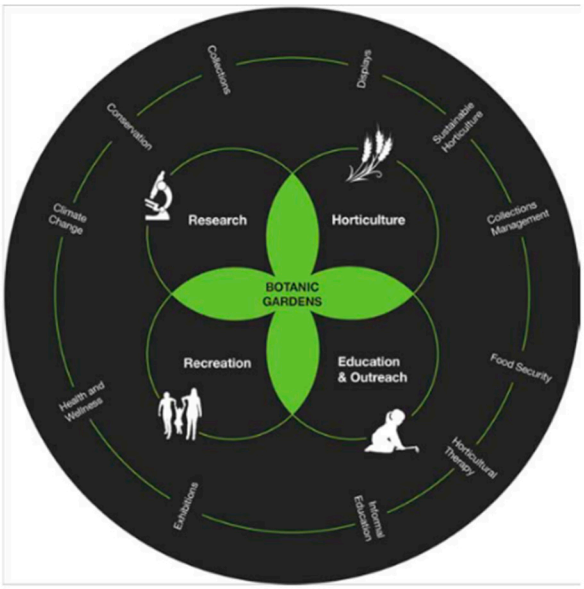

Role of botanical garden (Krishnan & Novy, 2016)

Role in Climate Change

Because forest plants and soils store carbon, they are essential for maintaining local and regional weather patterns because they sequester carbon through photosynthesis and release it through respiration. However, it is a sad fact that forests are being cleared for a variety of livelihood activities around the world, including farming, fiber production, timber, and fuel wood. When forests are burned or cleared of their surface, they release carbon back into the atmosphere because human activity is changing their ability to store carbon. Tropical deforestation is the main factor contributing to the extinction of forest species and accounts for 20% of annual carbon dioxide emissions caused by humans (Schimel et al., 2001). According to Shivastava (2002) Temperature, wind, sun radiation, and humidity are all influenced by trees. Because of their high canopy, forests are warmer in the winter and colder in the summer than open spaces. This is valid for the daily variations. Forests therefore have a moderating effect on temperature. The canopy of the night forest stops heat gained during the day from radiating back. Because trees block off the wind, the air inside a forest is moister than it is outside. If a mountain range is covered in forests, rain-bearing winds are diverted further up into the atmosphere, which cools the air and increases precipitation (Montagu, 2002).

Scientific research

Many areas of scientific inquiry benefit from the presence of botanical gardens. Botanical gardens function as centers for systematic and taxonomic research as well (Chen & Sun, 2018). However, they also serve as essential sources of data for the study of plant ecology, including phenological indicators of climate change, plant physiology and growth strategies, and interactions between plants and animals (MILLER et al., 2004). Botanical gardens can offer a wide variety of species for studying functional trade-offs between species attributes and plant performance in terms of plant functional qualities (Herben et al., 2012). Scientists studying endangered plant species in their ex-situ collections have also taught environmentalists not to overlook the possible dangers of hybridization. Particularly, it has been demonstrated that spontaneous hybridization in ex-situ settings compromises the genetic integrity of ex-situ collections and may contaminate open-pollinated seeds or seedlings (ZHANG, YE, YAO, & HUANG, 2010). Pollination ecology, which includes the breeding system, efficient pollinators, and other elements, should be meticulously documented and observed to preserve and maintain the ex-situ population of endangered species in botanical gardens (Chen, Luo, Mei, Shen, & Sun, 2015) (Figure 1). Plant conservation genetics offers useful instruments to assess and track processes, direct conservation and effective restoration, and eventually reduce the danger of extinction for threatened plant species in the wild (Kramer & Havens,

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2009). Conservation genetics has spent the last few decades mostly examining the genetic effects of small populations, which may limit the ability of populations and species to survive. However, according to recent evaluations on the genetic aspects of plant conservation, genetic erosion is becoming a bigger hazard to the long-term survival of both common and uncommon species (OUBORG, VERGEER, & MIX, 2006).

Figure 1. Green house at Gullele botanical garden, Addis Ababa, Ethiopia. Source: Gullele botanical garden communication department (Mr. Samuel Hembisa).

National Science

The method via which citizens conduct scientific research is known as citizen science and Historically connected to gardens of botany. Currently, "citizens as scientists" is the main goal of contemporary citizen science as opposed to "scientists using citizens as data collectors" (Conrad & Hilchey, 2011). To strengthen their capacity to oversee and manage natural resources, evaluate species that are at risk, and safeguard natural conservation areas, policymakers and non-governmental organizations are actually making greater use of volunteers (Silvertown, 2009). In western North America, for example, volunteers were able to present evidence of sharp drops in monarch butterfly populations during the previous 36 years (Schultz, Brown, Pelton, & Crone, 2017). Investigating the spread of invasive plant species by local residents through a citizens science programme may help to increase awareness and modify local behavior (JORDAN, GRAY, HOWE, BROOKS, & EHRENFELD, 2011) (see Figure 2). It is a reality that creating and carrying out public data collection initiatives frequently results in scientific and educational outputs like scientific teaching, biodiversity monitoring, and biological research (Bonney et al., 2009; Raimondo, Ebrahim, & Donaldson, 2006).

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Figure 2. Scientific teaching about plant. Source: Gullele botanical garden.

Reduction of Wind and Water Loss

Raindrops trickle down the leaves and branches of trees, preventing the moisture from striking the ground with force. Runoff is decreased by the humus and ground litter, which absorb water. Because organic matter maintains the soil's porosity and permeability, water can penetrate and be stored in the substratum (Bryan et al., 2005). The decline Sand is blown across fertile areas by wind, which also increases evaporation, dries out the soil and destroys fertile topsoil. Trees serve as shelterbelts and windbreaks. Wind speed is significantly lower (Bryan et al., 2005).

Source: Gullele botanical garden

shelter for Fish and Wild Habitat

While forest growth shades the water courses, it keeps streams from getting too hot, which is good for fish life. When trees were cut down in American rivers and streams, the water became unsuitable for trout fish to live in. Clear streams that are ideal for fish life are another benefit of forests. Many types of wild species find food and shelter in forests. Certain wildlife species vanish when forest trees are cut down. Other types of wildlife that depend on weeds, bushes, and young trees may

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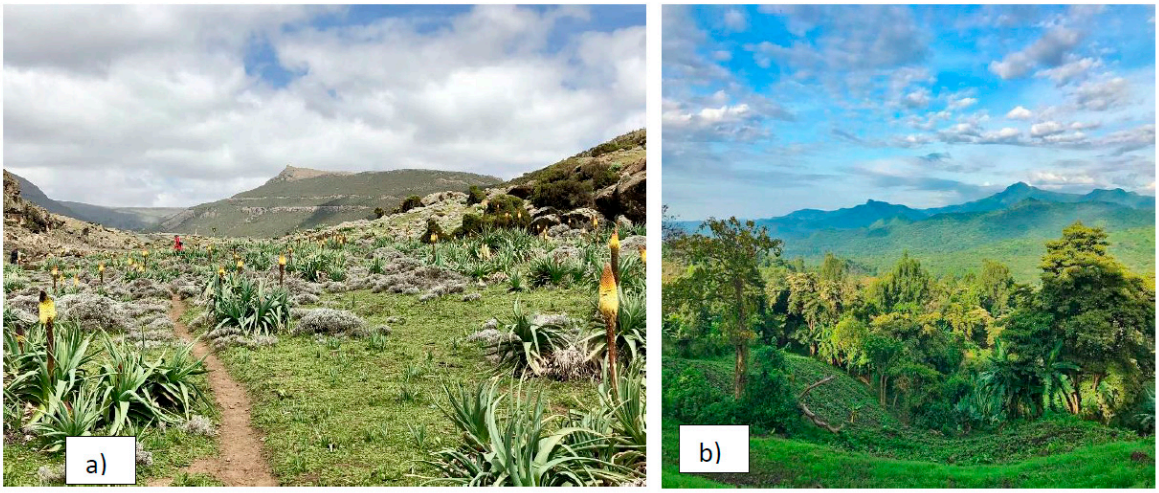
be able to live there once the habitat for trees has been restored. Over time, all wildlife will vanish when trees and other forest vegetation are eliminated.



a) Source: Mellisa Barry (Bale mountains national park, Ethiopia) b) Chebera churchura park (Workamba tour)

Noise and Pollution Control

As part of their regular gas exchange, trees take in airborne contaminants. The trees absorb and use trace amounts of Sulphur dioxide in their metabolism. Additionally, trees help to clean soil and water by absorbing different types of pollutants through their roots. Reduction Making appropriate use of trees and plants can help reduce noise. Even a few trees can be helpful if they are positioned between the people and the noise source. In the winter, deciduous trees are not very useful. Trees need to be near the noise source to be effective.

Serves as a Buffer Zone

A healthy ecosystem's services and activities depend critically on the integrated ecological responsibilities of forest trees, shrubs, forbs, grasses, water bodies, soils, and other elements. The existence of a network of these various resources is essential to ecosystem functions because they each play a different role in fostering a healthy environment. When these resources work together, they can filter water resources, act as a sink for carbon dioxide, support the growth of a healthy ecosystem for various microorganisms, provide food and shelter for wild animals, enhance fish habitats, and more.

Future challenges and opportunities of parks and botanical garden in Ethiopia

Several human endeavors are reuniting once separated populations and species, such as in situ/ex situ conservation studies and horticultural hybridization procedures in botanical gardens (BLACKMORE, GIBBY, & RAE, 2011; Kramer & Havens, 2009). But through outbreeding depression, the artificial gene flow that results from this could cause plant species to decline or become extinct. In fact, new research has shown that outbreeding depression negatively affects population persistence (EDMANDS, 2007). The purpose of botanical gardens is to advance knowledge, research, and preservation of the diversity of plant species. Studies on the species variety of botanical gardens itself, however, are scarce (Pautasso & Parmentier, 2007). stated that patterns of species richness seen in natural ecosystems have little to do with the living collections found in botanical gardens around the globe. The writers advocate for more funding for scientists in underfunded nations and botanical gardens located in areas rich in species. Furthermore, in order to track changing environmental conditions in gardens, botanical gardens ought to be major players in the creation of a plant information database (Paton, 2009). However, many studies have overlooked the beneficial impact that horticulture in botanical gardens has on plant conservation in recent

decades. As a result, we advise horticulturists at botanical gardens to work in conjunction with scientists studying taxonomy, genetics, systematics, and environmental education (BLACKMORE et al., 2011). Staff members in these scientific centres should make use of their vast field expertise and experience to perform conservation effect assessments and related studies, since they are essential to the effectiveness of conservation efforts in botanical gardens. Failure to do so may prevent the goals of scientific plant species conservation from being met. With the enormous volume of visitors both in person and virtually, citizen science offers botanical gardens a unique potential (Donaldson, 2009). When designing a citizen science programme, it is important to consider possible conflicts between scientific research, educational activities, and participant motivation. Basic guidelines should be followed by citizen science initiatives in botanical gardens: information gathered from the general public should be verified by various experts; data collection techniques should be standardized; and volunteers should be given feedback regarding their involvement in the gardens (Chen et al., 2015; JORDAN et al., 2011). Botanical gardens are excellent places to study the diversity of plants and how they use their resources. Still, research carried out in botanical gardens is generally overlooked in mainstream plant science. Leaders in the plant science community are not usually scientists working at botanical gardens. Plant collection and identification, species documentation and evaluations, horticulture and conservation methods, public education, and citizen science are examples of capacity building and training activities that should be carried out in botanical gardens to prepare future botanists and horticulturists (BLACKMORE et al., 2011). In conclusion, given the onset of the Anthropocene, it is imperative to deliberate on the notion of "new conservation." Additionally, novel technologies could potentially offer novel prospects for botanical garden researchers in the aftermath of GSPC 2020. It is essential for a scientific botanical garden that priorities science and conservation to have a thorough collecting policy for living collections. Plants of wild origin, representative populations, sufficient sample sizes, clear provenance and other collection details, and a direct connection between collections and botanical project design are a few examples of what this would consider. Ethiopia Botanical Gardens should i) create specialized gardens and support research linked to those gardens, ii) enhance and build facilities for molecular biology research, and iii) create digitalized botanical gardens to boost capacity and scientific research (Heywood, 2017).

Conclusion and Recommendations

The botanical garden has a huge role in conserving fauna and flora with in-situ and ex-situ methods in scientific ways. National parks provide refuge to untamed fauna and flora that would face extinction due to human activity. They also offer protection to many vulnerable and endangered species, preserve declining habitats, and offer safe havens for breeding where endangered species can thrive. For the benefit of the next generations, these vital ecosystems may be preserved with everyone's kindness and upbeat outlook. Globally, the depletion of natural resources poses a major danger to sustainable development. In developing nations, where a sizable portion of the populace depends on natural resources for their livelihood, the effects of resource degradation are more acute. Growing population pressure drives these countries' households to overuse their natural resources, which increases poverty. Households' motivation to labor for the defense of the park than the botanical garden. Ethiopia has a variety of indigenous and endemic plants and animals, that need preservation. So, additional botanical garden will have need.

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