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Establishing "GARA IFAA ''as Forest Species Restoration (Gene Bank) Site for Biodiversity Conservation, Shashemene District, Ethiopia

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Review Article

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ABSTRACT

Field gene bank is one of the techniques in the strategy for plant genetic conservation. It is an *ex situ* method where genetic variation is maintained away from its original location and samples of a species, subspecies or variety are transferred and conserved as living collections. Field gene bank is the most common method of conserving genetic resources with recalcitrant seeds and vegetative propagated plants. The site of study is "Gara Ifa'' which means light mountain by Afaan Oromo(Oromo province majority around the site) local name and fund in Dalati kebele of Shashemene District. The site was secured by joint agreement of West Arsi Agricultureand natural office, Shashemene wereda Agriclutre and Natural office and Dalati kebele administration in 2021. Gara ifa was a site where forested area and the forest are cleared by more than two decades ago. Through time the forest were cleared by local community for firewood, construction, charcoaling and over exploitation of medicinal plant by uprooting the whole plants. In the site many saplings were emerging so that shows the forest has dynamic recovery capacities in the short period of time.

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INTRODUCTION

In an agrarian society like Ethiopia, forestry can play significant role in economic development. The forestry GDP as a proportion of the whole economy and in relation to agriculture has been very low. The share of forestry in the GDP varied between 2% and 2.6% from 1971 to 1985 and declined to 1.9% between 1986 and 1987. If direct consumption of commodities such as fuel wood and charcoal and the indirect contributions of forests to watershed management and soil conservation as well as that of forest products utilized in other manufacturing and construction activities are considered in the calculation, the contribution of forestry to the total GDP [1]. New settlements in forests are increasing from time to time and hence resulted in the conversion of forested land into agricultural and other land use systems. [2].

LITERATURE REVIEW

Ethiopian forest degradation

In the early 20th century, about 35%-40% of Ethiopia was covered by forests. With the inclusion of savanna woodlands, some 66% of the country was originally covered with forest and woodlands [3]. The forest resources comprise both natural and planted forests. The natural forests are also different types: moist and dry tropical Afromontane forests, woodlands, and shrub lands. Planted forests comprise industrial, pre-urban energy planation and small-scale woodlots [4]. The forest resources of Ethiopia play critical roles in providing valuable ecological and economic resources for the country's overall development, and in particular rural population in forest regions which are heavily dependent on these resources for their livelihoods. Managing forests sustainably and equitably will be essential for maintaining the ecological integrity, maintaining or enhancing freshwater supplies, protecting biodiversity and improving rural livelihoods. Nevertheless, Ethiopia's remaining forest resources are under threat, inter alia, from agricultural expansion and unsustainable fuel wood collection, inadequacy of legal and regulatory frameworks coupled with their poor implementation, institutional instability of the forest sector and poor capacity, all these compounded with economic, cultural and demographic factors, Policymakers in Ethiopia, says that Africa's second most populous country after Nigeria, are attempting to make the country's economic development more sustainable. One of the difficulties they face is that traditional economic accounting does not adequately account for nature's contributions to the economy of a country. The study's findings can help strengthen Ethiopia's national REDD+ process by, among other things, allowing relevant government agencies to better understand the extent to which Ethiopia's forests underpin the economy, thereby building support for REDD+ implementation across different ministries (Table 1).

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Table 1. List of major indigenes forest tree species tree cleared decades before from local people interview.

No	Scientific name	Family	Localname	Uses/cause
1	*Rhus quartiniana*	Anacardiaceae	Qamo	Medicinal, construction
2	*Olea europaea*	Oleaceae	Ejersa	medicinal
3	*Syzygium guineense*	Myrtaceae	Badessa	construction
4	*Ozoroa pulcherrima*	Anacardiaceae	Garree	Firewood, construction
5	*Allophylus abyssinicus*	Sapindaceae	Hirqamu	Firewood
6	*Calpurnia aurea*	Fabaceae	Ceekata	Medicinal, construction
7	*Celtis africana*	Ulmaceae	Amelika	firewood
8	*Ficus sur*	Moraceae	Oda	firewood
9	*Acacia abyssinica*	Fabaceae	Muka qoree/garbii	Charcoaling, firewood
10	*Dodonaea angustifolia*	Sapindaceae	Ittecha	Medial, firewood
11	*Acacia tortilis*	Fabaceae	Techeda	Charcoaling
12	*Euclea racemosa*	Ebenaceae	Dedeho	Firewood
13	*Maytenus senegalensis*	Celastraceae	Kombolcha	Firewood and construction
14	*Grewia bicolor*	Tiliaceae	Haroresa	Firewood
15	*Schefflera abyssinica*	Araliaceae	Harfatu	Firewood
16	*Croton macrostachyus*	Euphorbiaceae	Garree/bika	firewood
17	*Psydrax schimperiana*	Rubiaceae	Galo	firewood

Field gene bank conservation methods

Field gene bank is one of the techniques in the strategy for plant genetic conservation. It is an *ex situ* method where genetic variation is maintained away from its original location and samples of a species, subspecies or variety are transferred and conserved as living collections. Field gene bank is the most common method of conserving genetic resources with recalcitrant seeds and vegetative propagated plants. As part of the *ex situ* conservation program the institute has established field gene banks in different agro-ecological zones of the country. The field gene banks mainly consist of crops, forage and pasture, medicinal plants, horticultural plants and forestry. Many important varieties of field, horticultural and forestry species are either difficult as their seeds, if produced, are recalcitrant or reproduce by vegetative. Genetic resources of such plant species are generally conserved in field gene banks. Despite the often-cited drawbacks, field gene banks provide easy and ready access to conserved material for research as well as for use. In addition, for a number of plant species the alternative methods have not been fully developed and hence the field gene bank is the most appropriate method. For species that have alternative methods, field gene bank is still a major component of a complementary strategy for the conservation of their genetic resources. Despite the importance of field gene bank in a plant genetic resources conservation system, the concepts and scientific principles for establishing and managing field gene banks are not very well understood by many workers.

Invasive plants species in Ethiopia

In Ethiopia, more than 35 invasive alien plant species intentionally and unintentionally introduced and posing negative impacts on native biodiversity, agricultural lands, range lands, national parks, water ways, lakes, rivers, power dams, road sides, urban green spaces with great economy and social consequences [5]. Invasive Aliens Species (IAS) are of great concerns in Ethiopia, posing particular problems on biodiversity of the country in general and Shashemene district in particular and affecting agricultural lands, rangelands, national parks, waterways, lakes, rivers, power dams, road sides and urban green spaces with great economic and ecological consequences. Among these parthenium weed (*Parthenium hysterophorus*), prosopis (*Prosopis juliflora*), water hyacinth (*Eichhornia crassipes*), cactus (*Euphorbia stricta*), Mimosa invisa and lantana weed (*Lantana camara*) were reported by Taye, et al. The high spread of invasive plant species in Ethiopia becomes a great concern in national parks, lakes, rivers, power dams, and urban green spaces. They are causing huge economic and ecological losses. They had become major threats to biodiversity loss and socio-economic welfare of the Ethiopians. According to the Ethiopian National Biodiversity Action Plan, about 35 alien and indigenous invasive species have been identified in Ethiopia. These species are negatively affecting agricultural lands, rangelands, national parks, waterways, lakes, rivers, power dams, roadsides and urban green spaces with huge economic as well as social consequences on the national economy and local livelihoods. Furthermore, invasive species have been threatening local biodiversity and ecosystem services [6,7].

Gara Ifa was a home for many indigenous and medicinal plant trees and animals for long period of time through time pass the forest were cleared by local community for firewood, construction, charcoaling and over exploitation of medicinal plant by uprooting the whole plants because of frequent drought and poverty of local community. In the site many saplings were emerging so that shows the forest has dynamic recovery capacities in the short period of time. Ethiopia is facing drought in many part of the country recently because of deforestation and investing on billion for afforestation of degraded land and Green Legacy strategy is working effectively more than 18 billion seedling in three years and more 350000 seedling in half day (new record in Africa) were planted and losing on billion birr per year because of invasive plants, so the germplasm and sample of forest tree should be conserved in gene bank to escape from extinction and lose if not those indigenous and important plants will lost (Figures 1 and 2) (Table 2).

Table 2. List of first round indigenous forest seedling plantation in the site after the site was secured.

No	Scientific name	Family	Local name (oromic)	Habits
1	*Calpurnia aurea*	Fabaceae	Cekata	Tree
2	*Dodonaea angustifolia*	Sapindaceae	Ittecha	Tree
3	*Acacia seyal*	Fabaceae	wacuu	Tree
4	*Cordia africana*	Boraginaceae	wadessa	Tree
5	*Acacia abyssinia*	Fabaceae	Garbi	Tree
6	*Acacia albida*	Fabaceae	Qartafa	Tree

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Even though the plants were cleared before the some plants were is emerging and regenerating. Below table show the major and minor dormant species (Table 3 and 4 respectively) that are regenerating and promising for future coverage of the site because they survive more than planted species (Tables 3 and 4).

Table 3. Lists of major dominant species in the site with simple survey.

No	Species name	Family	local name	Habit
1	*Acacia spps*	Fabaceae	Gosa muka ajo	Tree
2	*Olea europaea*	Oleaceae	Ejersa	Tree
3	*Dodonaea angustifolia*	Sapindaceae	Ittecha	Tree
4	*Rhus quartiniana*	Anacardiaceae	Qamo	Tree

Table 4. Lists of less dominant species in the site with simple survey.

No	Species name	Family	Local name	Habit
1	*Ozoroa pulcherrima*	Anacardiaceae	Garree	Tree
2	*Croton macrostachyus*	Euphorbiaceae	mokonisa	Tree
3	*Ficus sur*	Moraceae	Oda	Tree
4	*Maytenus senegalensis*	Celastraceae	Kombolcha	Tree
5	*Schefflera abyssinica*	Araliaceae	Harfatu	Tree
6	*Allophylus abyssinicus*	Sapindaceae	Hirqamu	Tree
7	*Combretum molle*	Combretaceae	Rukessa	Tree

Figure 1. *Lantana camara* eradication measure by local community in Gara ifa site (photo taken by author).

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Figure 2. Awareness creation program with local community around the site (photo taken by Author).

This project is initiated to secure and close the site to restore and protect the emerging sapling as to be site for forest gene bank conservation, so this project is initiated with:

General objectives

- Establishing Gara Ifa as forest species restoration(Forest field gene bank) site for biodiversity conservation

Specific objectives

- ✓ Area closing and securing the Gara Ifa Mountains forspecies restoration and regeneration site.
- ✓ Collecting data of previous existing species
- ✓ Identifying and eradicating invasive alien species from the site like *Lantana camara*

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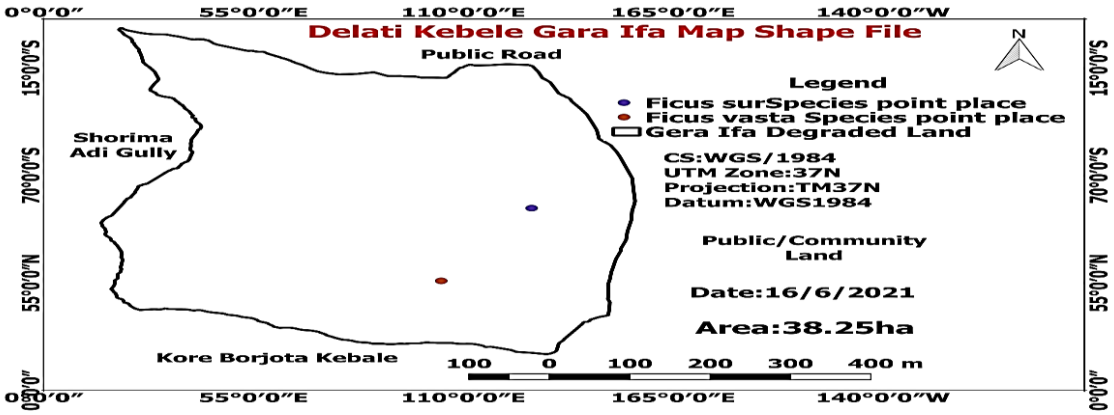
DISCUSSION

Study site

Gara Ifa is located in Shashamene district is which located at 38° 56´ N, 7° 23´ E, and average altitude of 2002 m.a.s.l. The rainfall pattern of the district is characterized by bimodal distribution with small rainy season belg (March-June) and main rainy seasons Meher and shashemene town is capital of West Arsi Zone, Oromia regional state of Region. The town lies on the Trans-African Highway 4 Cairo-Cape Town, about 250 Km from the capital of Addis Ababa to southern direction, the specific site of Gara Ifa is 16 km far from Shasheemene city found in Dalati Kebele (Figure 3).

Figure 3. Coordinate and map shape file of Gara Ifa site.



Shashemene Botanical Garden (SBG)

Shashemene Botanical Garden (SBG) is one of the centers that are managed under the Ethiopian Biodiversity Institute. It is located in Shashemene town of West Arsi zone in Oromia region and is reached after a drive of 245 km from Addis Ababa to south direction. Its geographic location is 7°12′ 48″ N and 38°37′ 14″E, its altitude range lies between 1950 and 1980 masl. The area of the garden is about 17.07 ha. SBG is established in 2005 based on the agreement made between Shashemene city administration and Ethiopian Biodiversity Institute. The agreement was signed by Mr. Demise Shito who was the mayor of Shashemene city council and Dr. Girma Balcha who were the General Director of Ethiopian Biodiversity Institute (EBI) by the time. SBG before it transferred to EBI it was a forest tree seedling planting site managed by the city council. But SBG officially begins the work after hiring employees and constructing office facility in the year 2015. The garden established with four major objectives of Conservation, research, Education and Eco- tourism

Conservation of plants is the main objective of SBG, the following are priorities considered in the conservation activities.

- Economically important crops/plants
- Endemic and rare plant species
- Indigenous /indigenous

Plants for the conservation purpose are collected from different parts of the country through the collection conservation and exploration team. Seeds, wild seedlings, cuttings, rhizomes, e.t.c can be collected from the wild and farmers home garden. Conservation collected plants are implemented in different approaches in the garden and plant conserved based on their uses on different blocks. More than 15 blocks were established and 12 were actively holding live plant currently. In these gardens more than 350 plant species are conserved and more than 720 plant species were conserved including two field gene bank and out- reach area.

The garden administer two gene bank and different outreach area from those area:

- "Wondo Genet" medicinal field gene bank where more than 320 medicinal plant species are conserved.
- "Lepis" forest field gene bank where more than 69 tree and shrub plants are conserved.
- "Gara Iffa" species restoration site where about 6 plant species are conserved.
- And also Hara cittu/Citu small lake/, Senbete gobu site were some of conserved place by the garden in collaboration.

Procedures

Establishing the gene bank requires different and complex steps regarding Gara Ifa the following major steps will be conducted by initiation of Shashemene botanical garden in collaboration with stakeholders.

- Communication between Ethiopian Biodiversity Institute/Shashemene Botanic Garden, Zonal and district Agricultural, Natural Recourse officers and Forest Climate change Authority of the west Arsi Zone on species restoration site establishment and securing Gara ifa site was selected and reconnaissance survey were conducted by joint groups of experts, and an Agreement were reached up for proceeding the securing the site as biodiversity conservation site. Next with Zonal and werada experts a meeting of a few days were hold and direction where sated. Discussion with local community and local leaders were hold and agreements were reached, because the site is an important for day to day activities and livelihood of community. Finally, after discussion, biodiversity committee were organized by and from local community selection in the kebele encompassing seven members from different professional people, from local leaders, from youth and female sector, Abba gada and Hadha sinke (cultural administration).with the committee members border demarcation and area closure activities were done and approved by local administration.
- With biodiversity committee the boundary was demarcated and Guard will be sated.

- Threatened indigenous trees and medicinal plants and their cause of eradication were identified through questioners and survey in the site
- Plantation site and naturally emerging sapling were located within the site and protection
- Site management plan /master plan developed and integrated conservation strategy adopted.
- Finally, agreement of site was signed and copy was distributed to each office for record.

CONCLUSION

Gara ifa forest species restoration site were established and secured in 2021 and more than 2200 seedling of more than six (6) forest species type was planted in the first round of green legacy plantation since area closure. Invading Invasive alien species was identified and controlling measure was taken by mobilizing community by awareness of its effect on natural resources and biological diversity(Lantana camara highly invaded the bottom side of the mountain gara ifa even many emerging sapling were suppressed and liberated after eradication of the invasive (an event that, one *Lantana camara* suppressed three indigenous and medicinal sapling of *Olea aeuropea*, *Clutina abyssinica*, *Maytenus senegalensis*) was seen when eradication was action taken. Methods of eradication used were, Physical uprooting and cutting before flowering and seeding, after uprooted collect in one place and burned. Generally, increasing the numbers of field gene bank in the country helps to conserve and restore the germplasm and live plant of endangered and threatened forest species in particular and biodiversity in general. The newly established site were administrated and managed by Shashemene botanical garden as one of forest species restoration site and near future different plant species will be conserved in it.

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RECOMMENDATIONS

Since deforestation may cause some variety to extinction, forest field gene bank should be increased in number and carrying capacity. Integrated biodiversity methods should be adapted and implemented accordingly with CBD in the site Invasive plant should be removing by joint action of stockholder and local community. Gene bank is one of the options of a complementary strategy for the conservation of germplasm of many plant species (Ramanatha Rao, 1998. Awareness creation program is required to local community about biodiversity, invasive plant and importance of species restoration site/forest gene bank.

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CONFLICTS OF INTEREST

The author declare that this work is original and none of conflict in interest.

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