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Soil Seed Bank Study and Propagation Methods of Selected Gums and Resin Producing Tree Species in Wachile District of Borana Zone

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Abstract: Gum and resin bearing tree species were one of the very important resources in Ethiopia. Particularly, Borana pastoralists were used these resources as a source of income generation for their livelihoods. However, the resource was declining over a time due to different natural and human made problems. Therefore, it is important to study for its future sustainability through soil seed bank, seed germinations, vegetative propagations and analyzing its natural regeneration status. *Commiphora myrrha, Boswelia neglecta, Boswellia microphylla* and *Acacia senegal* were gum and resin bearing tree species selected for this study. With this; soil seed bank samples were collected from under and outside the canopy of selected tree species. Five tree species of each tree were used to collect soil seed bank sample at two canopy cover and three different soil depth, and 120 soil seed bank samples were taken from all types of tree species and evaluated for its germination. Seeds of selected species were also collected and evaluated for their germination. Moreover, stems and branches of those species were cut, planted and evaluated for their sprout. As a result, the absence of seeds of those species both inside and outside the canopy of trees in all soil depth layers was confirmed. This may be due to seed losses through (fire, degradation and over grazing), improper settlement, over logging, debarking, human over use for food, improper tapping. The result of analysis of variance also showed that, seedling germination percentage, survival percentage, shoot height and root height were highly significant different at ($p<0.001$) among all the treatments. The observed mean value of germination percentage were 99%, 46%, 40% and 25% for *Acacia senegal*, *Boswellia microphylla, Boswelia neglecta* and *Commiphora myrrha* respectively. Thus, the seed of those species doesn't have dormancy and all healthy and filled seeds had high germination rates. About 60% of *Boswellia microphylla* and *50%* of both *Commiphora myrrha* and *Boswelia neglecta* were sprouted in the fourth year of the studies. Hence, it is advisable to use stem propagations for any conservation purposes incase seeds of those species fail to germinate except for *Acacia senegal* as it is naturally not propagated by stem cutting. Therefore, it is recommended to increase the regenerations of those species by reducing overgrazing, avoiding burning of those species and reduce land degradations and also using seeds and vegetative propagations if any management aims for conservations.

Keywords: Gum, Resin, Seed Bank, Propagation, Regeneration

1. Introduction

Non-timber forest products (NTFPs) are well known worldwide in their contributions to national and local economies. Several recent studies indicated that the actual and potential socio-economic, and ecological services obtained from gum and gum resin yielding species and the role they play in the livelihood of local society and nation at large is very significant [1-3]. Gum and resin producing trees and shrubs in the drylands of Ethiopia occupy a central position in terms of commercial importance and livelihood support. The importance of gum and resin production often

lies more in its timing than in its magnitude in rescuing rural populations from famine and even poverty if well managed and integrated with other options of land use [3]. Thus, NTFPs in general and oleo-gum resins in particular, were collected to serve as source of food mainly during slag periods as means of income generation, and employment among local poor communities [2]. For instance, oleo-gum resin collection and sale is reported to provide an income equivalent of 80 USD/household/year in the Liban zone of Somali National Regional State of Ethiopia; an income which ranked second after livestock in the livelihood of the pastoral community living in the area [2].

Gums and resin are one of the socio-economic improving income generation in Borana lowland. However, these tree species are currently under problem. According to some studies, the population structures of most of the species are not normal and some of them have no juvenile regeneration. A report from [4] in Yabello and Arero districts stated that the juvenile regeneration of *Commiphora baranesis*, *Commiphora myrrha*, *Boswellia neglecta* and *Boswellia rivea* are very small even *Commiphora boranesis* were not found at seedling level. These are due to over grazing, recurrent droughts and bush encroachments. According to [5] many useful gum-resin and incense producing species such as *Boswellia neglecta* and *Commiphora* species were adversely affected by the expansion of *Acacia drepanolobium.* In addition to such problems gum-resin and incense producing tree species are found in remote areas far from markets and where it is difficult to extract.

In order to conserve such very socio-economic important natural resource, establishing these species as a plantation or conserving it where they naturally found is very important. So that, identifying appropriate propagation method of the species is the base. However, so far no any research curried out on propagation method of gum-resin and incense producing species in lowland of Borana. Therefore, the current project was initiated to evaluate soil seed bank and propagation methods of selected gums and resins producing tree species performance thereby contributing to the well-being of the species in particular and the sustainable utilization of its products at large.

2. Materials and Methods

2.1. Description of the Study Areas

The study was conducted in Wachile district located in Borana Zone of Southern Oromia (Figure 1). Borana zone is generally found in between 3°36'-6°38'N and 36°43'-41°40'E geographical grids and has altitude ranging from 1000m in the south to 1500masl in the northwest. There are four seasons in the zone namely; Ganna; the long rainy season, Adolessa; the cool dry season, Hagaya; the short rainy season and Bona; the warm dry season. The climate is generally semi-arid and rainfall pattern is bimodal with annual rainfall averaging 500mm in the south to 700mm in the North [6].

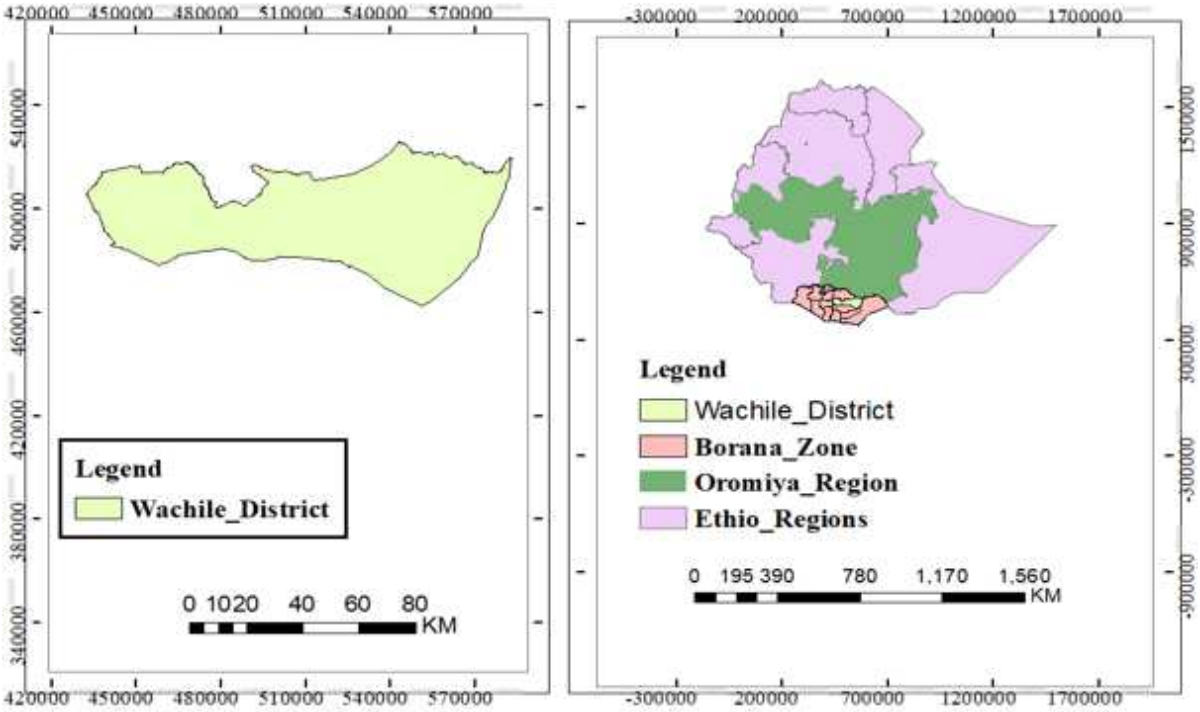

Figure 1. *Location of the study area.*

2.2. Methods

2.2.1. Site Selections

For the studies of soil seed bank and propagation methods of selected gums and resins producing tree species, Wachile district was selected purposively. The area where those species dominantly found were selected from Wachile for soil seed bank sampling and its propagation study was done

at Yabello Pastoral and Dryland Agriculture Research Center.

2.2.2. Species Selection

For this study, *Acacia senegal* (Saphansa diimaa), *Boswellia microphylla* (Ilkabuqis), *Boswelia neglecta* (Dakkara) and *Commiphora myrrha* (Qumbii) gum and resins bearing tree species were selected purposively as they are valuable non-timber forest product found in the study area.

2.2.3. Soil Seed Banks Sampling

From the selected site five individual trees of each species were identified and assigned for evaluations of soil seed banks of each species. Plots of 0.5 m x 0.5 m, was located along the four directions away from the trees within canopy of trees. At each of the sample site, soil samples was carefully taken from three separate soil depths (0-3 cm, 3-6 cm and 6-9 cm), following the method used by [7] and within each sample quadrant of 0.5m x 0.5m, located along the four directions away from the trees. Soil seed bank samples were collected from under and outside the canopy of four different gum and resin bearing tree species The samples taken from the same depth of individual trees was bulked and taken to Yabello pastoral and dryland agricultural research center and evaluated in large pots for seed banks of the species under studies. In this case, from each species a total of 30 soil seed bank samples was taken under two canopy cover (inside canopy and outside canopy) from five tree species at three different soil depth. Which is a total of 120 soil seed bank samples were taken from all four different gum and resin bearing tree species. Those, soil seed bank samples was collected at end of the growing season. Therefore, the sterile sand was filled in the plastic pots, and the taken soil sample was spread over the sand in each plastic pot for evaluation in randomized complete block design with three replications.

2.2.4. Propagation Methods

The appropriate propagation (vegetative and seeds methods) was evaluated in Yabello Pastoral and Dry Land Research Center (YPDARC) nursery. Seeds and the cuttings stems of these selected tree species was collected from representative mother trees found where the species are dominantly found (Wachile district). About 72 seeds of each *Acacia senegal* (Saphansa diimaa), *Boswellia microphylla* (Ilkabuqis), *Boswelia neglecta* (Dakkara) *and Commiphora myrrha* (Qumbii) were raised in nursery for its germination test. A total of 30 cuttings stems of three trees species was taken for evaluation of propagation methods by its vegetative parts. Thus, ten (10) stem cuttings from each *Boswellia microphylla* (Ilkabuqis), *Boswelia neglecta* (Dakkara) *and Commiphora myrrha* (Qumbii) were used for this case while no stem cuttings was taken from *Acacia senegal* (Saphansa diimaa) species as it was not propagated naturally by its stems. The stems and branches were cut and put off for one week before planting (which initiate sprouting). The seedlings and vegetative parts of the selected tree species was raised and planted at YPDARC on station in randomized complete block design with three replications. The vegetative parts were planted two weeks before rain. Plantations of these seedlings and vegetative parts was undertaken during onset of main rainy seasons. Growth performance and survival of the seedlings and vegetative parts of these species were evaluated under field conditions.

2.3. Data Collections

Sample of soil seed bank, number of seedlings of selected trees regenerate from seed bank, germination of soil seed bank were recorded. Germination of seeds, survival of seedlings, sprout potential of vegetative parts and growth conditions (height, DBH) were also collected from the experiments.

2.4. Statistical Data Analysis

The data was recorded in Excels and analyzed using SAS version 9.3 and Excels. Social survey was analysed using SPSS version 24.

3. Results and Discussions

3.1. Soil Seed Bank of Boswelia Neglecta, Boswellia Microphylla Commiphora Myrrha and Acacia Senegal

The current study revealed that, the absence of seeds of *Acacia senegal* (*Saphansa diimaa*), *Boswellia microphylla* (Ilkabuqis), *Boswellia neglecta* (Dakkara) *and Commiphora myrrha* (Qumbii) in the study area both inside and outside the canopy of the mother plants in all soil depth layers. The absence of seeds may be due to seed losses through high mortality risks (fire, degradation and over grazing). Thus, as the study was dominated by various bush encroachments governmental and non-governmental organizations were working on reducing those bush through burning. During this, important trees like *Acacia senegal* (Saphansa diimaa), *Boswellia microphylla* (Ilkabuqis), *Boswelia neglecta* (Dakkara) *and Commiphora myrrha* (Qumbii) were burned and their seeds were lost. In addition to these, the cultural practices that use fire as a tool like honey collection and farm clearing had an impact on the young seedlings survival rate. Similar studies reported that, the absence of seeds of *Boswellia papyrifera* in soil seed bank was due to seed losses through high mortality risks (fire, predation, and pathogen) and/or germination of the seeds [3]. Many studies were also reported that seed numbers were reduced after burning [8]. Thus, the continuous burning of the forest area might have killed the seeds dropped from the tree to the soil which absences seeds bank found in the soil. On the other hand, as observed on the field, seeds of those species were also taken away by runoff and floods as the area is common soil degradations. This indicates that the seeds have a high mortality risk due to degradation. Similar study confirmed that, despite the enormous socio-economic importance of these natural products, the species are declining at an alarming rate due to degradation resulted from agricultural expansion, overgrazing, fire, poor incense harvesting practices [1]. The absence of seeds of *Acacia senegal*

(Saphansa diimaa), *Boswellia microphylla* (Ilkabuqis), *Boswelia neglecta* (Dakkara) *and Commiphora myrrha* (Qumbii) in soil seed bank implies the recruitment of seedlings from seeds will depend on the few surviving seeds produced during the current year and if these seeds fail to germinate or the seedlings do not survive due to, for instance, fire or degradation, then the species will become locally extinct. From this, it should be actually noted that the seeds of those species could be recovered if the soil samples have been taken right after dispersal.

Figure 2. *The experimental field (Source: picture by the first author: Sisay Taye).*

3.2. Propagations Through Seeds

The result of the current study showed that seeds of selected gum and resins bearing species were evaluated for their germination. Accordingly, the result of analysis of variance showed that, seedling germination percentage, survival percentage, shoot height and root height were highly significant different at ($p<0.001$) among all the treatments of *Acacia senegal* (Saphansa diimaa), *Boswellia microphylla* (Ilkabuqis), *Boswelia neglecta* (Dakkara) and *Commiphora myrrha* (Qumbii) (Table 1). This indicated that the seed of those species doesn't have dormancy and all healthy and filled seeds had high germination rates.

Germination percentage: Analysis of variance showed a highly significance difference among treatments in germination percentage at ($p<0.001$). The highest germination percentage was obtained for *Acacia senegal* (Saphansa diimaa) (99%) while the lowest germination percentage was observed for *Commiphora myrrha* (Qumbii) (25%) (Table 2).

Survival percentage: Analysis of variance showed highly significant difference among different non-timber forest product tree species in survival percentage at ($P<0.001$). The highest survival percentage was observed in *Acacia senegal* (Saphansa diimaa) (95%) while the lowest survival percentage of gum and resin bearing tree species was observed for *Commiphora myrrha* (Qumbii) (23%) (Table 2).

Shoot height: Analysis of variance showed a highly significance difference among treatments in shoot height at ($p<0.001$). The highest shoot height was obtained for both *Acacia senegal* (Saphansa diimaa) and *Boswelia neglecta* (Dakkara) (25.84cm) while the lowest shoot height was observed for *Commiphora myrrha* (Qumbii) (16.52cm) (Table 2).

Root height: Analysis of variance showed a highly significance difference among treatments in root height at ($p<0.001$). The highest root height was observed for both *Acacia senegal* (Saphansa diimaa) (28.333cm) while the lowest root height was observed for *Boswellia microphylla* (Ilkabuqis) (11.5cm) (Table 2).

Table 1. *Mean square value of germination, growth percentage and growth parameters of four non-timber forest product of tree species.*

Source of variations	DF	Germination (%)	Survival (%)	Shoot height (cm)	Root height (cm)
Treatment	3	3117***	2887.861***	71.349***	191.521***
Replications	2	1.313ns	1.583ns	3.230ns	1.956*
Error	6	2.646	3.028	2.545	0.289
CV		3.098	3.440	7.36	3.267
Mean		52.5	50.583	21.675	16.458

ns,*, **&***, non-significant, significant at P<0.05, P<0.01 and P<0.001, respectively. DF= degree of freedom, CV= Coefficient of variations.

Table 2. *Mean value of germination and survival percentage and growth parameters of four non-timber forest product of tree species.*

Treatments	Germination (%)	Survival (%)	Shoot height (cm)	Root height (cm)
Acacia senegal (Saphansa diimaa)	99^{a}	95^{a}	25.84^{a}	28.333^{a}
Boswellia microphylla (Ilkabuqis)	46^{b}	44.667^{b}	18.5^{b}	11.500^{c}
Boswelia neglecta (Dakkara)	40^{c}	39.667^{c}	25.84^{a}	12^{c}
Commiphora myrrha (Qumbii)	25^{d}	23^{d}	16.52^{b}	14^{b}
Mean	52.5	50.585	21.675	16.458
CV	3.098	3.440	7.360	3.267

Means with the same letters in the same columns are not significantly different; CV=Coefficient of variations.

Germination days

Seeds of selected gum and resins bearing species were evaluated for their germination. Accordingly, all gum and resin bearing tree species were germinated. Hence, *Acacia senegal* (Saphansa diimaa), Boswellia microphylla (Ilkabuqis), *Boswelia neglecta* (Dakkara) and *Commiphora myrrha* (Qumbii) were germinated by 82.4%, 12.3%, 31.5% and 22.2% respectively during the first ten days and 99%, 46%, 40%, and 25% were germinated during the last ninety days of the study (Figure 3).

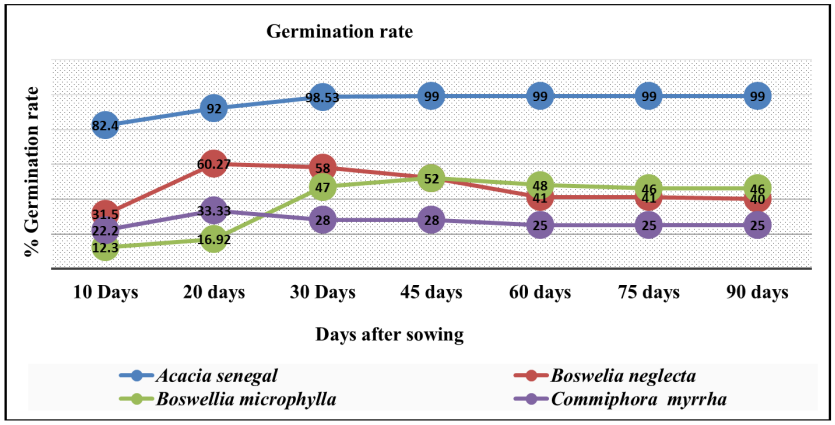

Figure 3. *Germination rate percentage.*

3.3. Vegetative Propagations (Stem or Branch Cuttings)

All planted cuttings of *Commiphora myrrha* (Qumbii) were sprouted (100%) while, 70% of *Boswellia microphylla* (Ilkabuqis) and 60% of *Boswelia neglecta* (Dakkara) were sprouted during the first year while About 60% of *Boswellia microphylla* (Ilkabuqis) and 50% of both *Commiphora myrrha* (Qumbii) and *Boswelia neglecta* (Dakkara) were sprouted in the fourth year of the studies (Figure 5). This showed that, in addition to propagations through seeds, *Boswellia microphylla* (Ilkabuqis), *Boswelia neglecta* (Dakkara) and *Commiphora myrrha* (Qumbii) were propagated through their stem cuttings. Hence, incase seeds of those species fail to germinate it is advisable to use stem propagations for any conservation purposes. However, *Acacia senegal* (Saphansa diimaa) is naturally not propagated by its stem cutting so that it is important to collect seeds this trees following its seed harvesting time.

Figure 4. *The experimental field (Source: picture by the first author: Sisay Taye).*

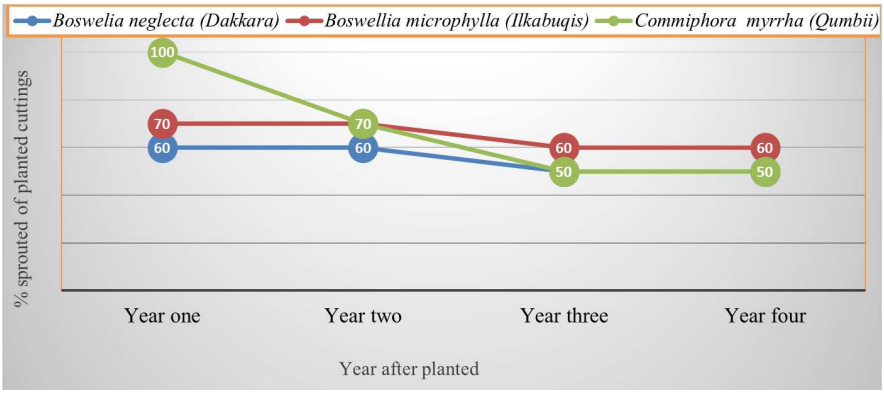

Figure 5. *Sprout percentage.*

Figure 6. *The experimental field (Source: Picture by the first author: Sisay Taye).*

3.4. Natural Regeneration Status

As observed on the field overgrazing, continuous burning and improper tapping are the main factors for the limited regeneration status of the tree in the study sites. Overgrazing resulted for deterioration of the seeds of trees fallen to the ground and limit the regeneration status of the trees. The study from [9] stated that in enclosed plots (closed from grazing), a number of germinant were observed. Thus, we observed that, to have seeds of those species in soil as seed bank in their ecology the area of those species need to be

enclosed or protected from such disaster of soil erosion and degradation. Similar studies reported that solving the regeneration limitation is very important to conserve viable gum and incense tree populations, and decreasing adult mortality may also play an important role in achieving sustainability and essential to maintain frankincense production in the short run [10].

The result from key informant's discussions revealed that, there are a number of factors that hindering the regenerations of those non-timber forest product tree species of the study area. Among those; improper settlement, logging for house construction, debarking, human over use of its root for food, use for livestock feed as it has water (for example, camel and goat) which easily destroy at its juvenile age, illegal cutting during extracting of product (at harvesting time there is worm used to produce this gum however, once those warm may die due to illegal cutting the product could be decreased, improper tapping of the tree resulted in damage of adult trees through exposing the tree to fire, worm and other attacks. Generally, due to above listed problems the regeneration of those NTFP tree species were not going as in previous times. Besides this, there is no any training given to the local community settled near the stands of those non-timber forest product tree species both on the conservations and proper tapping of the trees to keep mother trees healthy and sustainable.

The result from key informants' discussions also revealed that, mode of regenerations and time of harvesting for both seeds and stem cutting propagations of some species were identified. Likewise, *Boswelia neglecta*, *Boswellia microphylla, Commiphora myrrha* were all propagated through their seeds and stem (branch) cuttings while *Acacia senegal* was propagated by its seed only (Table 3). This confirmed our above discussed results that *Boswelia neglecta*, *Boswellia microphylla, Commiphora myrrha* were all propagated through their seeds and stem (branch) cuttings while *Acacia senegal* was propagated by its seed only. On the other hand, the focal group discussions were responded that, identifying the time of harvesting of both propagations (seeds and stem/branch cuttings) and procedures that to be applied particularly for vegetative propagations after the stem cut should very crucial to produce healthy seedlings and sprout.

Table 3. *Mode of regeneration, time of harvesting for both seeds and stem cutting propagation and treatments to be applied after stem cuttings.*

No.	Species	Mode of regeneration	Time of harvesting their seeds/ Time of harvesting their stem for propagation		Treatments applied after stem cuttings before planting
			Bona adolessa	Bona hagayya	
1	*Acacia senegal* (Saphansa diimaa)	by seed only	Camsaa- Adolessa	Sadaasaa-Amajjii	Stem cuttings should be at dry season unless, it may deteriorate Wait for 2-3/4 days after cutting to minimize the water content of the stem it holds inside It should bear incense/gum
2	*Boswellia* microphylla (Ilkabuqis)	Seed and stem propagation	Camsaa- Adolessa	Sadaasaa-Amajjii	
3	*Boswelia neglecta* (Dakkara)	Seed and stem propagation	Camsaa- Adolessa	Sadaasaa-Amajjii	
4	*Commiphora myrrha* (Qumbii)	Seed and stem propagation	Camsaa- Adolessa	Sadaasaa-Amajjii	
5	Siltachoo	Seed and stem propagation	Camsaa- Adolessa	Sadaasaa-Amajjii	

4. Conclusions and Recommendations

4.1. Conclusions

The present study confirmed that, the absence of seeds of *Acacia senegal* (Saphansa diimaa), *Boswellia microphylla* (Ilkabuqis), *Boswelia neglecta* (Dakkara) *and Commiphora myrrha* (Qumbii) tree species in the study area both inside and outside the canopy of the mother plants in all soil depth layers. This indicated that the high mortality of seeds after and before dispersal due to fire, degradation and over grazing. Thus, the improvement of seedling establishment relies on the current seed collections and the availability of safe/conserved sites. Therefore, any management activity that aims at conservation of those tree species through seeds should take care of these two facts; current seed collections and safe conserved sites as soil seed bank of those species is not promising. Unless these species will be endangered and locally extinct due to fire, degradation, over grazing and lack of conservation in general. From this, it should be actually noted that the seeds of *those species* could be recovered if the soil samples have been taken right after dispersal.

The result of the current study showed that seeds of selected gum and resins bearing species were evaluated for their germination. Accordingly, the result of analysis of variance showed that, seedling germination percentage, survival percentage, shoot height and root height were highly significant different at ($p<0.001$) among all the treatments of *Acacia senegal* (Saphansa diimaa), *Boswellia microphylla* (Ilkabuqis), *Boswelia neglecta* (Dakkara) *and Commiphora myrrha* (Qumbii). The observed mean value of germination percentage were 99%, 46%, 40% and 25% for *Acacia senegal*, *Boswellia microphylla, Boswelia neglecta and Commiphora myrrha* respectively. The observed mean value of survival percentage were 95%, 44.667%, 39.667% and 23% for *Acacia senegal*, *Boswellia microphylla, Boswelia neglecta and Commiphora myrrha* respectively. The observed mean value of shoot height were 25.84cm, 18.5cm, 25.84cm and 16.52cm for *Acacia senegal*, *Boswellia microphylla, Boswelia neglecta and Commiphora myrrha* respectively. The observed mean value of root height were 28.333cm, 11.5cm, 12cm and 14cm for *Acacia senegal*, *Boswellia microphylla, Boswelia neglecta and Commiphora myrrha* respectively. This concluded that the seed of those species doesn't have dormancy and all healthy and filled seeds had high germination rates. Therefore, since all of those tree species were propagated through their seeds, any conservation activity aims to those species should collect their seeds following the time of their seeds harvesting.

Planted cuttings of *Boswellia microphylla* (Ilkabuqis), *Boswelia neglecta* (Dakkara) *and Commiphora myrrha*

(Qumbii) were *sprouted.* Thus, incase seeds of those species fail to germinate it is advisable to use stem propagations for any conservation purposes.

The present study showed *Acacia senegal* (Saphansa diimaa), *Boswellia microphylla* (Ilkabuqis)*, Boswelia neglecta* (Dakkara) *and Commiphora myrrha* (Qumbii) are the denser tree species in the study area. However, the absence of regeneration status of those species were severely limited. Inappropriate settlement, logging for house construction, debarking, human over use its root for food, use for livestock feed, illegal cutting during extracting of product, improper tapping of the tree (methods of harvesting of the incense and gum) are the main factors for the limited regeneration status of those tree in the study sites as all these were resulted for the damage/death of those trees through exposing the tree to fire, worm and other attacks. Besides this, there is no any training given to the local community settled near the stands of those non-timber forest product tree species both on the conservation and proper tapping of the products in the way of keeping mother trees healthy and sustainable.

Thus, the study concluded that the absence of seeds of *Acacia senegal* (Saphansa diimaa), *Boswellia microphylla* (Ilkabuqis)*, Boswelia neglecta* (Dakkara) *and Commiphora myrrha* (Qumbii) tree species in the study area both inside and outside the canopy of the mother plants in all soil depth layers. However, those trees were propagated through seeds if their seeds is collected following the time of seeds harvesting. Moreover, except for *Acacia senegal* (Saphansa diimaa); *Boswellia microphylla* (Ilkabuqis)*, Boswelia neglecta* (Dakkara) *and Commiphora myrrha* (Qumbii) were sprouted and propagated through its stem cuttings in addition to their propagation through seeds. Consequently, Factors hindering the regenerations of those non-timber forest product tree species of the study area were identified.

4.2. Recommendations

The study have been discussing the soil seed bank and propagation methods of selected gums and resin producing tree species. Thus, the study concluded that the absence of seeds of *Acacia senegal* (Saphansa diimaa), *Boswellia microphylla* (Ilkabuqis)*, Boswelia neglecta* (Dakkara) *and Commiphora myrrha* (Qumbii) tree species in the study area. However, those trees were propagated through seeds if their seeds is collected following the time of seeds harvesting. Moreover, except for *Acacia senegal* (Saphansa diimaa); *Boswellia microphylla* (Ilkabuqis)*, Boswelia neglecta* (Dakkara) and *Commiphora myrrha* (Qumbii) were sprouted and propagated through its stem cuttings in addition to their propagation through seeds. Thus, Factors hindering the regenerations of those non-timber forest product tree species of the study area were identified. Accordingly, the following points are recommended for the sustainable utilization and conservation of those NTFP tree species stands:

1) Effort should be made to increase the regenerations of those species using rotational grazing (reduce overgrazing), selectively burning bush encroachments (avoiding burning of those species) and reduce land degradations.
2) For conservations of those valuable tree species seeds those tree species should be collected following right time of their seeds harvesting.
3) Incase seeds of those species fail to germinate it is advisable to use stem propagations of those tree species for any conservation purposes.
4) Forest policy or guidelines for the conservation and utilization of woodlands that enable local ownership are urgently required and management plans should be prepared and implemented quickly for the non-timber forest product tree stands.
5) Regulations about how, when, what and where to tap those species are necessary.
6) Land use policy that does not ignore but supports the local land use system and that considers the ecological necessities of non-timber forest product tree stands and other associated plant species should be established.
7) Training need to given to the local community settled near the stands of those non-timber forest product tree species both on the conservations and utilizations.
8) Efforts should be made to increase the involvement of the local people to conserve the resource base (co-management).

Conflict of Interests

The authors have not declared any conflict of interests.

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References

[1] Tadesse W, Desalegn G and Alia R, 2007. Natural gum and resin bearing species of Ethiopia and their potential applications. Investigación Agraria: Sistemas y Recursos Forestales 2007 16 (3), 211-221.

[2] Lemenih M and Teketay D. 2003a. Frankincense and Myrrh Resources of Ethiopia: I. Distribution, Production, Opportunities for Dry Land Development and Research Needs. SINET: Ethiopian Journal of Science, Faculty of Science, Addis Ababa University. Vol. 26 (1): 000–000, ISSN: 0379–2897, Addis Ababa, Ethiopia.

[3] Eshete A, Teketay D and Håkan. H 2005. The Socio-Economic Importance and Status of Populations of Boswellia papyrifera (Del.) Hochst in Northern Ethiopia: The Case of North Gondar Zone. Forests Trees and Livelihoods.

[4] Worku A, 2006. Population status and socio-economic importance of gum and resin bearing species in Borana Lowlands, Southern Ethiopia.

[5] Lemenih, M. and Kassa, H. (eds) 2011. Opportunities and challenges for sustainable production and marketing of gums and resins in Ethiopia. CIFOR, Bogor, Indonesia.

[6] Coppock, D. L., 1994. The Borana Plateau of Southern Ethiopia: Synthesis of Pastoral Research, Development and Changes, 1980-91 (No. 5). International Livestock Centre for Africa, Addis Ababa, p. 374.

[7] Teketay D & Anders G, 1995. Soil seed banks in dry Afromontane forests of Ethiopia. Journal of Vegetation Science 6: 777-786, 1995.

[8] Skoglund, J. 1992. The role of seed banks in vegetation dynamics and restoration of dry tropical ecosystems. J. Veg. Sci. 3: 357-360.

[9] Ogbazghi W, 2001. The distribution and regeneration of *Boswellia papyrifera* (del.) Hochst. in Eritrea. Tropical Resource Management Papers, No. 35. Phd. Desertation. Wageningen University. 131 pp.

[10] Peter G, 2010. Are frankincense populations going extinct? A demographic approach using matrix models. Wageningen University.