Empowering community to introduce area enclosure for enhancing natural regeneration of the endangered *Boswellia papyrifera* and its degraded habitat in Ethiopia
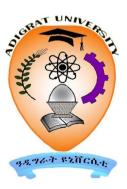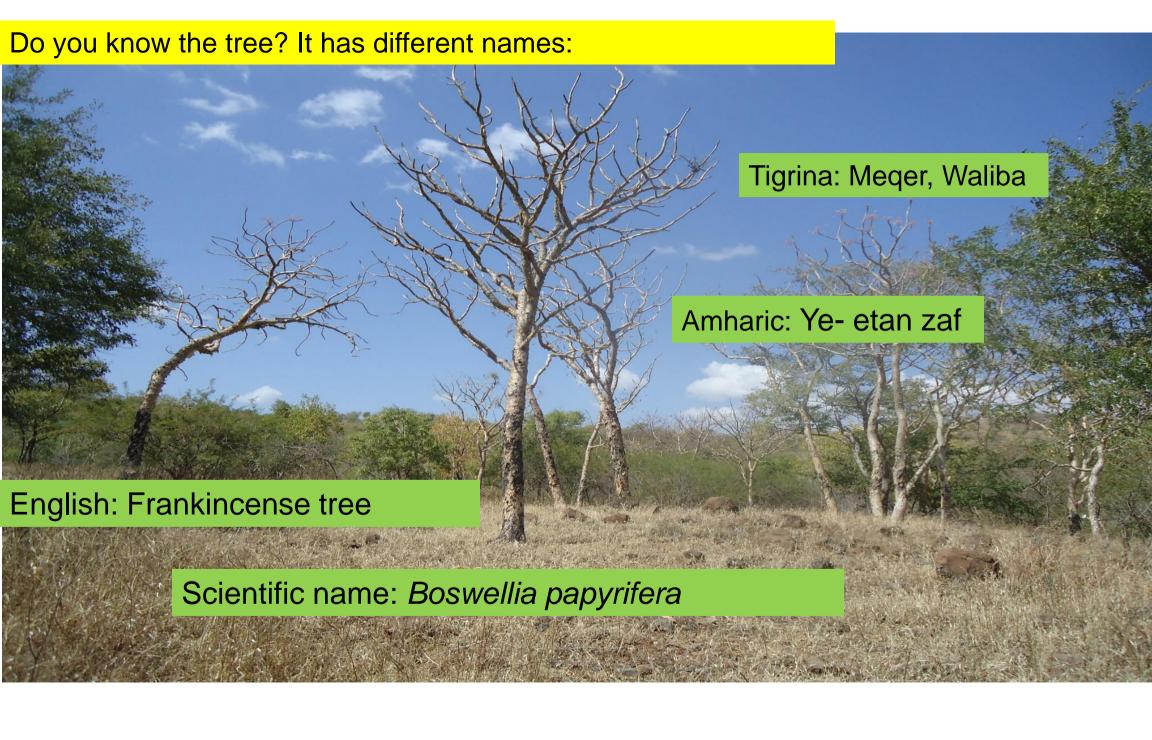

By

Tesfay Gidey Bezabeh

2ND RSG project presentation to stakeholders

December, 2019

Adigrat, Ethiopia

First RSG project (to give stakeholders a general information about my RSG projects)

Population status of *Boswellia papyrifera* woodlands and prioritizing their conservation interventions using multi-criteria decision model in northern Ethiopia

Do you know the tree? It has different names:

Tigrina: Meqer, Waliba

Amharic: Ye- etan zaf

English: Frankincense tree

Scientific name: *Boswellia papyrifera*

1. Introduction

- The species is native to Ethiopia, **growing mainly in Tigray, Amhara , Oromia and Somali regions**

- It provides several **economic and ecological benefits in Ethiopia**

- It is known for its **internationally tradable frankincense resin** from tapping its stem

Introduction Con't

- In 2008, Ethiopia exported **about 3,450t** of frankincense with **a value of US$4.8 million** (Lemenih and Kassa, 2011)

- Its associated activities also support livelihoods of many **local poor Ethiopians, residing in dryland areas**

- It is also a valuable for **fodder, medicine, apiculture, SWC, and adaptation to CC impacts**

- However, its populations are **now declining at an alarming rate and its natural regeneration is also hampered due different factors**

Introduction con't

- It also is found in areas where neither **clear ownership nor a mechanism for participating stakeholders for its conservation**

- **Multiple stakeholders** with competing interests also present in **utilization of the woodland promoting its deforestation**

- As a consequence, it has now been listed as endangered species **by IUCN** (Gebrehiwot et al., 2003)

- To ensure sustainable conservation of the woodland, **the diverse stakeholders with competing interests need to be accommodated**

- The AHP model offers an analytical framework to accommodate **these conflicting interests through a pairwise comparison method** (Saaty, 1995)

Introduction Con't

- For future conservation of the species, **determine its current population structure and prioritize its conservation interventions using the AHP approach**

- The specific objectives were then to:

1) **Characterize the population structure of *B. papyrifera***

2) **Prioritize conservation intervention alternatives for the *B. papyrifera* woodlands using AHP model by involving stakeholders**

2. Material and Methods

2.1 Study district

Abergele district, TRS, northern Ethiopia

- Altitude: **1500 to 1600 m**

- Average temperature: **25.3 °C**

- Average total annual rainfall: **445 mm**

- Soil: **Leptosols**

- Vegetation: **B. papyrifera and Acacia spps.**
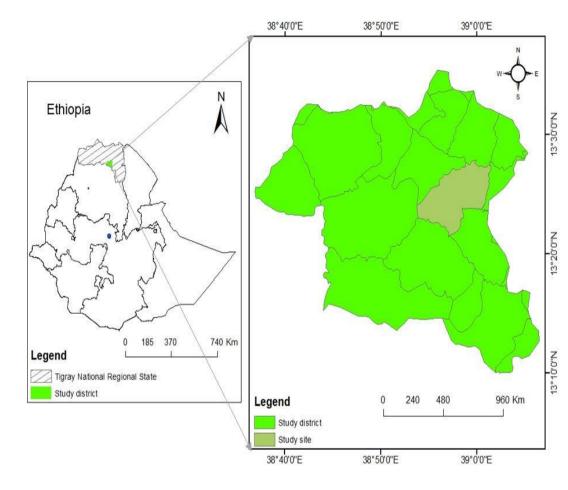
- **Frankincense** is the main source of income

Fig 1. Location of the study area

Material and Methods Con't

2.2 Development of conservation alternatives using AHP model for the study

- Intervention alternatives for the woodland and their evaluating criteria were first developed based **on LR, consultation with experts and field experiences**

- These were then validated using focus **group discussion, including local community, frankincense enterprises and experts**

- Participants of the workshop were exchanging their **opinions on the proposed alternatives and their evaluating criteria**

Evaluation and validation of the intervention alternatives by representative stakeholders

Material and Methods Con't

- Finally reached an agreement on the hierarchical structure, with four **alternatives (Fig 2), for prioritization using the AHP (Table 1) techniques**
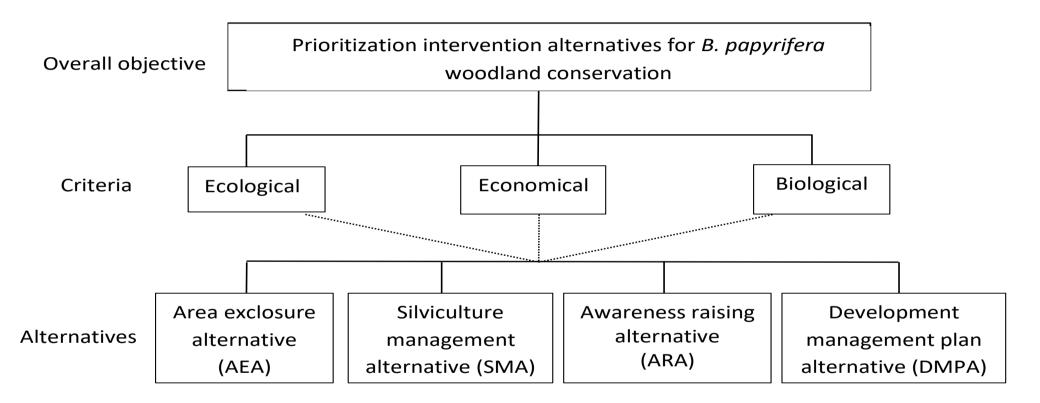

Fig 2 Hierarchical structure of the AHP model for the study

Material and Methods Con't

Table 1 The AHP pairwise comparison scales, Saaty, 2001

Intensity of relative importance	Definition
1	Equal importance
3	Weak importance of one over the other
5	Strong importance of one over the other
7	Very strong importance one over the other
9	Absolute importance of one over the other
2,4,6, and 8	Intermediate values between two adjacent judgements

Material and Methods Con't

2.3 Data collection and analysis

- **Species related** data tree were collected from **a total of 33 sample plots** along three parallel transects, 500 m apart

- Each plot measured 20 m × 20 m in size

- In each plot, the following data were recorded: **identity of all woody species, number of each woody species, DBH and height of each woody species.**

- Besides, tapping status, damage types and possible causes of damage on *B. papyrifera* were recorded based on visual observation **diagram**

Data collection related to the tree species

Material and Methods Con't

- The **floristic composition, species richness, species diversity and evenness of the study area were determined** using different ecological induces
- **Species** richness is the total number of different woody species recorded in the sample plots
- The **diversity of wood**y species was calculated using the Shannon Diversity Index
- **Evenness** was calculated by using Shannon's Evenness Index
- The **mean density** of each woody species was also determined
- **Relative density**
- **Frequency**
- **Relative frequency**
- **Dominance** of the woody species was analysed using basal area
- **The relative dominance**

Material and Methods Con't

- **The important value index (IVI**) by the summation of the relative values of **density, frequency and dominance of each woody species**

- The **population structure of the *B. papyrifera*** species in the study area was also assessed **through histogram**

- Besides, **data for prioritization of the four intervention alternatives for the *B. papyrifera* woodlands conservation** were collected using a structured questionnaire

- The **questionnaire was developed using the hierarchical structure of the study** (Fig 2), for pairwise comparisons using the AHP matrices (Table 1) by selected individual stakeholders
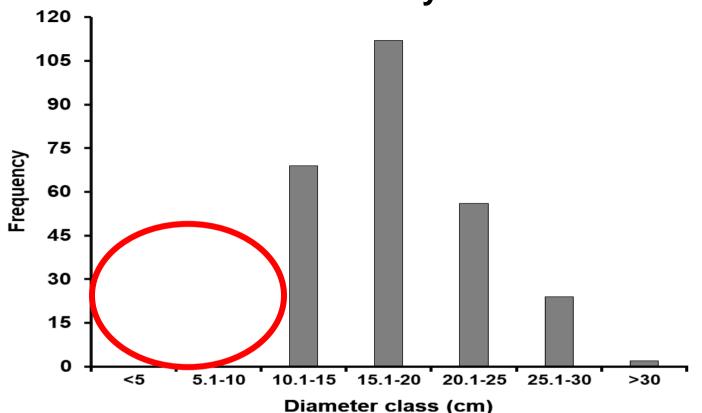
Material and Methods Con't

- For this, **24 representative individuals** were selected from the three stakeholder groups participated in the focus group discussion

- Ahead of the comparison activities, **the selected individuals were briefly informed about the study, the alternatives and their evaluating criteria, and the way they were compared using the AHP techniques**

- After checking the **questionnaires were appropriately filled-up, a total of 24 usable individual questionnaires were considered for analysis**

- The individual's pairwise comparisons data were then analysed using the computer software **Expert Choice (Expert Choice 2009),** in order to generate the overall relative prioritized ranks and weights

3. Key results

Table 2 List of woody species recorded in Gera site with their family names, mean densities (in decreasing order), relative densities (RD in %), frequencies and relative frequencies (RF in %), dominance, relative dominance (RDO in m^2 ha^{-1}) and important value index (IVI)

Species	Family name	Density	RD	Frequency	RF	Dominance	RDO	IVI
Boswellia papyrifera (Del.) Hochst	Bruceraceae	266	46.6	100	26.0	7.1	81.6	154
Senna singueana (Del.) Lock	Caesalpiniaceae	132	23.2	87.8	22.8	0.35	4.0	50
Dodonaea viscosa var. angustifolia (L.f.) Benth.	Sapindaceae	111	19.5	51.5	13.4	0.38	4.4	37
Acacia etbaica Schweinf.	Fabaceae	20	3.4	51.5	13.4	0.26	3.0	20
Acacia oerfota (Forsskal) Schweinf	Fabaceae	11	1.9	27.3	7.1	0.21	2.4	11
Acacia abyssinica Hochst. ex Benth	Fabaceae	7	1.2	18.2	4.7	0.20	2.3	8
Terminalia brownii Fresen	Combretaceae	6	1.1	15.2	3.9	0.13	1.5	7
Stereospermum kunthianum (Cham, Sandrine. Petit)	Bignoniaceae	5	0.9	12.1	3.1	0.03	0.3	4
Acacia mellifera (Vahl) Benth.	Fabaceae	5	0.9	12.1	3.1	0.01	0.1	4
Lannea fruticosa (A.Rich.) Engl.	Anacardiaceae	3	0.5	6.1	1.6	0.02	0.2	2
Lannea triphylla (A.Rich.) Engl.	Anacardiaceae	3	0.5	3.0	0.8	0.01	0.1	1
Total		569			16			

Key Results cont

Fig 3 DBH of *B. papyrifera* in Abergele district, northern Ethiopia

- **266 trees ha^{-1}**

- **DBH moved from 8 cm (Negussie et al., 2008) to 10 cm (Fig 3)**

- **Prevailing populations area unstable**

- **Its economic and ecological benefits also decreased**

Key Results Con't

- From our foucus **discussion with the stakeholders and field observation, regeneration and unstable populations due to:**

Over grazing

Agricultural expansion

Over tapping
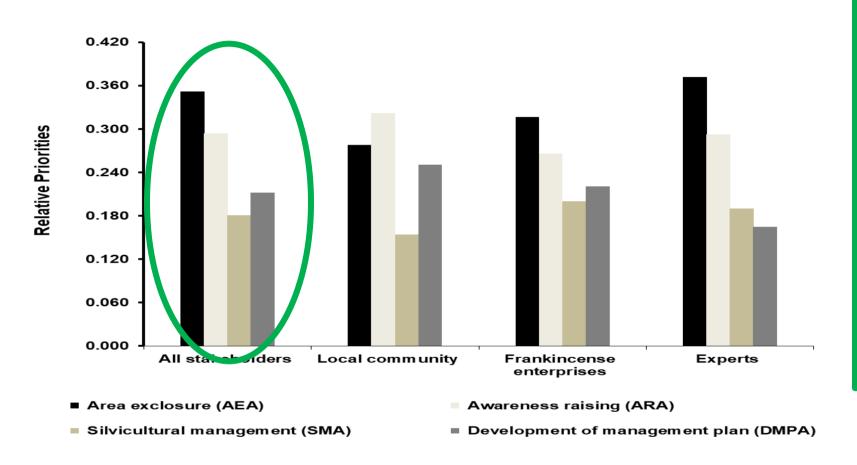

Could be an insect

Could be a disease

Key Results Con't

3.2 Prioritization intervention alternatives for *B. papyrifera* woodland conservation

- AEA is ranked first for future *B. papyrifera* conservation

- ARA activities, e,g optimum tapping

- DMPA

- SMA

Legend:
- ■ Area exclosure (AEA)
- □ Awareness raising (ARA)
- ■ Silvicultural management (SMA)
- ■ Development of management plan (DMPA)

Fig 4 Relative priority of the stakeholder for the *B. papyrifera* woodland conservation alternatives

4. Conclusion

- This study evident that the endangered *B. papyrifera* **woodlands are more shrinking from time to time**

- Its existing population structure **is unstable**

- Due to this, its economic is also in a declining trend that is affecting **livelihoods of thousands of poor people, and Ethiopian national economy**

- **Our AHP modelling approach** showed **AEA and ARA are key interventions for the future** *B. papyrifera* **woodland conservation**

- Hence, for effective implementation of these alternatives in the woodland, **all relevant stakeholders should be involved and consulted**

The 2ⁿᵈ RSG

Empowering community to introduce area enclosure for enhancing natural regeneration of the endangered *Boswellia papyrifera* and its degraded habitat in Ethiopia

2nd RSG con't

Following our 1st RSG recommendation, our 2nd RSG project was focused on introduction of area-enclosure into the *B. papyrifera* woodland by involving stakeholders **with the following specific objectives:**

▪ To provide intensive capacity building training for local community and stakeholders on roles of area enclosure for restoring degraded habitats and their species under threats

▪ Introduce area enclosure with full participation of all stakeholders in the degraded habitat of B. papyrifera

▪ Introduce community-based soil and water conservation activities in the introduced area enclosure for enhancing natural regeneration of B. papyrifera

2nd RSG con't

▪ Analyze scientifically roles of the established area enclosure for natural regeneration and seedling growth of B. papyrifera

▪ Provide on-field training for local community and other stakeholders on roles of the established enclosure for natural regeneration of B. papyrifera habitat

▪ Share results of the project with key stakeholders through training and workshops

▪ Share results of the project using different e-sources

2nd RSG con't

The 2nd RSG project was used the following methods for achieving its objectives:

- Before starting the project, the project team members held a meeting with local community and other relevant local stakeholders

- During the meeting, we presented our project benefits for community and receive their feedback on the project

- Local community was then given a chance to select their three key informants who joined us as project team members

- These selected representatives helped us in train stakeholders; establish and manage the area enclosure; and sharing results of the project with stakeholders

2nd RSG con't

- Through detail discussion with team members, we established area enclosure of 20 x 20 inside of the degraded habitat of B. papyrifera

- The established area enclosure was then fenced using locally available wire to protect it from grazing and human interference

- For enhancing natural regeneration of B. papyrifera inside of the enclosure, soil and water conservation structures were also introduced

2nd RSG con't

- The established area enclosure was well managed for seven months

- Then, for analyzing its roles for natural regeneration of B. papyrifera, data related to seedlings performance were collected, including

  - newly regenerated seedlings of B. papyrifera and other woody species
  - B. papyrifera's height, basal diameter, leaf number, branch numbers, biomass

2nd RSG con't

- These collected data were then scientifically compared with the collected data from adjacent non-enclosure area

- GenStat statistical software was used to analysis the collected data

- Achievements of the established area enclosure for B. papyrifera rehabilitation were practically trained at field level for stakeholders for improving their awareness

- Results of the project were shared with different stakeholders through training and workshops to improve their awareness on use of area enclosure for conservation of the species

- Results of the project were also shared with e-sources like Facebook, Research gate and peer-review publication

2nd RSG con't

Key Results of the project

We provided intensive capacity building training for the relevant stakeholders on role of area enclosure for conservation of the study species

Providing capacity building training for stakeholders on roles of area enclosure for conservation of *Boswellia papyrifera* woodland and its degraded habitat

2nd RSG con't

Key Results of the project

- We statistically analysed the roles of the introduced area enclosure for natural regeneration of B. papyrifera and its seedling growth

- We found number of newly regenerates of B. papyrifera and other woody species found higher in the area-enclosure than that of adjacent non-enclosure **(Table 1)**

- We also found average B. papyrifera seedling height, collar diameter, leaf number, branch numbers and biomass per seedling higher in area-enclosure compare to the adjacent non-enclosure area **(Table 1)**

Key Results of the project

Table 1. *Boswellia papyrifera* seedlings responses under area enclosure and non-area enclosure conservation interventions in Abergele district, northern Ethiopia

Interventions	Number of Boswellia papyrifera regenerates	Number of regenerates Other woody species	Average B. papyrifera Seedling height (cm)	Average B. papyrifera Root collar diameter (cm)	Average B. papyrifera Leaf number per seedling	Average B. papyrifera branch number per seedlings	Average B. papyrifera biomass per seedling (g)	Mortality of B. papyrifera seedlings
Enclosure	15.1a	6.2a	8.5a	5.3a	9.4a	6.2a	58.17a	1.2a
Non-enclosure	9.3b	2.2b	5.4b	2.5b	4.2b	3.4b	33.34b	4.8b
LSD (5%)	0.33	0.31	0.57	0.50	0.39	0.23	0.43	0.28
CV (%)	2.3	3.9	4.4	6.8	3.1	2.6	0.5	4.8

Key Results of the project

Trained local community and local experts on roles of the introduced area enclosure for natural regeneration and seedlings growth of *B. papyrifera*

Key Results of the project

Results of the project were also shared with different stakeholders through workshop and conference

For researchers and students

Presented at Rufford conference in Ethiopia

For local experts and policy makers

2nd RSG con't

Key Results of the project

Share results of the project were also disseminated with different e-sources to aware stakeholders at local, regional and global levels

I) Facebook

https://www.facebook.com/tesfay.gideybezabeh

https://www.facebook.com/RCINKenya/?epa=SEARCH_BOX

https://www.facebook.com/groups/793719180726678/?epa=SEARCH_BOX

ii) Research Gate

https://www.researchgate.net/project/Prioritizing-the-Factors-Affecting-Conservation-of-the-Endangered-Boswellia-papyrifera-Tree-Species-And-Developing-Its-Community-Based-Solutions-in-Ethiopia

https://www.researchgate.net/project/Empowering-Community-to-Introduce-Area-Enclosure-for-Enhancing-Natural-Regeneration-of-the-Endangered-Boswellia-Papyrifera-and-its-Degraded-Habitat-in-Ethiopia

2nd RSG con't

iii) Publication (under review)

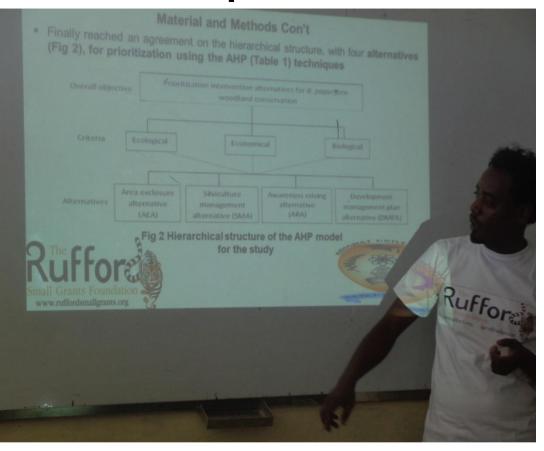https://www.editorialmanager.com/heliyon/default.aspx

Some photos of this workshop with stakeholders

Some photos of this workshop with stakeholders

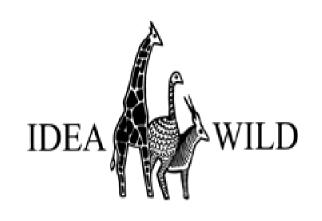# Some photos of this workshop with stakeholders

Participants of the workshop were:

- Researchers
- Local experts
- Local community members
- Policy makers at local and regional levels
- Students
- Others

Acknowledgements

The Rufford - UK based foundation

IDEA WILD- USA based

Adigrat University, Ethiopia

Thank you very much!