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

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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 tree 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
In 2008, Ethiopia exported about 3,450 Mg 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 TRAFFIC (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)
For future conservation of the tree, determine its current population structure and prioritize its conservation interventions using the AHP approach.

The specific objectives were then to:

1) Quantify 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, 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

- Interventions for the woodland and their evaluating criteria were first developed based on consultation with experts, field experiences and literature review.

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

- Participants of the workshop were exchanging their opinions on the proposed alternatives and their evaluating criteria.
Material and Methods Con’t

- Finally reached an agreement on the hierarchical structure (Fig 2), for prioritization using the AHP (Table 1) techniques by selected representative individual stakeholders.

Fig 2. Hierarchical structure of the AHP model for the study
Table 1 The AHP pairwise comparison techniques, Saaty, 2001

<table>
<thead>
<tr>
<th>Intensity of relative importance</th>
<th>Definition</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Equal importance</td>
</tr>
<tr>
<td>3</td>
<td>Weak importance of one over the other</td>
</tr>
<tr>
<td>5</td>
<td>Strong importance of one over the other</td>
</tr>
<tr>
<td>7</td>
<td>Very strong importance one over the other</td>
</tr>
<tr>
<td>9</td>
<td>Absolute importance of one over the other</td>
</tr>
<tr>
<td>2, 4, 6, and 8</td>
<td>Intermediate values between two adjacent judgements</td>
</tr>
</tbody>
</table>
2.3 Data collection and analysis

- *B. papyrifera* data tree were collected from a **total of 32 sample plots**, along an elevation gradient.
- In each plot, a **total number of *B. papyrifera*** were counted and DBH measured.
- **Causes of damage** on the tree were also recorded based on **visual observation**.
- **Population structure** was then depicted **using a frequency diagram**.
Data for prioritization of the alternatives for the 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 techniques (Table 1).

32 **individuals were purposively** selected from the four stakeholder groups (community, frankincense enterprises, experts and NGOs).

The individual’s pairwise comparisons data were then analysed **using Expert Choice software for prioritization**.
3. Key Results

3.1 Current population status of *B. papyrifera*

- 266 trees ha\(^{-1}\)
- DBH moved from 8 cm (Negussie et al., 2008) to 28 cm (Fig 3)
- Lack of regeneration and small trees
- Prevailing populations of the tree are unstable
- Its economic and ecological benefits also decrease

![Graph showing current populations of *B. papyrifera*](image)

**Fig 3.** Current populations of the endangered *B. papyrifera* in Abergele district, northern Ethiopia
Key Results Con’t

- From our **group 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

Fig 4. Relative priority of stakeholders for alternatives for the *B. papyrifera* conservation
4. Conclusion

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

- Its existing populations are also unstable

- Due to this, its economic and ecological values are also decreasing that will affect the **liveliihoods of thousands of poor people, and the Ethiopian national economy**

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

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

Workshop for stakeholders

Train students
The Second RSG project

- Following this, our second RSG is focused on introduction of area exclosure (AE) and its roles on regeneration of *B. papyrifera* by involving stakeholders
- So far, we introduced the AE into the woodland and trained stakeholders
Some photos during my presentation at Rufford conference in Addis Ababa, Ethiopia
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Thank you very much!