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Sacrificing the Sacred: Land-Use Changes and Moral Shifts in Northern Ethiopian Church Forests

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Introduction

Less than 5% of Ethiopia's original Afromontane forest cover remains intact, following decades of rapid deforestation (Bongers *et al.*, 2006). The remaining natural forest in Ethiopia's Northern Highlands is almost exclusively found in “church forests,” which are small pockets of indigenous trees surrounding Ethiopian Orthodox Christian churches that have been preserved as sacred sanctuaries for centuries (Wassie, 2002).

This research uses Geographic Information Systems (GIS) and social surveys to examine the past and present condition of church forests in South Gondar, Ethiopia. We explore the following questions:

- How well does observed forest cover change over time (from satellite imagery) correspond to priest and community member accounts of church forest degradation (from social surveys)?
- How do priest and community member reports on the “roles and rules” of church forests (i.e., the ecological/social functions of the forests, and the institutional/legal rules governing church forest use) relate to observed forest cover change over time?

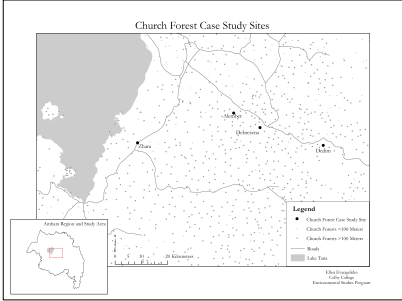
We argue that temporal and informational disconnects – between ecological realities and popular perceptions of forest governance – can pose serious threats to the long-term health of church forest ecosystems.

Methods

Methods combine declassified aerial photography from the 1960s, US Geological Survey Landsat satellite data from 1984-2014, present-day satellite imagery, and in-person social surveys.

We first developed a typology of church forests defined in terms of variation in their extents (by area) and densities (by vegetation indices) over time. We specifically focus on four church forests within the South Gondar Zone of Ethiopia (Figure 1), selected based on this typology.

Figure 1. Church Forest Case Study Sites



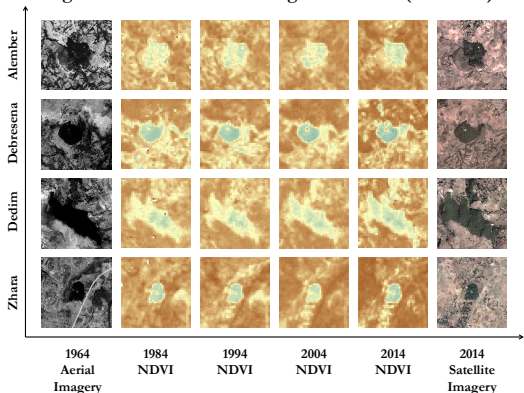
We first calculated the Normalized Difference Vegetation Index (NDVI) for all Landsat data. NDVI is an indicator of green biomass and tree density on a piece of land, which helps understand the overall extent and density of vegetation in the area. This calculation yields a range of pixel values from 0 to 1.

Typically, pixels that are:

- <0.25 are non-forested land
- >0.25 are forested land
- >0.50 are densely forested land

On-site visits in 2013-2014 allowed for more detailed data on each church forest; we conducted 20-30 household interviews (37 questions on church forest status, uses, and rules) within each church forest community.

Figure 2: Church Forest Change Over Time (1964-2014)



Forest Cover Change Over Time

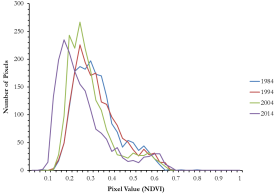
Figure 2 visualizes the church forest change between 1964 and 2014, allowing us to classify changes in size and density for each forest (Table 1).

Table 1. Church Forest Typology

Church	Forest Size	Forest Density
Alember	Decrease	Constant
Debresena	Increase	Constant
Dedim	Increase	Increase
Zhara	Constant	Increase

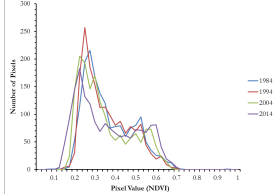
Figures 3-4 show the distribution of pixels in two forests, Alember and Dedim, further highlighting differences in NDVI between 1984 and 2014. These changes are consistent with on-site ground truthing, as well as historical accounts from local community members, supporting the validity of this spatial method for application to future landscape-scale research.

Figure 3. Alember NDVI Change (1984-2014)



Size: Decreasing over time (fewer forested pixels)
Density: No change over time (constant average NDVI pixel value)

Figure 4. Dedim NDVI Change (1984-2014)



Size: Increasing over time (more forested pixels)
Density: Increasing over time (higher average NDVI pixel value)

Other spatial and historical variables that may be associated with forest size and density were also examined. The oldest church in the sample was the only church forest to increase in both size and density, while the newest church was the only one to decrease in size. Churches at higher elevations were typically better off in both size and density. Proximity to the nearest paved road and to the nearest urban center both showed no relationship to forest cover change in this small sample.

Community Responses

Linking social survey results to remote sensing data yields important insight into plausible drivers of the observed vegetation change trends. Figures 5-6 gauge relative levels of respect and fear for religious sanctions and civil courts and law. Overall trends suggest that people tend to favor rules in the form of religious instruction and leadership. Conversely, trends also show that communities are more receptive to the threat of a mixture of religious sanctions and civil courts and law.

Figure 5. Community Respect for Rules

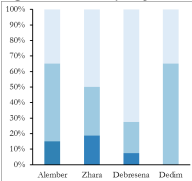
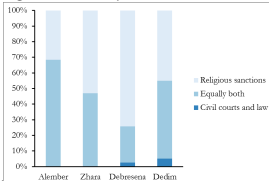


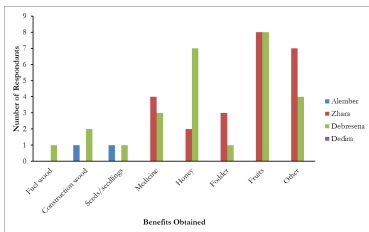
Figure 6. Community Fear of Penalties



in forest outcomes. Members of Alember have the lowest respect and fear of the church – Alember has also seen the most significant decrease in size, perhaps due to this lack of religious authority. In contrast, religious sanctions dominate in the Debresena community, both in terms of respect and fear. NDVI trends show Debresena's forest has increased in density over the past 40 years; however, Figure 2 also highlights that Debresena has experienced recent clearing *from the inside*. This spatial finding, combined with our survey results, suggests that where religious norms are strong a significant driver of forest degradation may be priests themselves.

Figure 7 shows the distribution of benefits community members obtain from their respective church forests. Note that in Dedim, a forest that has increased both in size and density over the past 40 years, zero respondents reported that they obtain any benefits from the forest.

Figure 7. Community Benefits Obtained from Forest



Conclusions

Today, even in areas of deep cultural and religious significance such as church forests, the effects of economic pressures can be seen as native forests continue to be degraded by agricultural expansion, grazing, and fuel wood demand. These methods can be applied in further studies to analyze the management and success of other community managed forests in Ethiopia and beyond.

Literature Cited

Bongers, F., Wassie, A., Sterck, F., *et al.* (2006). Ecological restoration and church forests in northern Ethiopia. *Journal of the Drylands*, 1(1): 35- 44.
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