Vegetation Cover Dynamics Assessment in Dokmit Micro-Watershed, Esala Kebele, BahirDar Zuria Woreda

By Mulugeta Worku Ayele

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Abbreviations

BfDE	Bees for Development Ethiopia
BfD-UK	Bees for Development United Kingdom
NDVI	Normalized Vegetation Index
NIR	Near InfraRed
NRM	Natural Resources Management

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1. Introduction

From 2018 to 2021, Bees for Development Ethiopia (BfDE), in collaboration with Bahir Dar Zuria Woreda office of Agriculture and Esala Kebele Administration, and through financial support from Rowse Honey PLC, was implementing natural resources management (NRM) works in Dokmit micro-watershed. This site is learned to have entertained land degradation for the past several years and was targeted by BfDE to undertake restoration works. The intervention involved activities encompassing: community mobilization, training, area closure, check-dam construction for gully treatment, and planting tree seedlings.

As in other development projects, added values of a specific intervention need to be documented and more importantly at the end of the project period. Accordingly, BfDE by the middle of April 2022, commissioned a land cover dynamics assessment of the project site where NRM activities have been implemented. The main objective of this assessment is therefore to document evidence on whether packages of land restoration activities have brought about real changes in vegetation cover of the selected micro-watershed. It is specifically aimed to quantify the net increase in various categories of perennial vegetation between the baseline year (2018) and the endline year (2022).

This assessment report is organized into four sections. The first is a brief introductory section containing project background and objectives of the assessment. The second section is the methodology of doing the assessment that describes types of data used, methods of data collection and analysis and location where the study was conducted. The third is about the findings that relate to the objectives of the study and the fourth section contains conclusions and recommendations. Google earth maps and photos are also annexed to provide additional information regarding changes in landcover.

2. Methodology

2.1 Data collection and analysis

The study involved time series analysis of vegetation cover dynamics. A 10-meters resolution and cloud-free Sentinel2satellite images[1] were used as data inputs and further analyzed in ArcGIS software environment. The Normalized Difference Vegetation Index (NDVI)[2] method was used to detect changes in the density of different categories of vegetation. NDVI was calculated from reflectance values of the Near Infrared (NIR) band (B08) and the Red Band (B04) of Sentinel2 imagery as per the following equation.

$$NDVI = \frac{NIR - RED}{NIR + RED}$$

[1] Sentinel2 is a constellation of two polar orbiting satellites under the Copernicus programme of the European Space Agency. More information about Sentinel2 can be found here.

[2] NDVI s defined by the reflectance of red (RED) band and near infrared (NIR) band since they sense very different depths through vegetation canopies. RED channel has strong chlorophyll absorption region while NIR channel has high vegetation canopy reflectance in this area. More information about can be found here or here.

The same month (January) was used to ensure reliable comparison between 2018 (baseline year) and 2022 (endline year). This specific month was selected to minimize the effect of rainfall on vegetation phenology. It is characterized by cloud-free (clear) skies and represents a month by when the green leaves of annual crops are dried and harvested after the end of the last rainy month (October) while perennial vegetation retain their greenness. In addition to NDVI-based change detection, a snapshot of Google Earth maps for different time periods were also taken for visual comparison.

2.2 Study location

This landcover change assessment was conducted in a specific micro-watershed called 'Dokmit'. It is located in Bahir Dar Zuria Woreda (South of Lake Tana) in Amhara Region of Ethiopia (as shown in Figure 1) and its total area is 31.17 hectares.

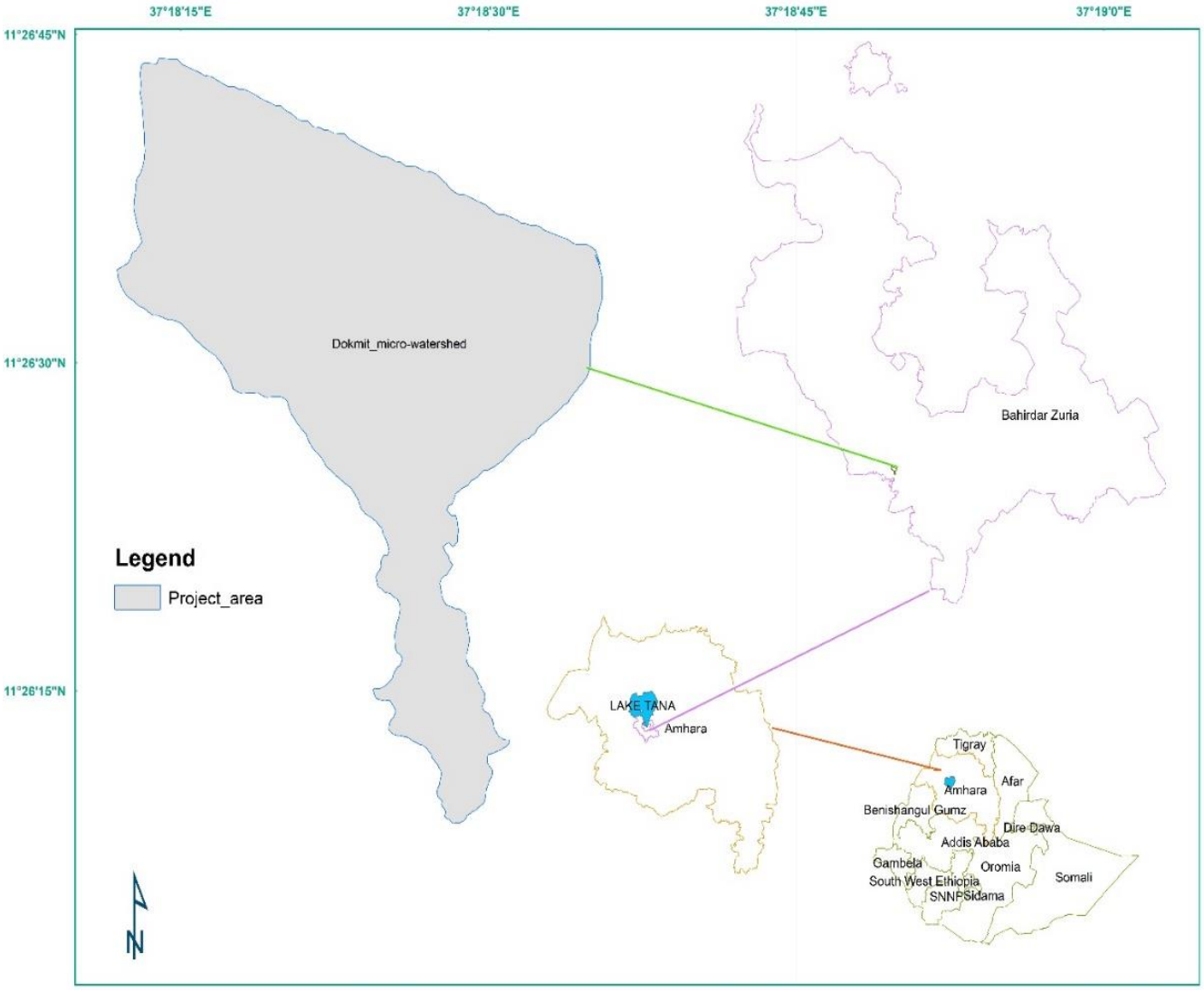

Figure 1: Map of Dokmit micro-watershed (study site)

3. Findings

It is proved from this study that NRM activities of the project have exhibited positive impacts on the coverage and density of vegetation cover including the transition from one form of vegetation category to the other as shown in Figure 2 and table 1.

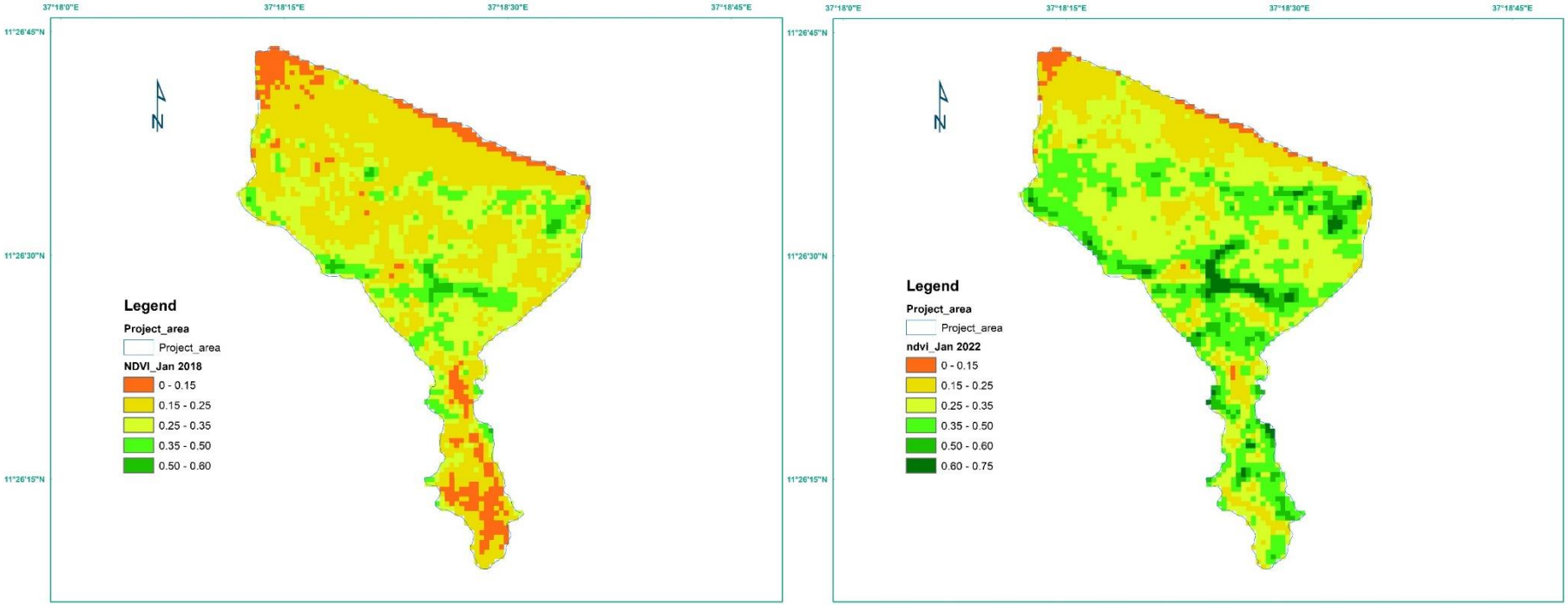

Figure 2: NDVI-based vegetation cover in Dokmit in January 2018 (left panel) compared to vegetation cover in January 2022 (right panel).

The coverage of barelands and semi-dried grasslands together formed around 61% of the total land area of Dokmit micro-watershed in 2018. However, this proportion has been significantly reduced to only 11.7% in 2022. On the other hand, the proportions of vegetation types characterized by mosaic of Scrub, saplings and grasses/herbs increased from 28 to 40%; bushland cover increased from 10 to 28% and low to medium density trees increased from 1.4 to 6.5%. The study also found out evolution of high-density trees (see Table 1 for more information).

Table 1: Summary of changes in vegetation cover in Dokmit micro-watershed

NDVI range	Landcover category	NDVI in January 2018 (a)			NDVI in January 2022 (b)			Landcover change in hectares (a-b)
		Cell count	Area (Ha)	%	Cell count	Area (Ha)	%	
0 - 0.15	Barelands, gullies, barelands with tiny herbs and grasses	281	2.81	9.02	59	0.59	1.89	-2.22
0.15 - 0.25	Semi-dried grassland	1611	16.11	51.68	665	6.65	21.33	-9.46
0.25 - 0.35	Mosaic of Scrub, saplings and grasses/herbs	872	8.72	27.98	1256	12.6	40.30	3.84
0.35 - 0.50	Bushlands and growing trees	309	3.09	9.91	859	8.59	27.56	5.5
0.50 - 0.60	Low to medium density trees	44	0.44	1.41	202	2.02	6.48	1.58
0.60 - 0.75	High density trees	0	0	0.00	76	0.76	2.44	0.76
Sum		**3117**	**31.17**	100	**3117**	**31.17**	100	

Notes: cell counts in this table refer to the number of pixels with an area of 100 Square meters (10 m X 10 m) having corresponding NDVI values.

4. Conclusions and recommendations

Resources invested in Dokmit micro-watershed for land restoration purposes have brought about meaningful and expected changes. The results demonstrated can be attributed to combinations of factors including stakeholder engagement, community awareness and ownership, training and mentoring supports from the project, and sufficient time clearance for plant regeneration.

It is recommended to showcase the changes in vegetation cover to stakeholders in high levels of government and dedication of additional resources so that processes and actions can be scaled up and replicated in other degraded landscapes.

5. Annex:

Annex A: Comparison of Google Earth maps of the project site between 2018 and 2022

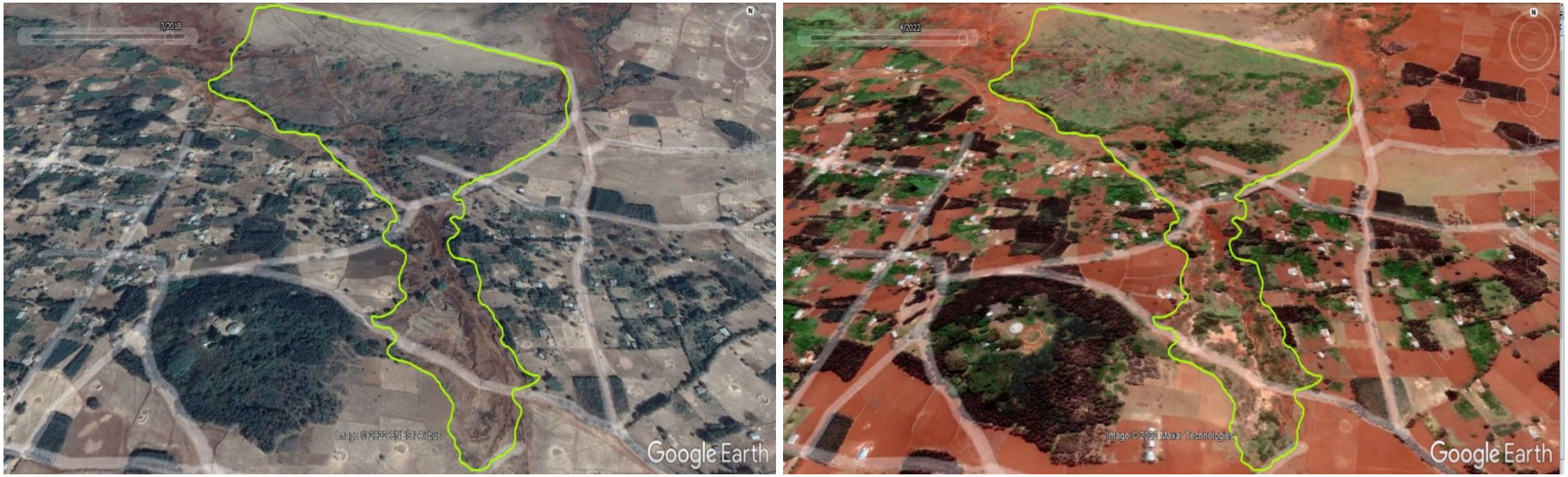

Figure 3: Illustration of Google Earth-based vegetation cover comparison in Dokmit between March 2018 (left) and April 2022 (right).

Note: The map with yellowish-green boundary is the project site (Dokmit micro-watershed). Differences in brightness of maps is due to differences in the specific time during which Google Earth Satellites passed over.

Annex B: Site-level photos witnessing positive changes in vegetation cover

Figure 4: Kes Imegnew Simeneh (Local priest) witnessing the extent to which the land that was degraded and out-of-use ha been restored into its current status (left) and partial snapshot of a fully-recovered land (right). Source: BfDE photo archives.