Monitoring Land Degradation Neutrality in the Birim North Mining Community of Ghana

Presenter: Aaron Tettey Tetteh

Authors Name: Aaron Tettey Tetteh, Lily Lisa Yevugah, Abdul-Wadood Moomen

Institution: University of Energy and Natural Resources (UENR), Ghana

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PRESENTATION OUTLINE

- Introduction
- Significance of study
- Aim & Specific Objectives
- Methodology
- Results and Discussion
- Conclusion and Recommendations
- Acknowledgement

INTRODUCTION

- Land Degradation (LD) is the reduction in biodiversity and ecosystem functioning, impacting ecosystem services (IPBES, 2018; Petrosillo et al. 2023).
- LD has compromised the land's ability to fulfill its functions.
- LD causes $400 billion in losses annually, impacting 1.5 billion people worldwide (Jiang et al., 2022; Uthappa et al., 2023; Anteneh & Zewide, 2021).
- The UNCCD seeks to combat LD through advocating Land Degradation Neutrality (LDN).

INTRODUCTION

- LDN aim to reverse, reduce, and restore degraded lands by the year 2030 (Cowie, 2020).
- Land is humanity's most valuable resource, forming the foundation for all other resources.
- Monitoring LDN and its drivers aid decision-making (Hannam, 2022; Jiang et al., 2022).
- Ghana targets rehabilitation of degraded mine sites and 882.86 km^2 of forest by 2030 (UNCCD,2017). This study will monitor progress towards LDN in the Birim North Mining Community.
- The study monitors progress towards LDN in the Birim North Mining Community.

SIGNIFICANCE OF STUDY

- The study provides the baseline for assessment of LD for policymakers and stakeholders, facilitating informed decision-making and sustainable land management practices;
- It provides status of LDN in mining communities;
- It offers tailored solutions to improve livelihood of residents in mining communities.

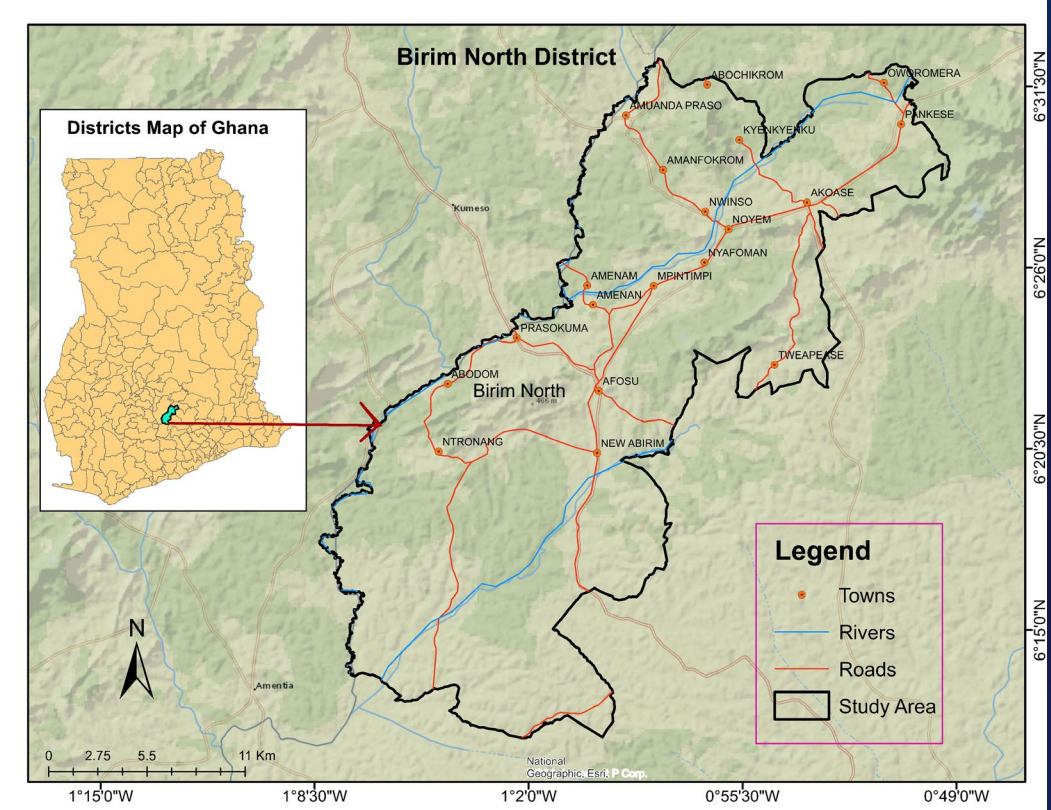
AIM & SPECIFIC OBJECTIVES

- This study aims to monitor and assess LDN in the Birim North mining community.

SPECIFIC OBJECTIVES:

- To map the extent of land degradation in the Birim North district.
- To assess evidence of rehabilitation efforts; and analyze the perception of mining communities on rehabilitation activities.
- To examine the drivers influencing the achievement of Land Degradation Neutrality
- To examine the sustainability of rehabilitation methods used.

METHOD: STUDY AREA



Study Area

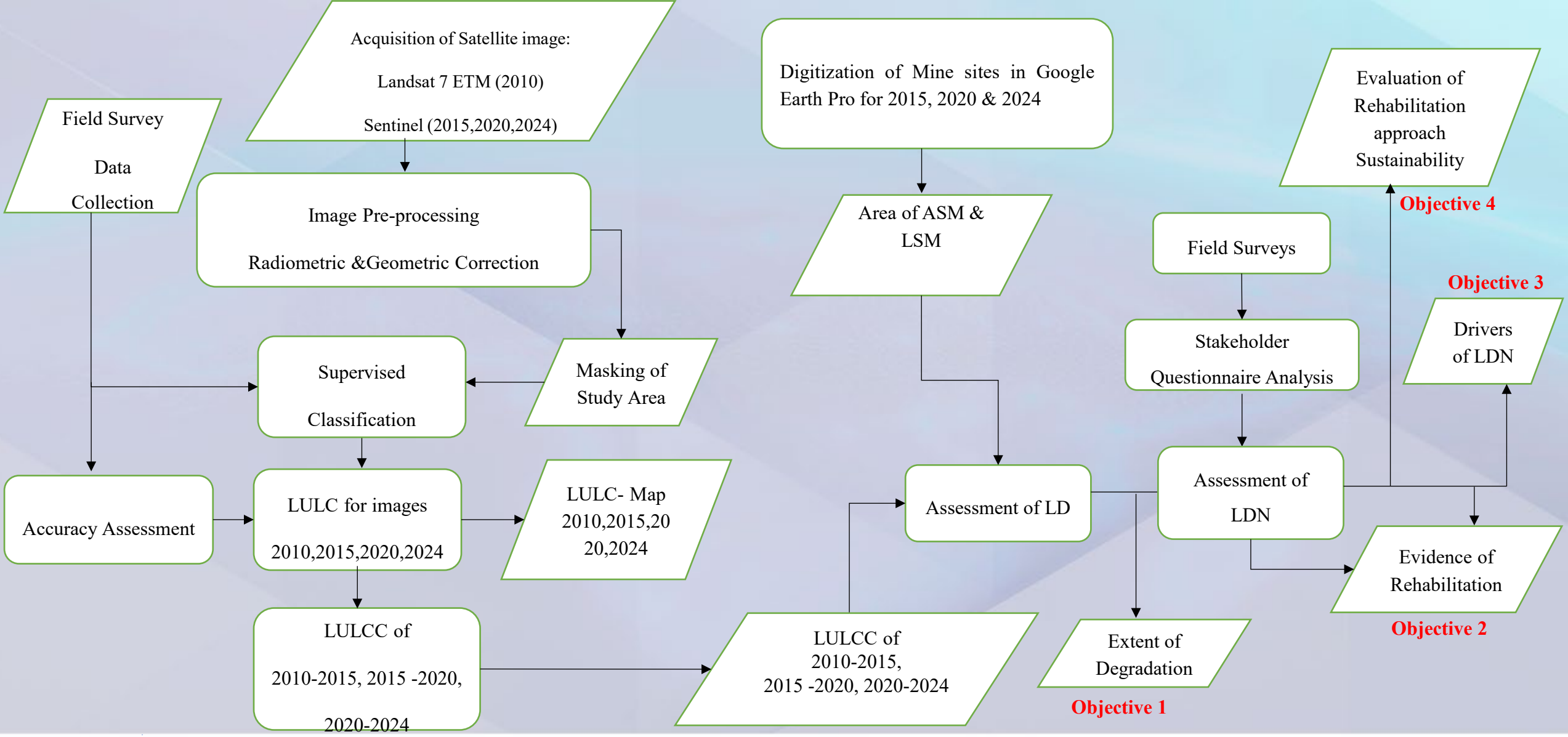
- **Climate:** Semi-equatorial, double rainfall peaks (1,500–2,000 mm), warm temps (25–28 °C); supports cocoa & oil palm.
- **Geology:** Gold-rich Birimian & Tarkwaian rocks; driving mining.
- **Vegetation:** Semi-deciduous forest rapidly declining due to mining and farming.
- **Relief:** Mountainous (112–497 m), drained by Pra & Birim Rivers.
- **Population:** 82,669 people; livelihoods rely on farming and mining.

MATERIALS & SOFTWARE

Data Sources

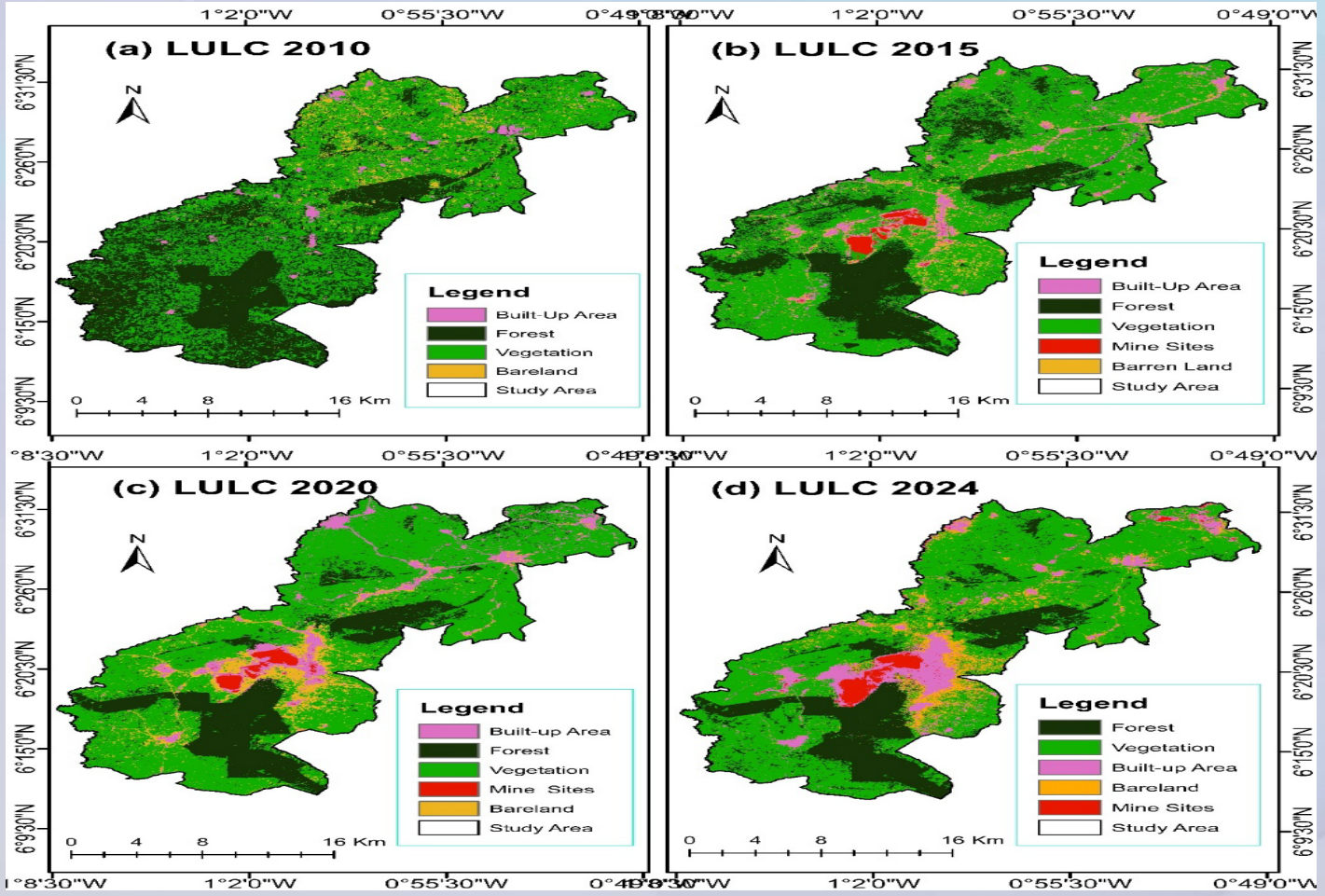
- Landsat imagery 7 ETM+ for the year 2010 from USGS.
- Sentinel imagery for the years 2015, 2020, & 2024 from Copernicus.
- Field Surveys.
- Stakeholder Interviews.

Software	Purpose
ArcGIS 10.8	Mapping and GIS Analysis
QGIS 3.28	Mapping and GIS Analysis
Google Earth Pro	Time-series analysis and Classification validation, and Mine sites digitization.
MS Excel	LULCC analysis and graphs, and questionnaire analysis.



Flowchart of the methodological framework used

RESULTS & DISCUSSION



LULC from 2010 to 2024

LULC Changes from 2010 to 2024

Class name	Area in 2010 (km^2)	Area in 2024 (km^2)	% change (2010 - 2024)
Forest	235.35	117.15	-50.22
Vegetation	288.47	341.47	18.37
Built-Up area	13.34	51.92	289.21
Bare land	29.84	42.73	43.20
Mine sites	-	13.73	_
Total	567.00	567	

RESULTS & DISCUSSION

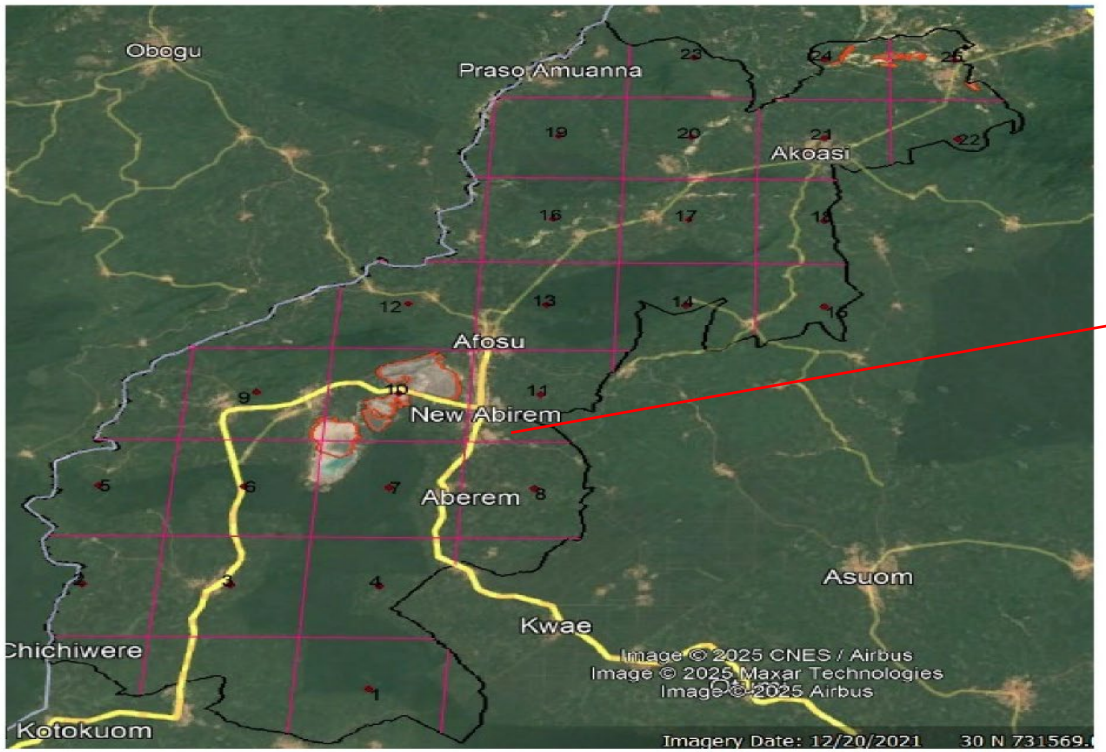
LULC Transition Matrix from 2010 to 2024 (km2).

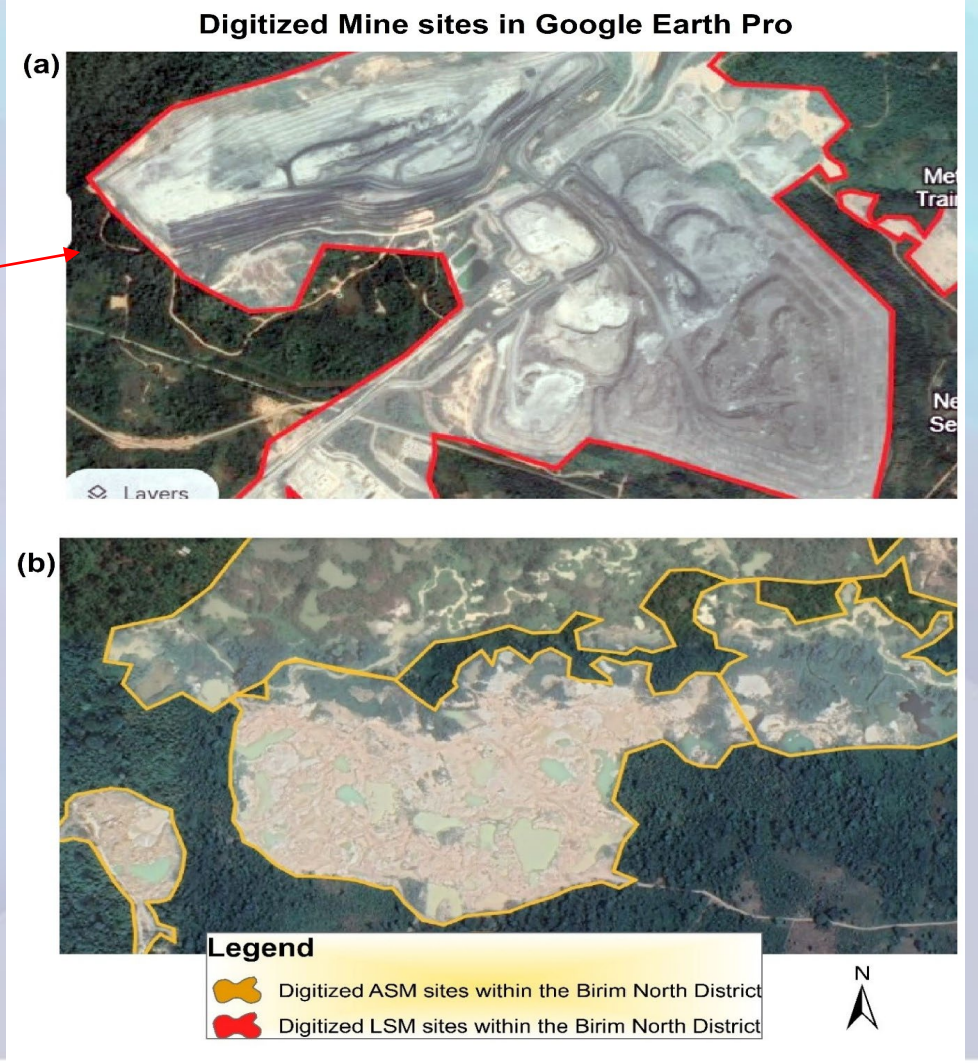
2010 \ 2024	Forest	Vegetation	Built-up area	Bare land	Mine Sites	Total (2010)
Forest	92.461	111.829	15.872	10.978	4.217	235.357
Vegetation	22.212	205.009	25.346	26.804	9.087	288.459
Built-up area	0.118	2.405	9.059	1.561	0.202	13.346
Bare land	2.358	22.227	1.643	3.391	0.220	29.838
Total (2024)	117.149	341.469	51.920	42.735	13.726	567

Accuracy- Assessment of LULC for 2010-2024

Year	Overall Accuracy (%)	Kappa Coefficient
2010	86.6	0.854225
2015	93.8	0.911259
2020	94.1	0.933625
2024	88.2	0.858665

RESULTS & DISCUSSION





Map showing the fishnet griding of the study area used as a guide for ease of digitizing ASM and LSM sites in Google Earth Pro.

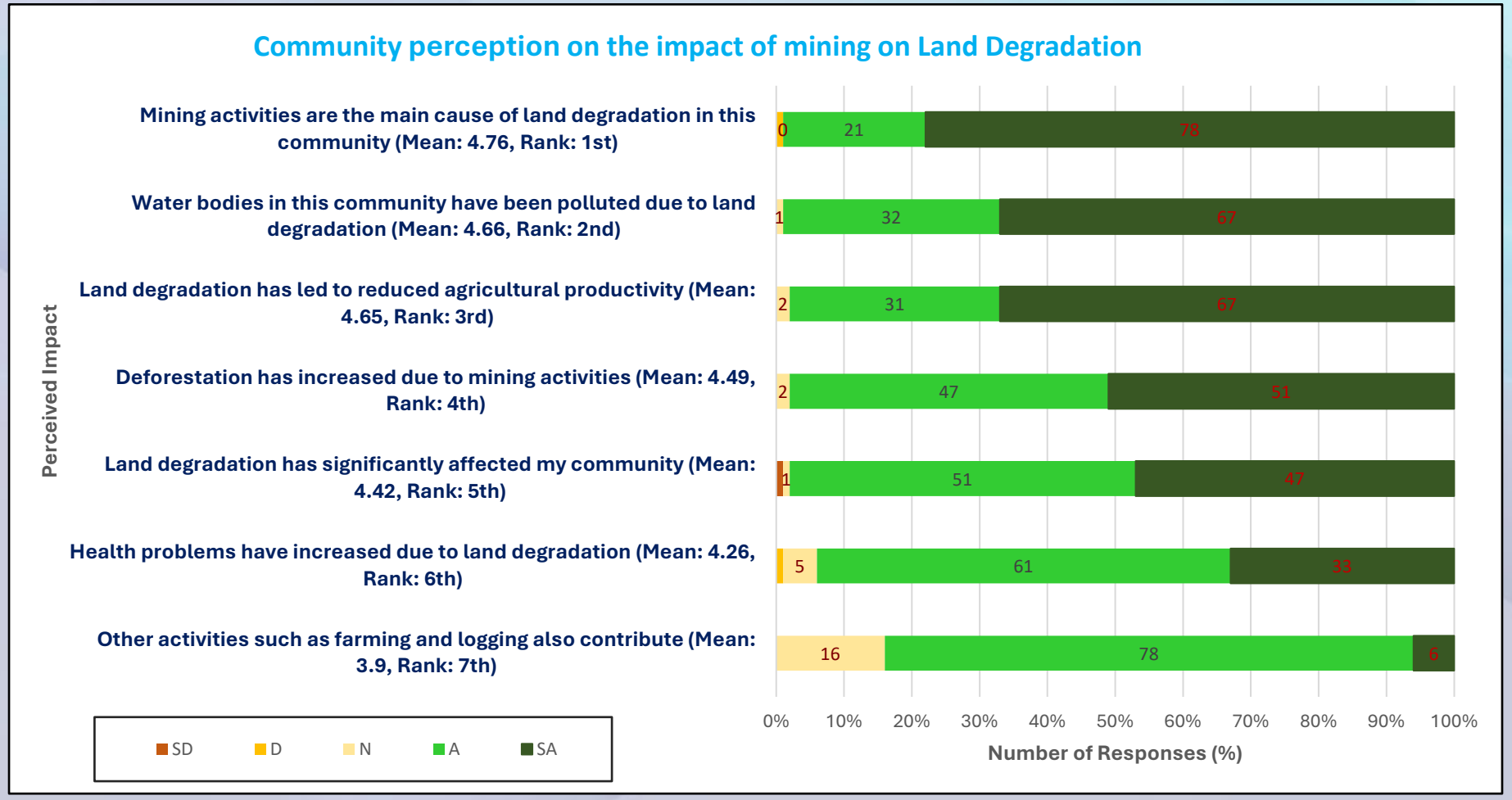
RESULTS & DISCUSSION

Digitized Mine sites within the study area (km^2).

Year / Time Period	ASM Site Area (m^2)	ASM Site Area (km^2)	LSM Site Area (m^2)	LSM Site Area (km^2)	ASM Change (%)	LSM Change (%)
2015	1,452,563.50	1.4526	8,212,659	8.2127	—	—
2020	1,225,082.00	1.2251	9,129,594	9.1296	-15.67	+11.17
2024	3,301,555.08	3.3016	11,279,772	11.2798	+169.50	+23.56
2015–2024	—	—	—	—	+127.30	+37.34

RESULTS & DISCUSSION

- Mining Surge – ASM and LSM are main contributors to forest loss, bare land expansion, and soil degradation.
- Urbanization & Deforestation – Expanding settlements and tree loss intensify land degradation (Table 3).

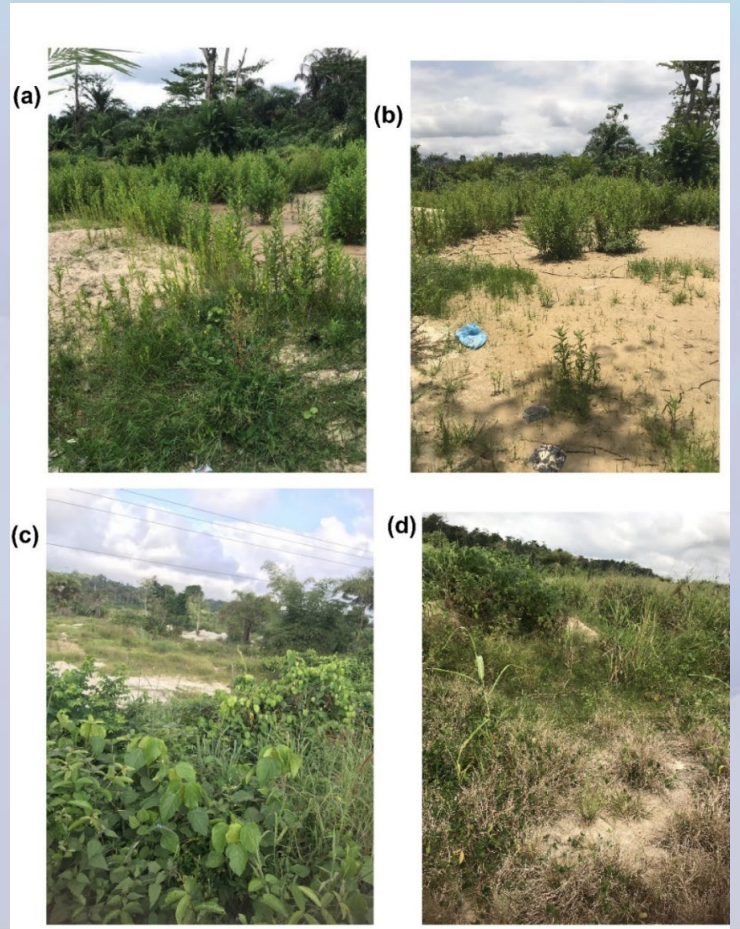


Community perception on the impact of mining on land degradation.
SA = Strongly Agree, A = Agree, N = Neutral, D = Disagree, SD = Strongly Disagree. Longer dark green segments reflect stronger agreement.

RESULTS & DISCUSSION

Objective 2: Evidence of Rehabilitation Efforts in the study area and the perception of mining communities on restoration activities

- Natural Regeneration was the rehabilitation technique observed.
- Water and vegetation-covered pits pose health and safety risks.
- Some Abandoned pits are re-mined by locals.



Natural regeneration at an abandoned ASM site

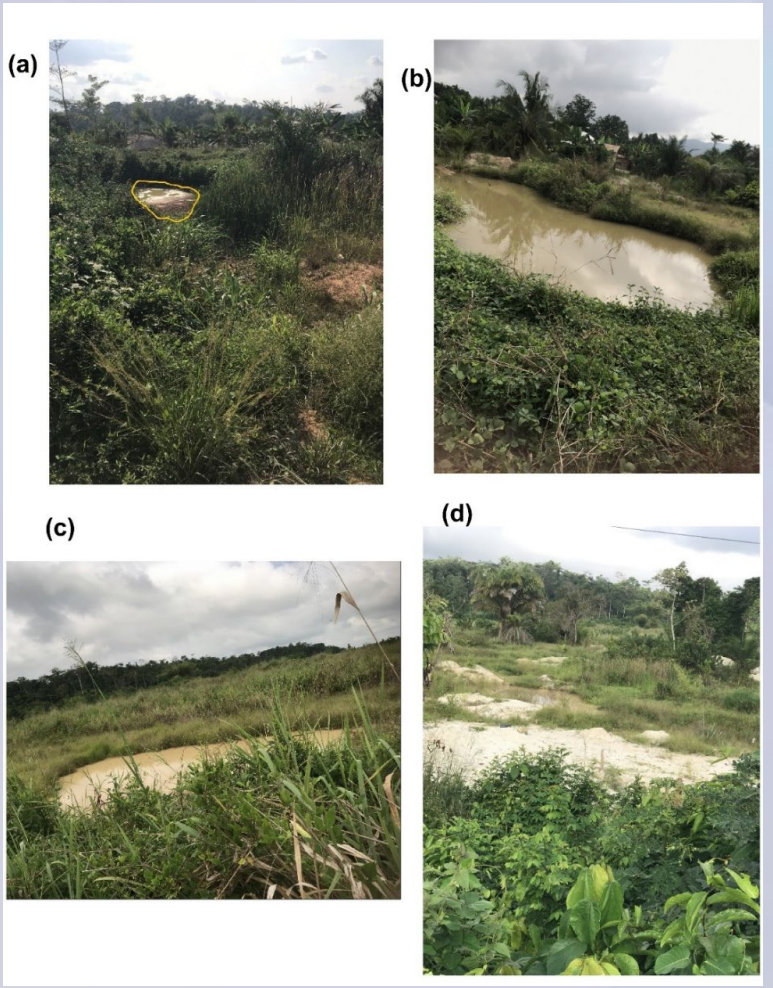
a

b

Re-mining of old abandoned pits observed in the study area.

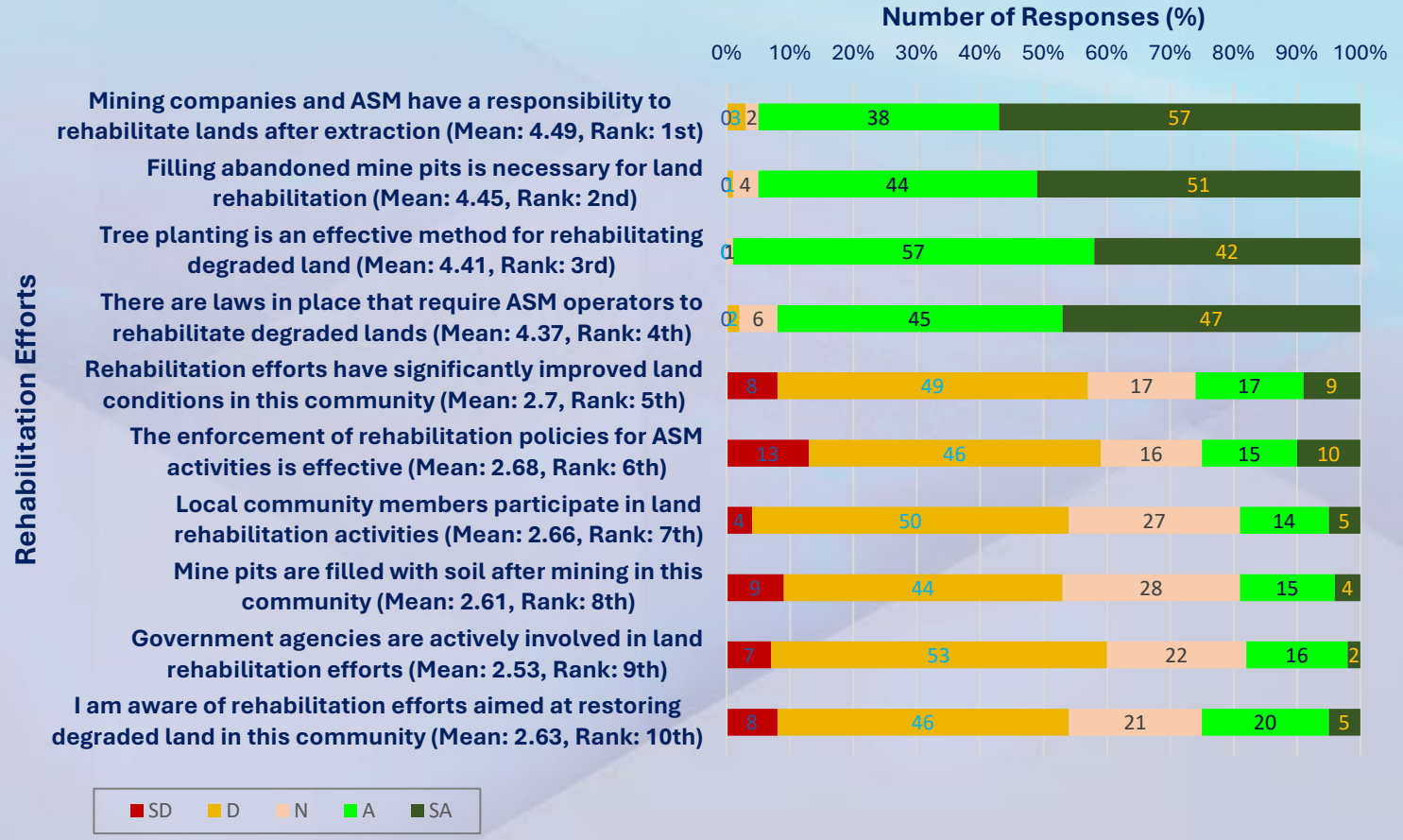
Objective 2: CONT'D

RESULTS & DISCUSSION



Water-filled pits at a naturally regenerated ASM site, vegetation surrounding the flooded areas.

Community perception on Rehabilitation efforts and its effectiveness



Community perception of the effectiveness of land rehabilitation efforts.
SA = Strongly Agree, A = Agree, N = Neutral, D = Disagree, SD = Strongly Disagree. Longer dark green segments reflect stronger agreement.

RESULTS & DISCUSSION

Objective 4:Drivers Influencing the Achievement of Land Degradation Neutrality

Enabling Drivers (Opportunities):

- Natural vegetation regeneration observed on abandoned mine sites.
- Strong community willingness to engage in rehabilitation.
- Training and awareness creation identified by 39% of respondents.
- Collaborative interventions proposed: 56% – joint training, 17% – law enforcement, 6% – education & taskforces, 3% – alternative livelihoods.

Constraining Drivers (Challenges):

- Weak enforcement of environmental regulations.
- Limited institutional & technical capacity for rehabilitation.
- Inadequate funding and poor disbursement.
- Low LDN policy awareness (72% unaware).
- Competing land uses (re-excavation, farm-to-ASM conversion).
- Rapid ASM expansion (+169.5% from 2020–2024) undermines neutrality.

RESULTS & DISCUSSION

Objective 4: Evaluating the Sustainability of Rehabilitation Practices

- **Natural Regeneration alone is insufficient** – Passive recovery fails to fully restore ecosystems.
- **No other structured methods** – Reforestation, phytoremediation, soil restoration required.
- **Capacity Gaps** – Limited expertise, and resources hinder rehabilitation.
- **Community Support** – Strong backing for training, involvement, and inclusive decision-making.
- **Policy & Enforcement Gaps** – High demand for stricter laws and mandatory post-mining rehabilitation.

CONCLUSION

- Severe land degradation due to loss of forest and rise in built-up and bare lands.
- Mining (illegal ASM) and urbanization are the dominant drivers of degradation.
- Rehabilitation efforts largely relied on natural regeneration.
- Weak enforcement and limited expertise hinder progress toward LDN.
- Current rehabilitation methods are unsustainable and require structured interventions.

RECOMMENDATION

- Implement reforestation and land restoration programmes to curb severe degradation.
- Enforce sustainable mining and land management practices.
- Shift from passive to active rehabilitation through pit refilling, phytoremediation, and afforestation.
- Enhance law enforcement and technical capacity to advance LDN progress.
- Foster collaboration and provide livelihood support for sustainable rehabilitation.

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Thank You!

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Aaron Tettey Tetteh

aaron.tetteh.stu@uenr.edu.gh

LinkedIn: www.linkedin.com/in/aaron-tettey-tetteh-aaa105186