FIG WORKING WEEK 2023
28 May - 1 June 2023 Orlando Florida USA
Protecting Our World, Conquering New Frontiers

A GEOSPATIAL APPROACH IN RESOLVING ILLEGAL MINING ACTIVITIES IN GHANA

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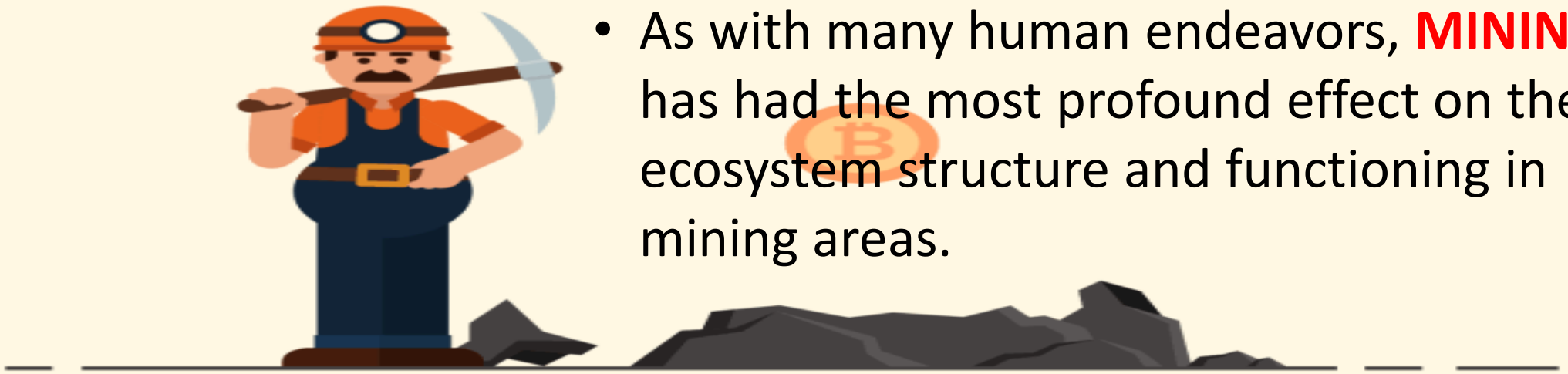
Contents

Introduction

- Over the past few decades, human activity has caused severe changes to the Earth's surface and ecosystems.



- As with many human endeavors, **MINING** has had the most profound effect on the ecosystem structure and functioning in mining areas.

- **Ghana** is a beautiful country endowed with rich mineral deposits, fertile lands, serene rivers and breathtaking coastal landforms
- To add to this, it is one of the leading producers of gold in Africa and the seventh leading producer in the world.
- Gold is the most commercially exploited mineral in **Ghana**, accounting for about 95% of the country's mineral revenue
- This has attracted both legitimate and illicit gold prospectors from all over the world to the country

The Problem

- Mining on its own has consequences on the earth. The issue becomes more grievous when mining activities are unregulated.
- For the past 10 years, one of the leading problems faced in Ghana is the growing menace of **Illegal Mining Activities**
- The unregulated small-scale and artisanal gold mining is known locally as **Galamsey**, a slang word derived from the Ghanaian words “gather” and “sell.”

The Problem ?

14 out of 16 regions in Ghana face these issues

Ghana: Dealing with illegal mining is a 'nightmare', says Minister Jinapor

By Kent Mensah

ar Reserved for subscribers

Posted on January 6, 2023 11:55

Illegal mining threatens Ghana forests

Regional News of Tuesday, 30 May 2023

Source: www.ghanaweb.com

Over 300 illegal miners trapped in AngloGold's Obuasi mine shaft - Report

Stripping northern Ghana naked – Illegal mining wreaking havoc on fragile vegetation cover

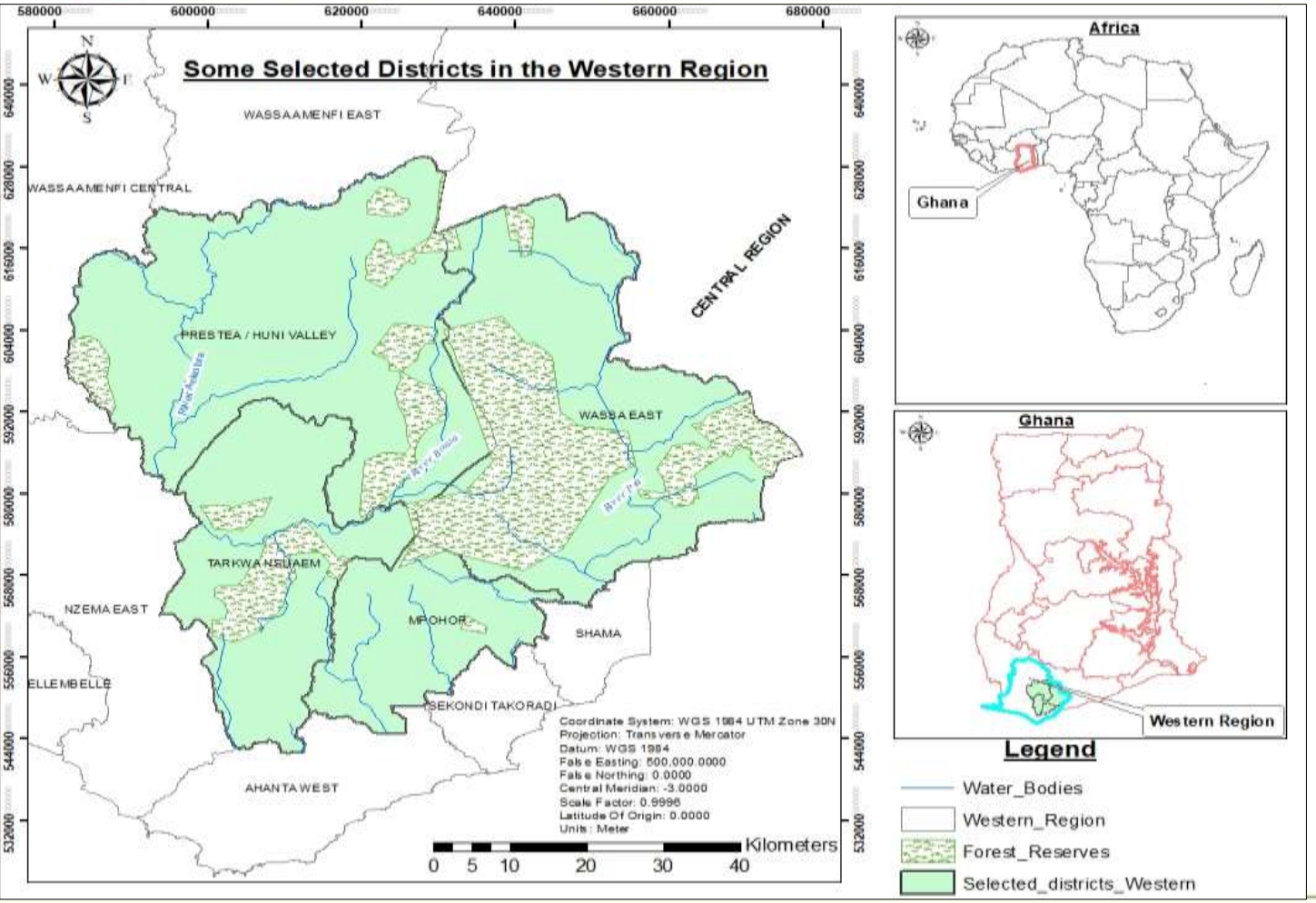
Mohammed Fugu / Nov - 19 - 2022 , 10:46

Research Objectives & Questions

The unresolved concerns are:

- How can we use technology to better track the repercussions of mining, both good and bad?
- How can geospatial data and technologies help governments and people make more informed decisions for mineral resource development that will have a positive impact on future generations?

This research, then, investigates the application of geospatial technology in an effort to resolve unlawful mining activities in Ghana, with the hopes of answering the aforementioned issues.



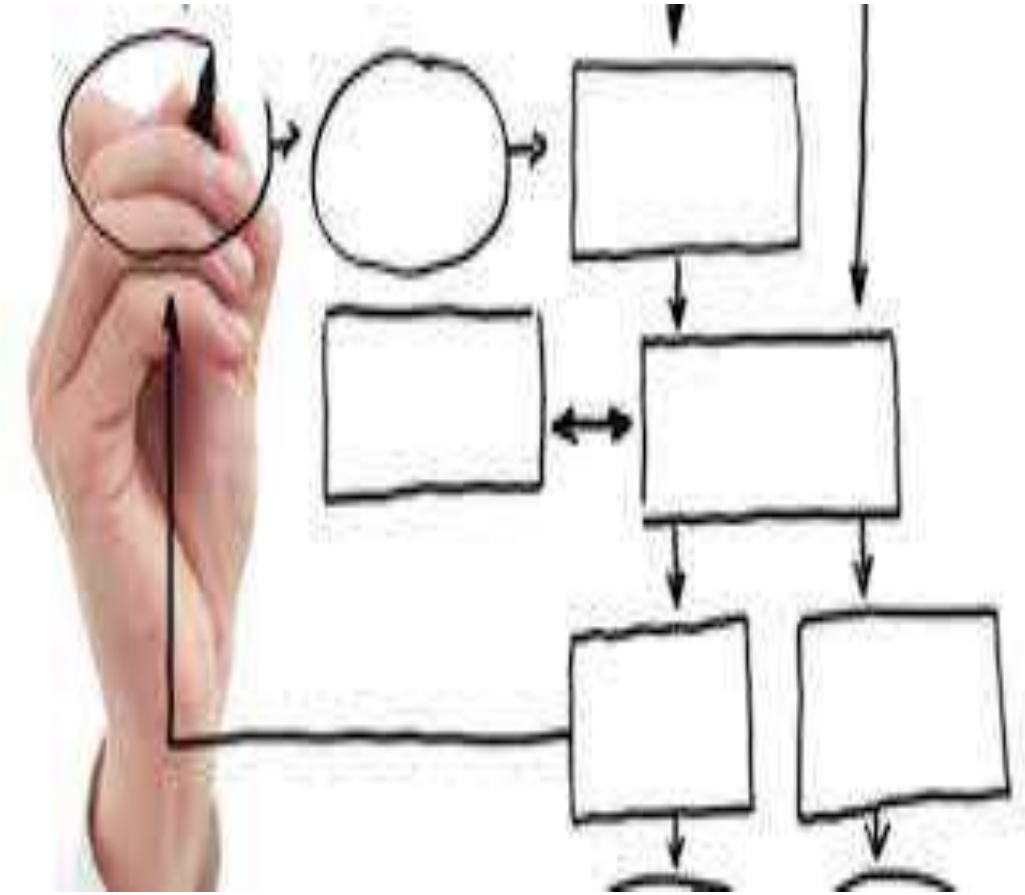
Study Area

- The Western Region is characterized rich diverse forests, high annual average rainfall, beautiful green hills and excellent soils.
- It has been a leading supplier of cocoa, rubber, and coconut for decades, and it is also among the world's top oil palm suppliers.
- The Western Region's economy is dominated by offshore oil platforms and a plethora of gold miners, both small and large in gold, bauxite, iron, diamond and manganese.

Research Methodology

Secondary data comprising of satellite tiles with minimum cloud cover of 10% from the United States Geological Survey (USGS) were mainly used

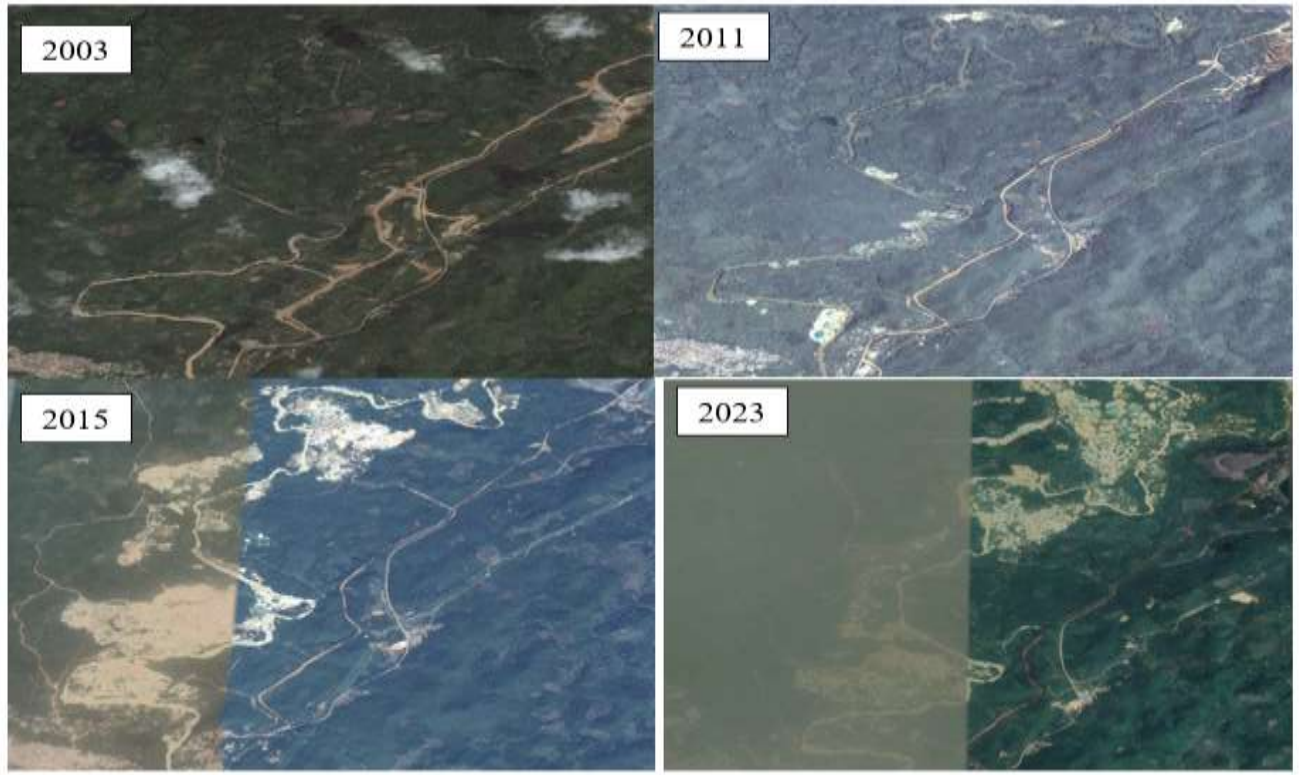
Path/ Row ID	Date of Acquisition	Land sat Type
194/056	2007/01/13	7
	2023/01/02	9
193/056	2007/01/13	7
	2023/01/02	9



Data Analysis

- Interactive Supervised classification analysis.
- To ensure accuracy in the analysis, Google Earth was used to select training samples in the classification process.
- Change detection analysis was also explored to quantify the various changes in land use/land cover from 2007-2023.
- Vegetative indices were also analyzed to determine both quantitative and qualitative measures of vegetation cover, vitality, and growth dynamics.
- Temperature maps were developed to identify the resultant changes in land use/land cover on thermal emission rates.
- CA Markov chain model to predict future changes in LULC

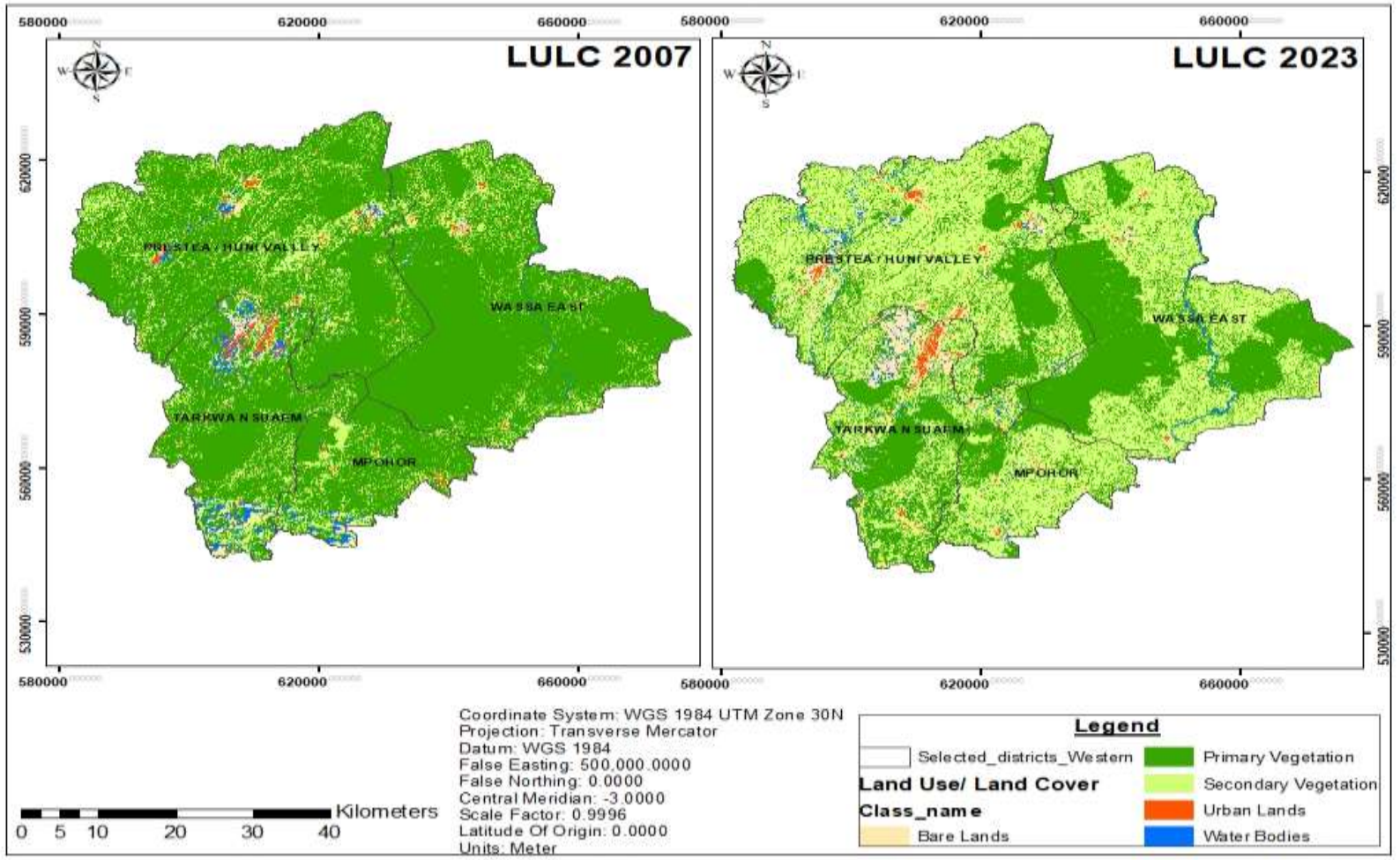
Results & Discussions

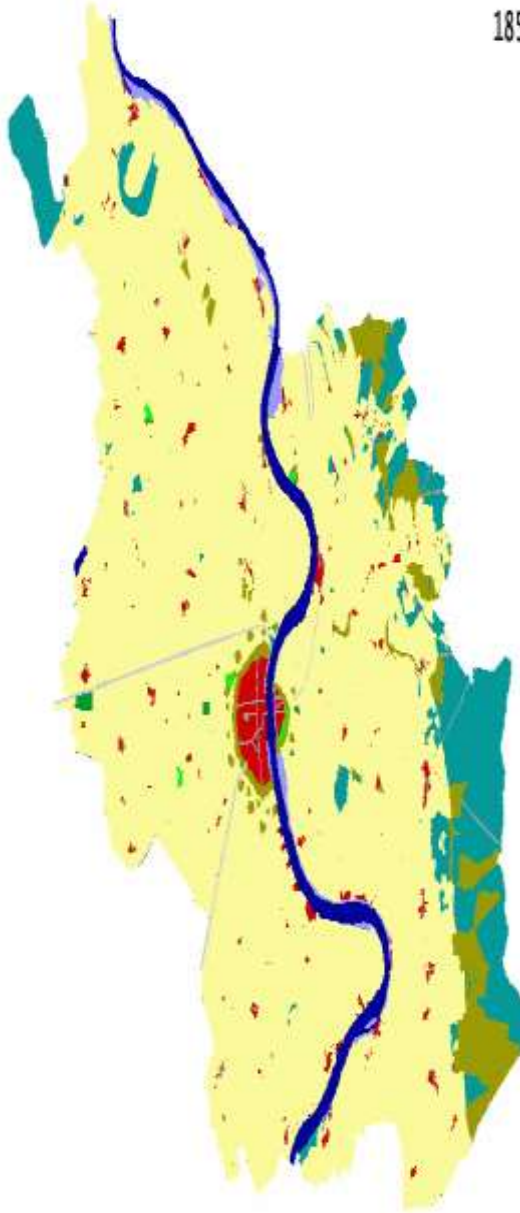


- Initial investigation using Hyperspectral images from Google Earth gave a broader understanding of the changes on the surface due to illicit mining activities
- High Cloud cover in the study region was a limitation, it however did not distort the results of the study

Visual Analysis

- Urban Lands- This refers to parts of the landscape altered by human activity.
- Primary Vegetation- This refers to dense forested lands.
- Secondary Vegetation- This refers to scattered trees, shrubs, farmlands and grasslands
- Bare Lands- This refers to exposed land surface, rocks and soil
- Water Bodies- This refers to all flowing water sources in the study area

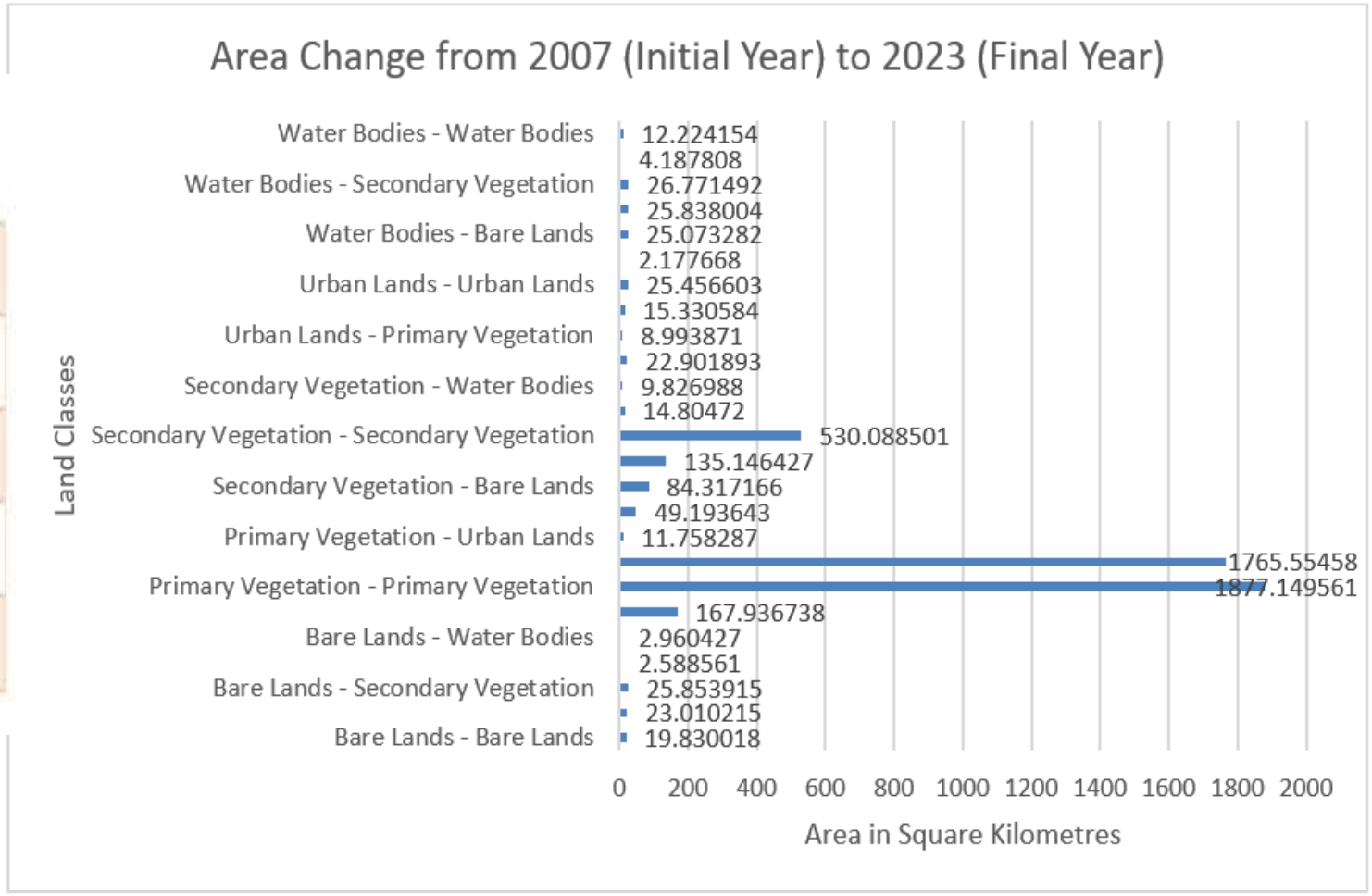


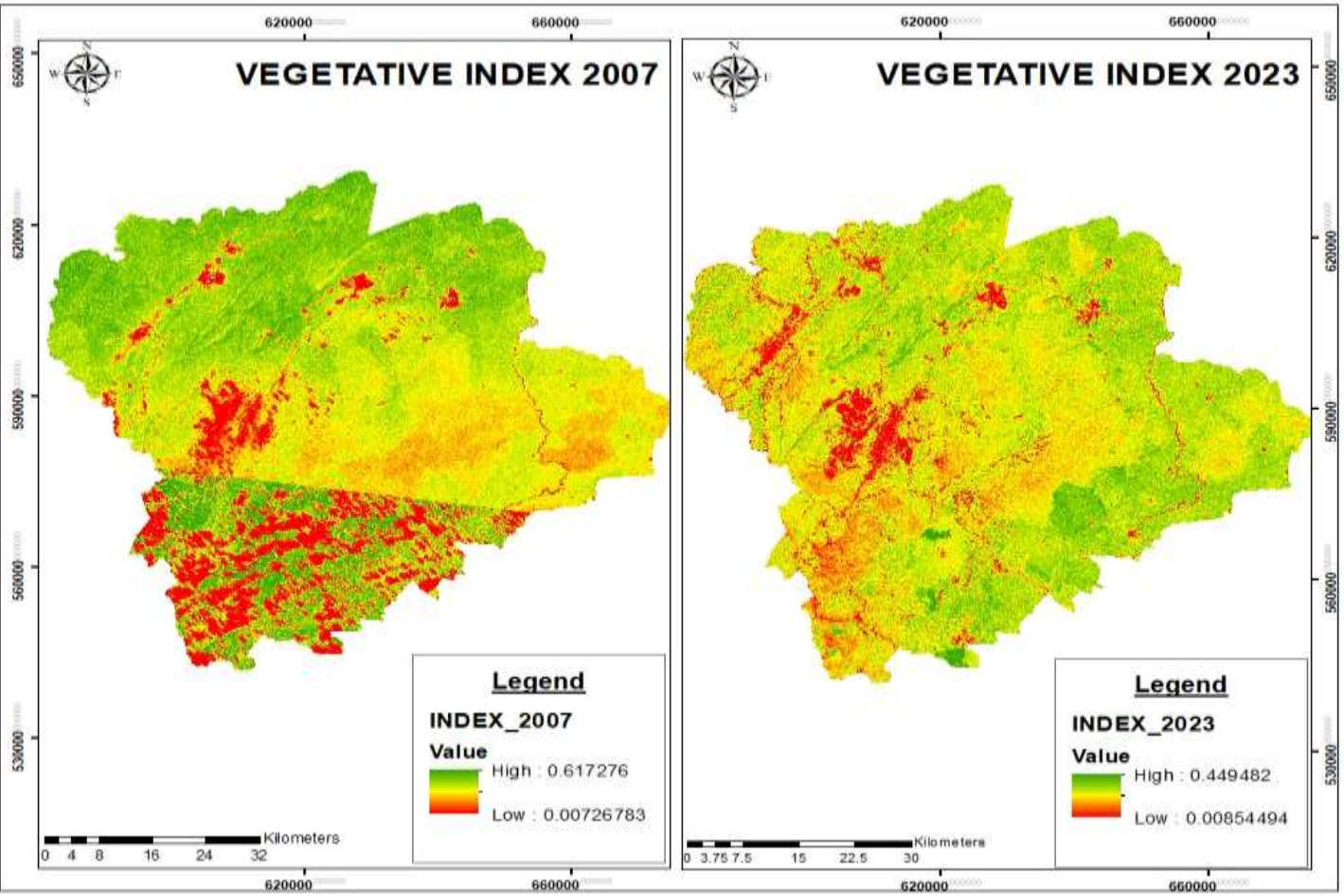


- Examining the LULC alterations from 2007 to 2023 in Figure above reveals a distinct decline in primary vegetated lands.
- This is cause for concern because, as of 2010, 75% of the region's land was located within Ghana's forest zone.
- Interviewing key stakeholders in issues related to "Galamsey," they attributed this rapid conversion of primary vegetation to mining activities in which individuals degrade forested lands ir search of valuable minerals

Change Detection Analysis

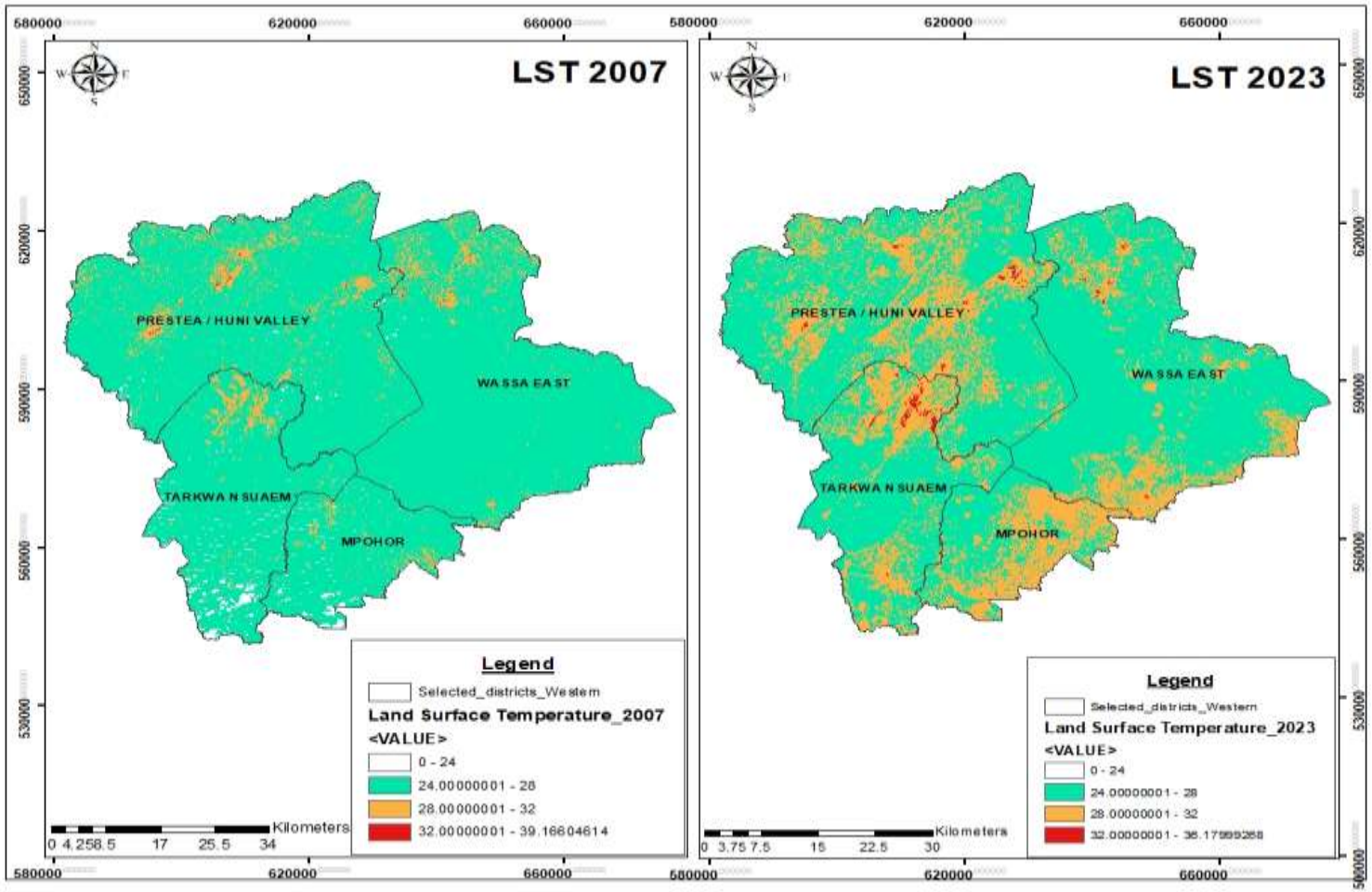
Land Cover	2007 (sq. km)	2023 (sq. km)	Percentage Change
Bare Lands	74.3	320.2	76.8%
Primary Vegetation	3,872.3	2,070.4	-87%
Secondary Vegetation	774.4	2,364.1	67.2%
Urban Lands	74.9	58.8	-27.4
Water Bodies	94.1	76.5	-23.1%





Vegetative Index

- NDVI values ranges between -1 and +1.
- Negative values or values less than 0.1 indicate a lack of vegetation
- Values between 0.2 and 0.5 may be induced by sparse vegetation
- The highest vegetative index registered in 2023 was 0.45 indicating the presence of moderately healthy plants.

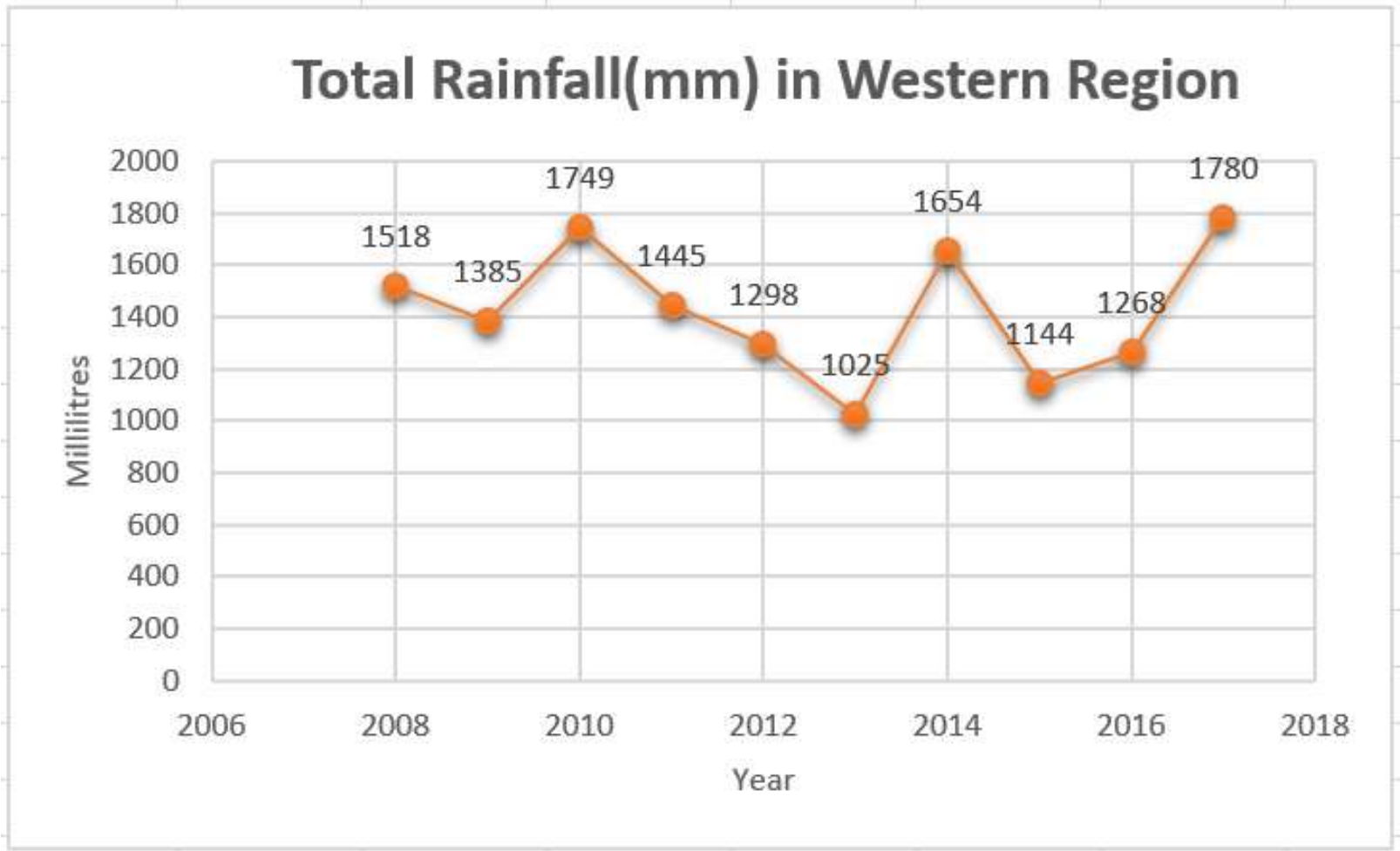


Land Surface Temperature (LST)

An average increase of 4^{0C} in LST from 2007 to 2023 is cause for alarm in the context of global warming and climate change

- The available data showed a weak relationship between LULC shifts and the related surface temperature shifts.

- This may, however, be because too little is known at this time to make any firm conclusions



Predicting Future Changes

- Kappa index accuracy also indicated very excellent agreement of the selected periods, and the overall accuracy for each period was above 80%, indicating extremely good precision of the analysis in LULU

- Using the CA Markov Model, it predicts that every 16 years without the proper safeguards in place, primary vegetated areas is anticipated to decrease by 31.5%.

Summary & Conclusions

Illegal mining activities in Ghana has clearly resulted in rapid environmental degradation

Remote sensing technologies and geospatial tools provide the requisite tools to monitor and take the necessary measures to curtail the problem

- After examining the results of mining activity in the area over a 16-year period, the analysis of these changes revealed that 87% of primary vegetated areas had been altered.
- Predictive analysis also revealed that every 16 years without the proper safeguards in place, vegetation is anticipated to decrease by 31.5%.

Recommendations

Although the government is putting measures in place, there is much more to be done. This includes;

- Constantly identify areas most vulnerable to illegal mining through geo-spatial information
- Invest in the acquisition of cloud-free multispectral images in order to frequently monitor the changes on the land caused by mining
- Formal registration process for artisanal miners should made available, intense education is needed to the general public.
- Alternate jobs in mining communities
- Mining corporations can lessen their influence on the environment by switching to innovative and low-impact mining methods
- Rehabilitation of former mining sites can aid in promoting environmental sustainability.


Thank you!