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Deforestation in Ghana: Evidence from selected Forest Reserves across six ecological zones.

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Abstract**—** *It is an undeniable fact that the forest resources of Ghana are ever depleting. This has however been given little attention in action, though a lot of consultations have been done according to literature. This study reviewed literature on the causes and effects of deforestation. Evidence from literature was supported with images of selected forest reserves across six (6) ecological zones in the country, thus Sudan Savannah Zone, Guinea Savannah Zone, Transitional Zone, Semi-deciduous Zone, Rain Forest Zone and Coastal Savannah Zone. Results reveal that, between the late 20th century and2020, all ecological zones have seen significant depletion of forest cover. Causes and effects of these has however been highlighted in this paper. It is much evident that the reserves in the drier ecological zones were the most affected. The Gbelle Game Reserve lost an approximate 56,049.67 ha of forest cover whiles the Ankasa National Park in the Rain Forest Zone lost an approximate forest cover of 1,792.90 ha between 1990 and 2020. It is recommended that forest protection policies in the Ghanabe strictly implemented and enforced to curb the entry and destruction of the forest reserves and forest cover, thus supporting the SDG 13 (Climate Action).*

Keywords**— Deforestation, Forest Reserves, Ghana's forests, Climate change, Forest cover.**

I. INTRODUCTION

The tropical rainforest is home to diverse life forms (Kessie, 2020), thus the nickname "lungs of the planet (Kessie, 2020).The worlds forest serves as home to about 13 million distinct species (Kwawuvi *et al.*, 2021). Amongst these are mainly trees and woody perennial that playdiverse roles in the environment (Yiridoe and Nanang, 2020).The destruction of trees (Nunez, 2019),or the permanent change in the use of the forest for other purposes is continually on the rise globally (Kyere-Boateng and Marek, 2021; Zambrano-Monserrate *et al.*, 2018). Though forest generally plays three major roles, thus, ecological, economic and social functions (Dissani*et al.*, 2021), deforestation has rendered the ecosystem functions and biodiversity level of the world forests, facing serious threats (Kyere-Boateng and Marek, 2021). Globally, forests cover about 1/3 of the world's total land area but is ever reducing speedily (Amankwah *et al.*, 2020). Though there have been many conferences and agreements signed to curb the rising levels of forest reduction and conversions, deforestation still persists in almost every country (Amankwah *et al.*, 2020; Oral, 2020).The Reduced Emissions from Deforestation and Forest Degradation, Foster Conservation of Forest Carbon Stock, Sustainable Management of Forests and Enhancement of Forest Carbon Stocks(REDD+) projectin 2005 gave hope to the fight against forest cover loss and carbon accumulation in the atmosphere (Amankwah *et al.*, 2020).

The forest cover in Ghana is an estimated 9.17 m ha, which is nearly 40% of the nation's total land cover (FAO, 2021). The country's forest has been classified into open forest, closed forest and plantation forest according to reports ofBaffoe(2020). Forest resources in Ghana are lost

at a comparatively faster rate than other developing countries (Yiridoe and Nanang, 2020; Afele *et al.*, 2021; Nimo *et al.*, 2021).The reasons for this have been duly evaluated in this paper. Deforestation and its causes in Ghana, have recently been relatively given less attention according to literature (Amoah and Korle, 2020; Asamoah *et al.*, 2020). This has necessitated this study, to bring to light, the current state of selected forest reserves across the country's known ecological zones.

II. MATERIALS AND METHODS

The research took the form of a desk study, where relevant materials till the year 2021 relatingto the topic in focus were reviewed to access the divers, causes, as well as effect of deforestation in Ghana. Data for the various protected areas were derived from Landsat 5 and 8 images in 1990 and 2020. Supervised classification was used to analyse images. Images were classified into two, thus, forest and non-forested areas.In each ecological zone, one protected reserve was selected; Gbelle Game Reserve (Sudan Savannah), Mole National Park (Guinea Savannah), Digya National Park (Transitional Zone), Boin National Park (Semi-deciduous Forest Zone), Ankasa National Park (Rain Forest) and Kalapka Game Protection Reserve (Coastal Savannah) as shown in Figures below.

III. RESULTS AND DISCUSSION

Deforestation

Deforestation, a spreading canker across the globe with Ghana been no exemption is caused by severalfactors categorized into direct or indirect (Quacou, 2016). The direct causes include; agricultural expansion, unsustainable wood extraction (logging and the use of wood for domestic purposes), infrastructural expansion such as road construction, urbanization and mineral exploitation (Tsai *et al.*, 2019). The indirects,on the other hand are poor education on the side of inhabitants, low per capita income which influences poverty rates, and economic hardships which often compel inhabitants of forest reserve fringe communities to degrade its resources for subsistence purposes (Fagaribaet *al*., 2018). The drivers of deforestation vary across the various forest zones in the Ghana based on available livelihood opportunities (Boafo, 2013; Acheamponget *al*., 2014).

Direct causes

1. ***Agricultural Expansion***

According to reports ofCakmak (2002) and Ranganathan *et al.* (2018), it is estimated that the world's population will rise to 10billion people by the year 2050. The United Nations report in 2015, estimated same to a 9.7 billion people by 2050. Surge in population has led to the expansion of farmlands even into reserved areas by farmers to increase output, thus, sustain human existence.The expansion of agricultural land, potentially, is the major cause of deforestation in tropical forests. In Ghana, the agricultural sector employs approximately 60% of the entire population and results in vast land clearing for production as a means of farmer livelihoods (Quacou, 2016). Deforestation is supported by reports of Fagariba *et al.*(2018) and Acheampong *et al.* (2019)who emphasized that agricultural expansion for annual crop farms and tree crop plantations is the highest driver of deforestation in forest reserves. Generally, poor farmers engage in subsistence farming where they occupy patches of the forest floor to grow food for their family's survival (Mohammed, 2014;Quacou, 2016). These farmers cultivate the land until the soil is nutrient exploited and then move to other plots in the forest. Afele *et al.* (2021) reported that, historically, smallholder farmers have encroached into forested areas in a bid to capitalize on fertile forest land to compensate for reduced yields experienced on existing tree crop plantation especially with cocoa production inGhana.

2. ***Unsustainable wood extraction***

Aside agricultural encroachment, another major cause of deforestation is that of wood extraction in forests (Fagaribaet *al*., 2018). "A total of about 249,846 m^3 of timber worth €98.5 million was exported in the first three quarters of 2014 alone", making unsustainable wood exploitation the second major driver of deforestation in Ghana (Forestry Commission, 2016). Attributed to the above mentioned are: the increasing demand for quality wood species in the world market like that of *Dalbergia sissoo*; rosewood tree (Shaban, 2020). Others include the growing global demand for secondary products such as fuel wood and charcoal production, proliferation of chainsaws and small-scale mills and the attractive prices for the wood products outside the country (Forestry Commission, 2016; Agyei *et al.*, 2020). Charcoal production as stated by Chiteculo *et al.* (2018) and Agyei *et al.* (2020) is a major driver of deforestation in Angola and Ghana respectively.

3. Mineral exploitation

According to Boafo *et al.* (2019), weak institutional capacities, poor policies and corruption have led to mining operations in forest reserves. The remaining vestiges of forests reserves in Ghana are under siege from small scale

illegal miners as well as large-scale exploration and production companies (Boafo *et al.*, 2019). About 15 forest reserves have been affected by mining, and an estimated 13,165 hectares of forest reserves are under mining lease. This trend is a major contribution to both diminishing terrestrial carbon sink and the ecological and social functions that forests provide for survival and development (Kwawuvi*et al.*, 2020). A high percentage of mining activities take place in the Bono East, Ahafo, Brong Ahafo, Eastern, Central, Western and Western North Regions which is home to about 70% of Ghana's rainforests (Schueler*et al*., 2011). Mining activities in these areas have led to the destruction of forests and water bodies. This necessitated Operation Vanguard in 2017 (Abdulai, 2017) and another declared operation by the president (Nana Addo Dankwa Akuffo-Addo)in 2021 to clear miners off water bodies and forest reserves(Liege, 2021). Studies of Schueler*et al*. (2011), indicates that surface mining resulted in about 58% deforestation and a substantial 45% loss of farmland within mining concessions in the Western Region of Ghana. Land destruction in the form of excavations for resources is similarly common (Yelpaala, 2004; Aryee*et al*., 2003). In some parts of the country, river banks are mined to a depth of 35 m expanding about 60 m wide, destroying the aquatic ecosystem (Hilson, 2002).

4. Infrastructural Expansion and Urbanization

The ever-growing population of the country has necessitated the expansion of facilities, expansion of cities and towns all in the bid to meet the growing demands of man (Kyere-Boateng and Marek, 2021). These necessary social amnesties see the light of day at the expense of forests (Kwawuvi*et al*., 2021).

Indirect causes

Generally, Poor governance, corruption, low capacity of public forestry agencies, land tenure uncertainties, and inadequate natural resource planning and monitoring are crucial fundamental causes of deforestation and forest degradation (Blaser, 2010).In developing countries like Ghana, factors including poor education, low income, high poverty rates and economic hardships compel forest fringe communities to enter forest reserves for subsistence purposes (Shackleton *et al*., 2011; Fagariba*et al*., 2018). About 90% of African countries dwell directly or indirectly on agriculture and forest products for employment and food security (Neilson *et al*., 2010). According to (YouMatter, 2020), clearing of forests are expected to upsurge in the future due to global urbanization, the current fluctuation in the demand of meat-based diets and increasing population trends. Other stated reasons include, increasing developing country prosperity, the export of primary commodities and increasing demand for timber and also agricultural products in the globalizing economy.

Effects of deforestation

Mainly, adverse effects of deforestation include the following; climate change (Lawrence &Vandecar, 2015; Bennett, 2017; Afele *et al*., 2021), threat to biodiversity (Giam, 2017; Symes *et al*., 2018; Paiva *et al*., 2020), food insecurity (Ajiola and Ilesanmi, 2017; Ngome*et al*., 2019), local people and their livelihood (Agyei *et al.*, 2019; Ekhuemelo *et al.*, 2019) and soil erosion (Khodadadi *et al.*, 2021; Nimo *et al.*, 2021).

Forest and Non-Forest Cover area lost or gained.

From the analysis of images obtained, it was discovered that reserves in the relatively drier ecological zones (Guinea Savannah, Sudan Savannah and the Transitional) were the largest affected between the years 1990 and 2020. As shown in Table 1, these ecological zones lost most forest cover with the highest been that of Gbelle Game Reserve (56, 049.67 ha) and the second highest been Digya National Park, which lost about 7, 451.06 ha of forest cover. Generally, forest cover area lost was least in the Ankasa National Park in the Rain Forest Zone, which lost 1, 792.9 ha of forest cover(Table 1).The reasons for these changes mainly due to anthropogenic activities and climate change effect according to literature.

Table 1: Forest cover area of selected reserves across six ecological zones between the years 1990 and 2020 in Ghana.

Ecological Zone	Protected Area	Forest Area/ha at 1990	Forest Area/ha at 2020	Forest Area lost (-) or gained(+)/ ha
Guinea Savannah	Mole National Park	20, 789.04	14, 500.28	(-) 6, 288.76
Sudan Savannah	Gbelle Game Reserve	62, 922.68	6, 873.01	(-) 56, 049.67
Transitional	Digya National Park	12, 123.06	4, 672.00	(-) 7, 451.06
Semi-deciduous	Boin National Park	28, 082.24	25, 522.50	(-) 2, 559.74
Rain Forest	Ankasa National Park	31, 423.3	29, 630.40	(-) 1, 792.9

Coastal Savannah	Kalakpa Game Protection Reserve	1195.74	468.18	(-) 727.56

(-) = Indicates area lost.

Images of selected forest reserves across six ecological zones in Ghana as at 1990 and 2020.

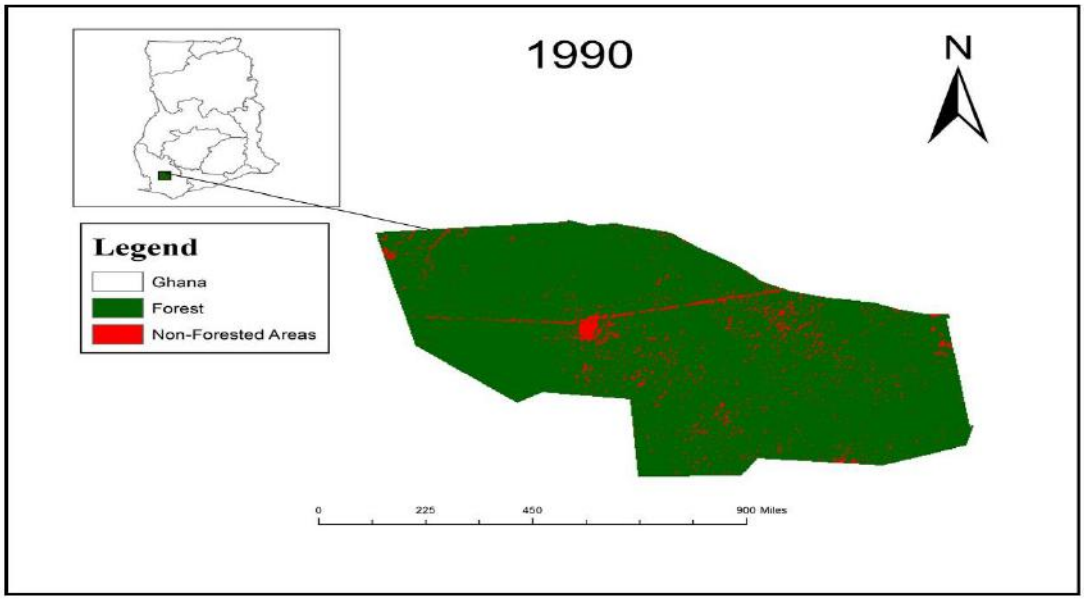

Fig.1a: Image showing Ankasa National Parkin the Rain Forest Zone of Ghana at the year 1990.

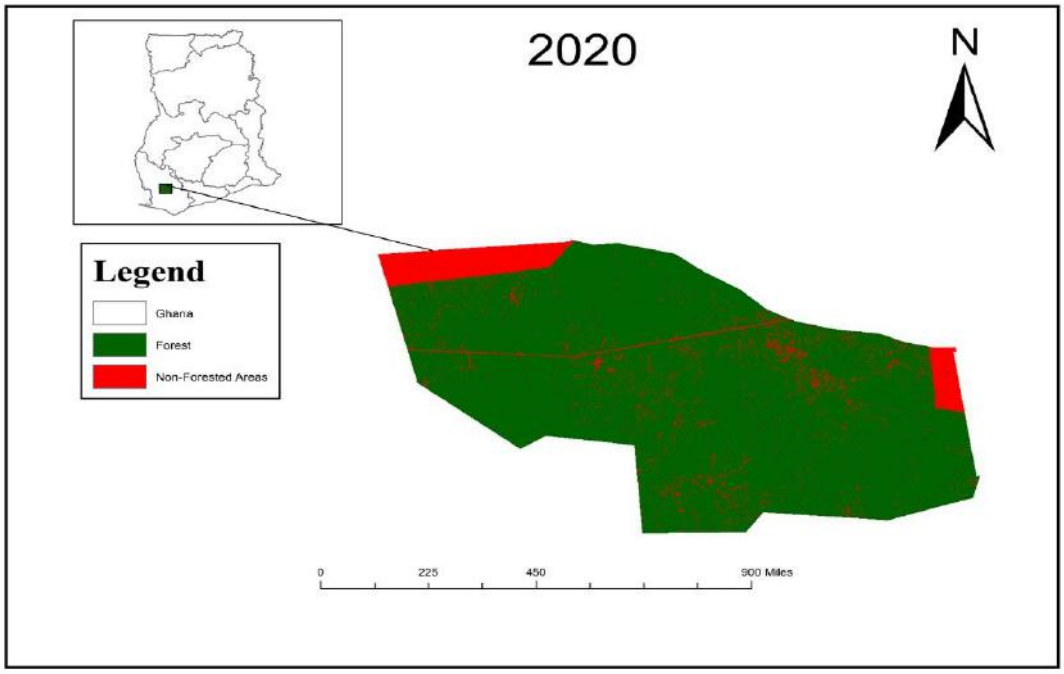

Fig.1b: Image showing Ankasa National Park in the Rain Forest Zone of Ghana at the year 2020.

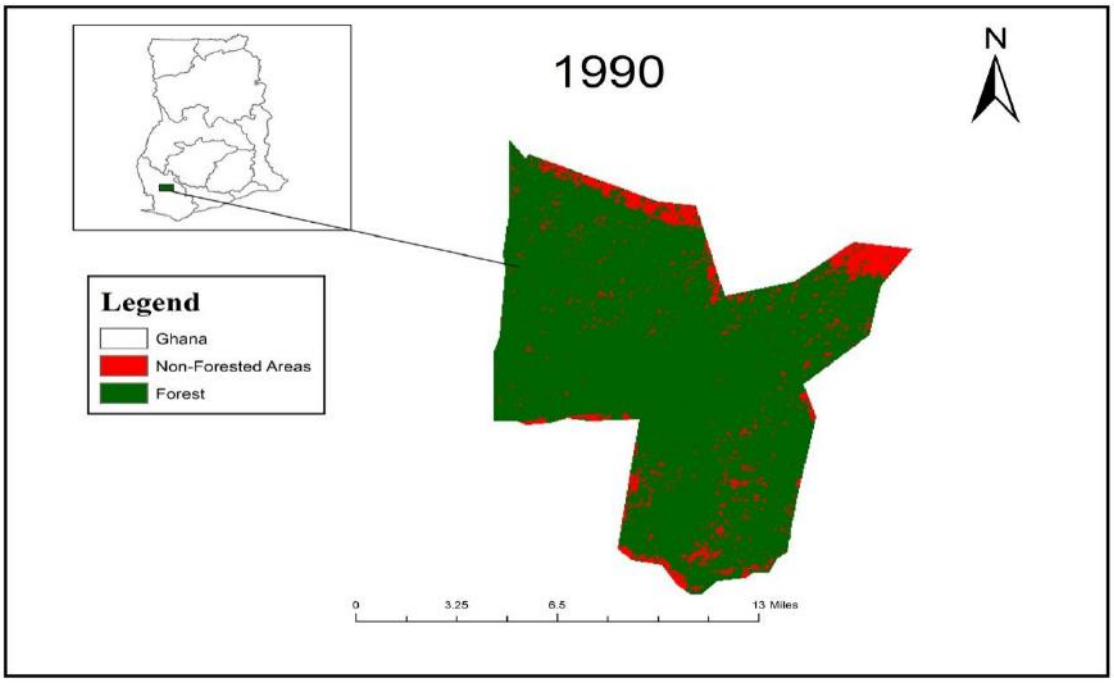

Fig.2a: Image of Boin National Park in the Semi-deciduous Forest Zone of Ghana at the year 1990.

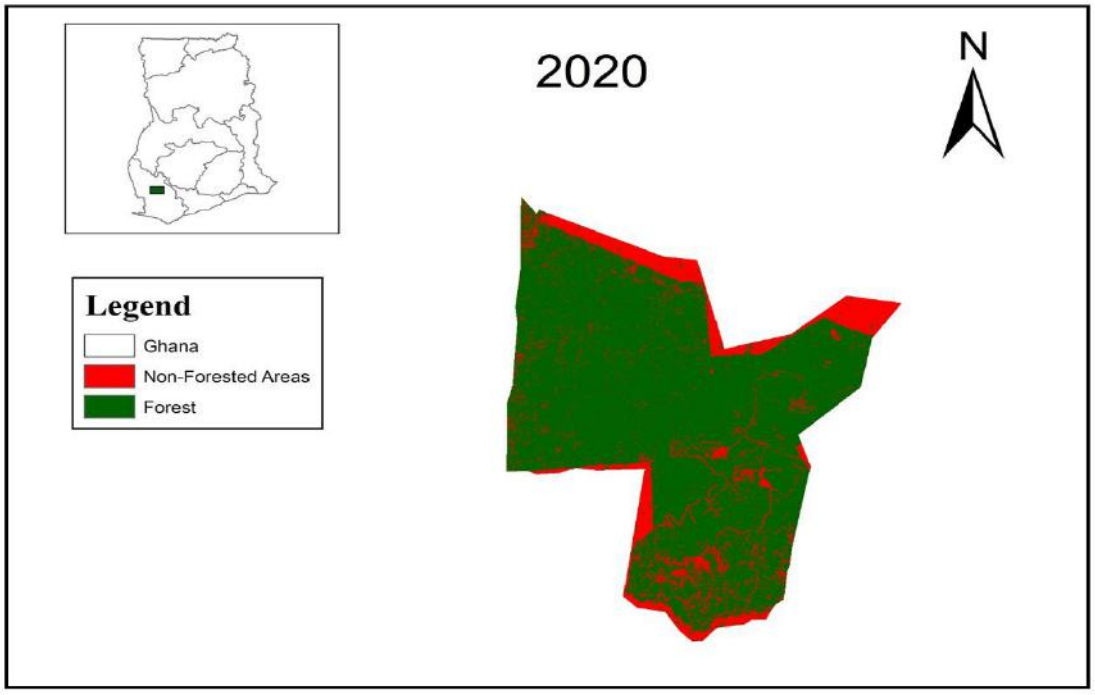

Fig.2b:Image of Boin National Park in the Semi-deciduous Forest Zone of Ghana at the year 2020.

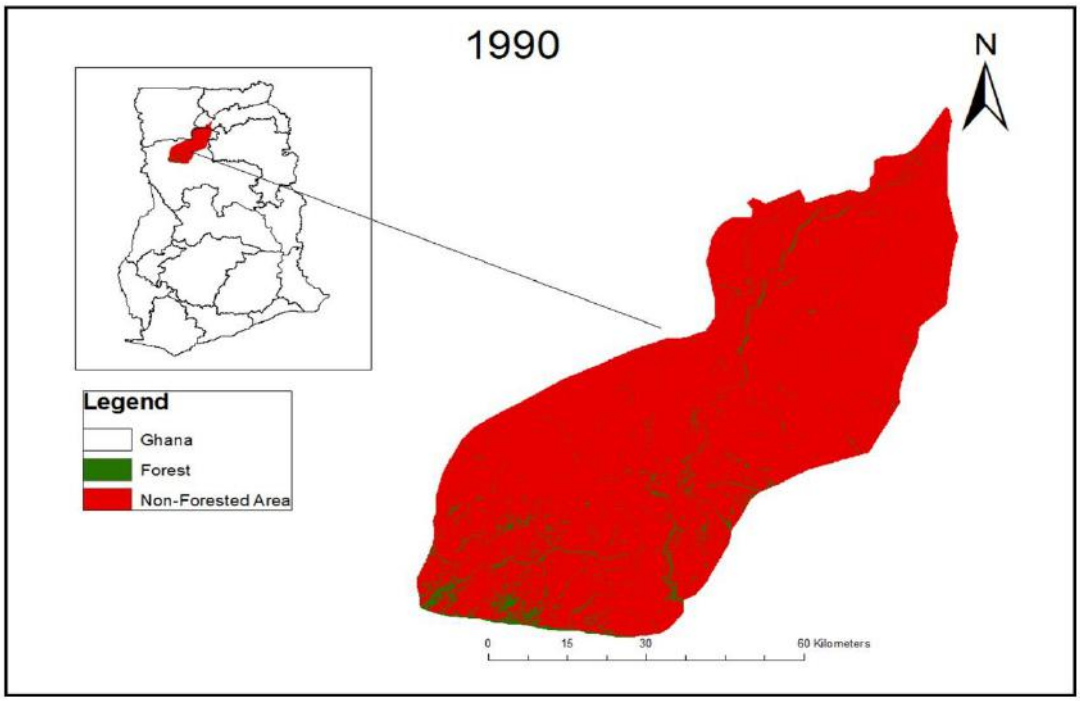

Fig.3a: Image of Mole National Park in the Guinea Savannah Zone of Ghana at the year 1990.

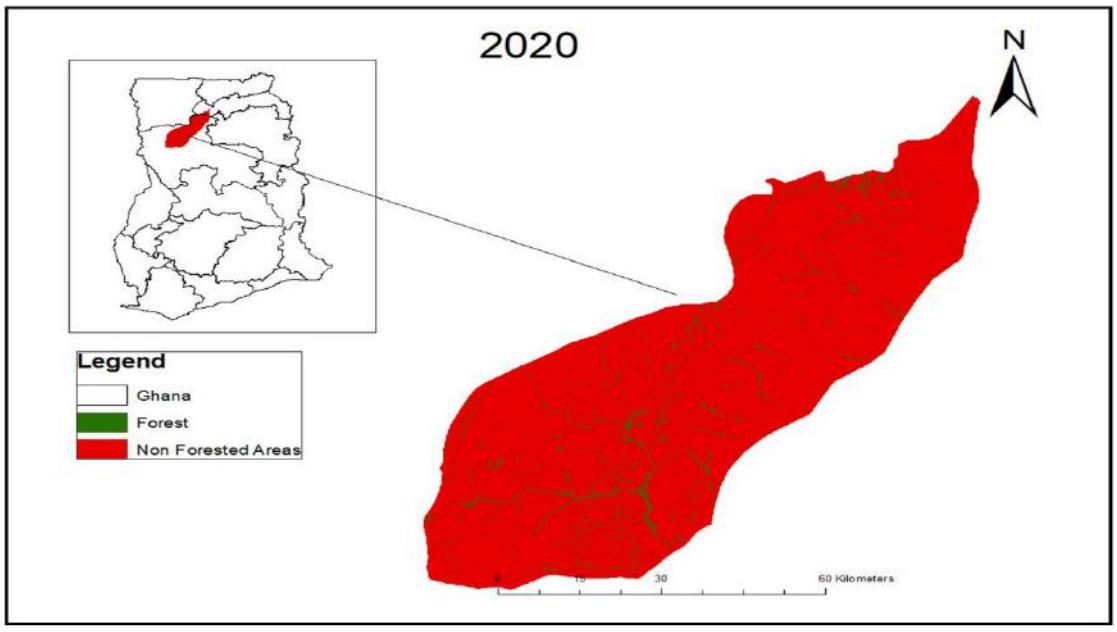

Fig.3b: Image of Mole National Park in the Guinea Savannah Zone of Ghana at the year 2020.

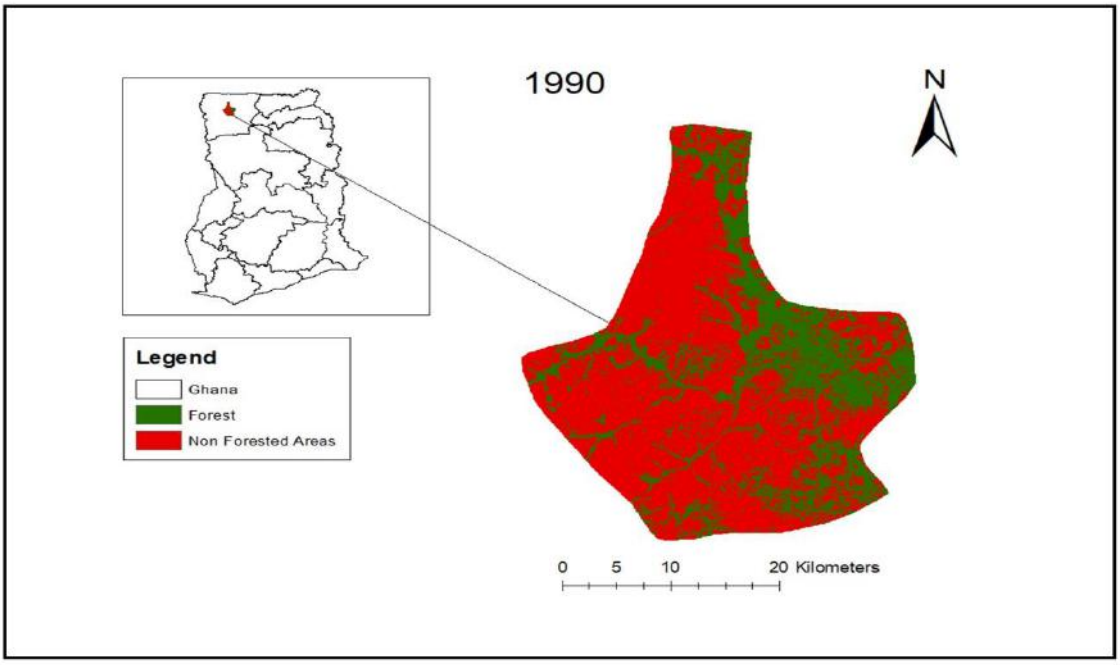

Fig.4a:Image of Gbelle Game Reserve in the Sudan Savannah Zone of Ghana at the year 1990.

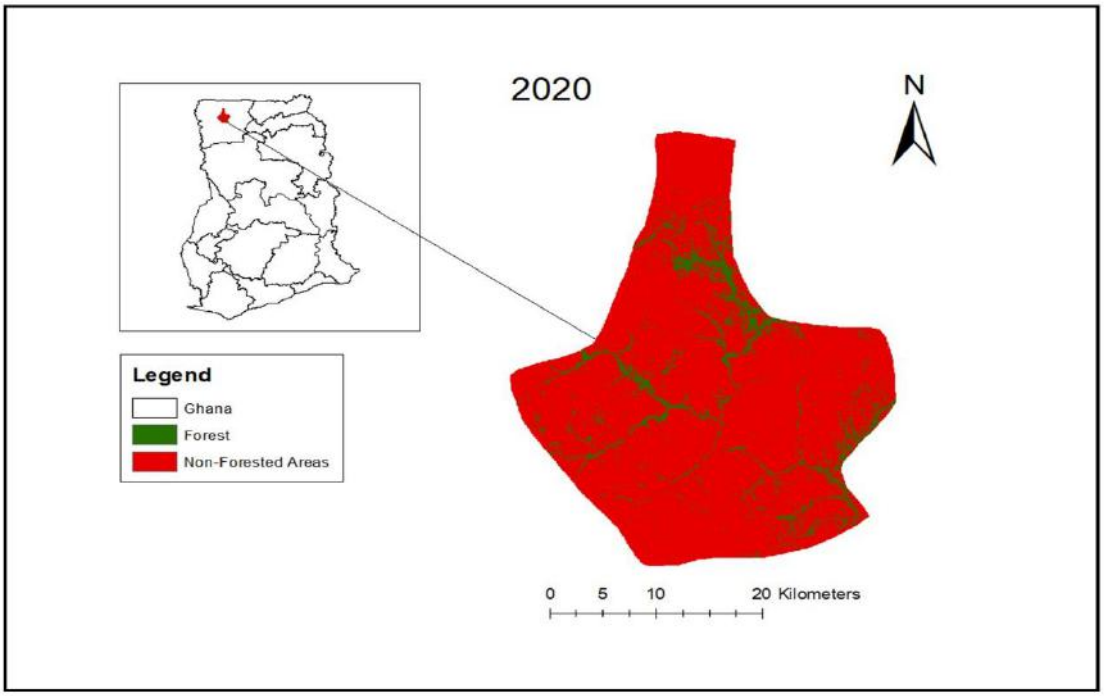

Fig.4b: Image of Gbelle Game Reserve in the Sudan Savannah Zone of Ghana at the year 2020.

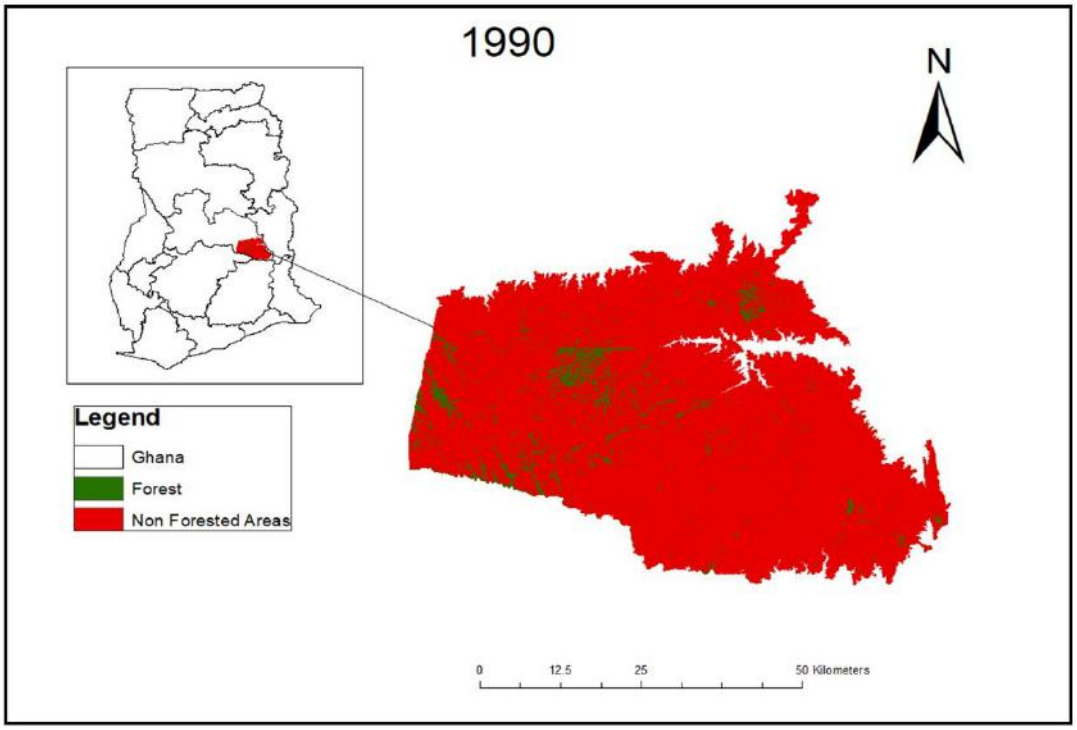

Fig.5a: Image of Digya National Park in the Transitional Zone of Ghana at the year 1990.

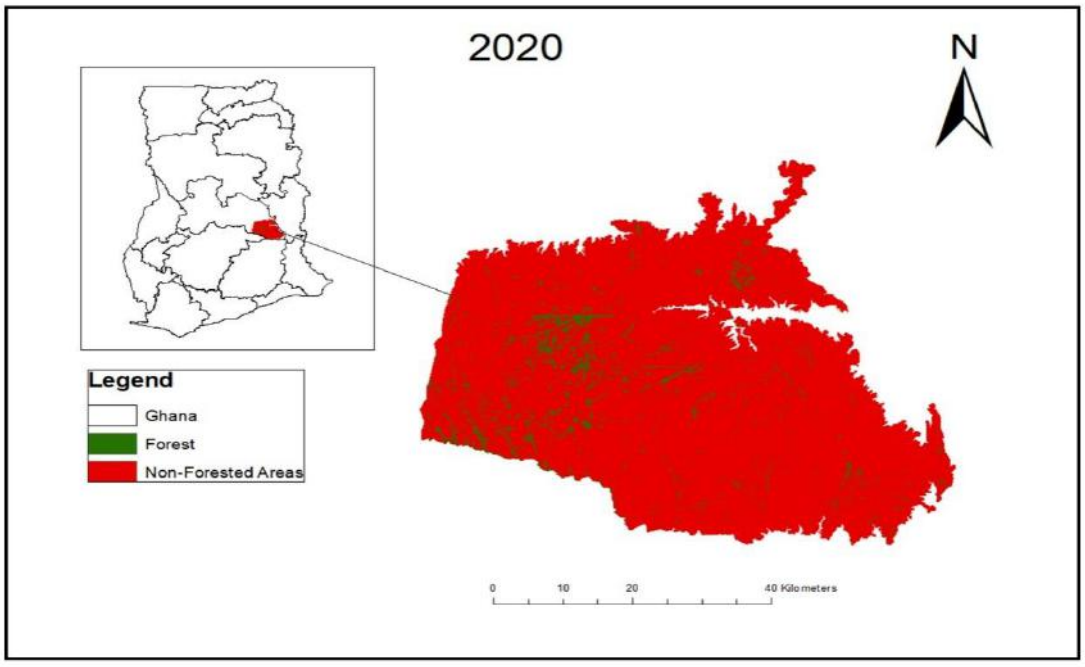

Fig.5b: Image of Digya National Park in the Transitional Zone of Ghana at the year 2020.

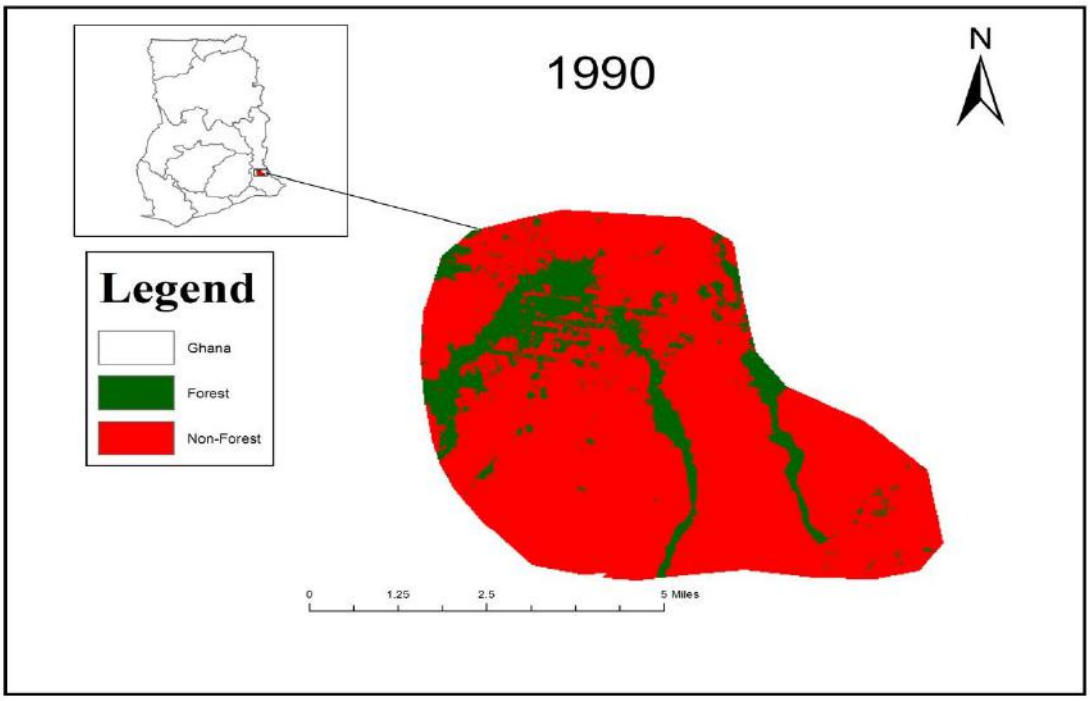

Fig.6a: Image of Kalakpa Game Protection Reserve in the Coastal Savannah Zone of Ghana at the year 1990.

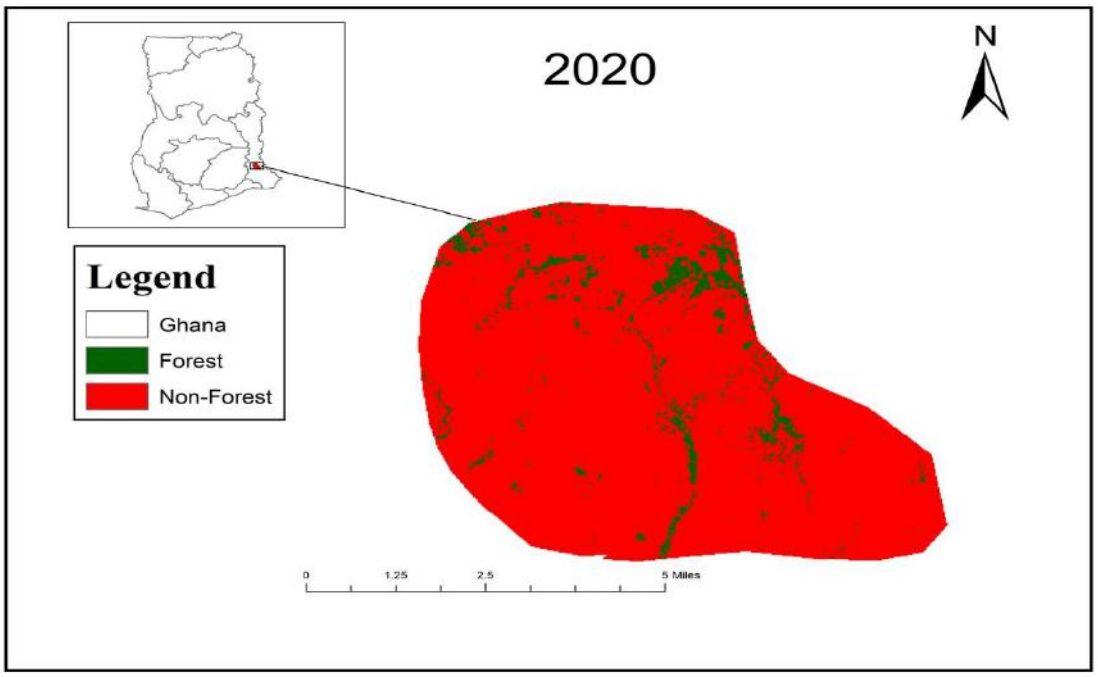

Fig.6b: Image of Kalakpa Game Protection Reserve in the Coastal Savannah Zone of Ghana at the year 2020.

IV. CONCLUSION

From literature and images generated, deforestation in Ghana is on the rise and highest in the dry areas.Though governmental policies have been structured to fight deforestation, it appears other unknown hidden factors are limiting the success of these policies. Data on forest area lost was negative (-) for all selected protected areas across the country, and the reverse (+) for non-forest areas. This gives an indication that deforestation is ever increasing and it is recommended that it be given quick and effective

attention to curb the rise.Also, enforcement of forest laws should be much implemented to reduce deforestation rates in Ghana.

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