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Gendered Activities and Vegetation Change: A Study of Vegetation of Bunkpurugu-Yunyoo District

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Abstract

This paper looks at the change in the vegetation cover in Bunkpurugu-Yunyoo District in the Northern Region of Ghana as contributed to by gendered domestic economic activities. The study became necessary due to the increasing dependence on the biodiversity for fuel wood (mainly), timber and livestock grazing, amidst persistent bush burning in the district. The study adopted Remote Sensing and GIS technologies for the determination of the changes in vegetation. It considered 2000 and 2015 as base and current years respectively for the determination of the change. Specifically, it used ArcGIS, ENVI and NDVI software to process the LandSat 7 images it acquired from the study area. The study sought to determine the nature of vegetation of the area in each of the years, determine the extent of change and explain the possible drivers to the change. The results showed that vegetation decreased inversely with the increases in settlement, bare land, and burnt land sizes. The main drivers of the change were identified as human related – gendered roles of women, urbanization and drive for development. It concluded that the vegetation of Bunkpurugu-Yunyoo District detected at 25% is rather a drastic change, given the short time period of six years.

Keywords: Change detection, Pixel, Bunkpurugu-Yunyoo, Gendered roles.

1. Introduction

Several studies have looked into the causes of environmental degradation at the world level, in Africa, and in Ghana. Some studies have even narrowed their scope to livelihood pursuits the play leading roles in depleting the biodiversity in sub-Saharan Africa, specifically, northern Ghana (Agyeman et al, 2012). The framework for biodiversity preservation and sustainability by the United Nations recognizes the real value of biodiversity and ecosystems to the survival of societies worldwide. These are “in relation to secure livelihoods, food, water and health, enhanced resilience, conservation of threatened species and their habitats, and increased carbon storage and sequestration” (Grynspan, 2012). It therefore, calls for countries and civil societies to innovate and draw on the potential of nature for the achievement of multiple survival needs of households. Juxtaposing the contributions of biodiversity to human sustenance, the impact of human activities on the environment cannot just be ignored for a moment. Humans could just maintain the environment the way they see it if not protect and improve upon its state, reciprocally.

1.1 Local Gin (Pito) Business and Biodiversity

Aside overgrazing by large herds of kraals, which cause depletion of large tracks of lands elsewhere (Fryxell and Sinclair, 1988), households in Bunkpurugu-Yunyoo district engage in cutting and selling firewood to support their income needs. This form of forest tree depletion constitutes the prevalent commercial activity of women in the district. Fuelwood use is the most dominant factor in the commercial activities of the women in Ghana, especially, the three northern regions (Agyeman et al, 2012). Pito is a known business for women of the three northern regions (Demuyakor & Ohta, 1992: Sefa-Dedeh et al, 1999: Glover et al, 2005). For instance, almost every woman in the study district, except the Muslims, brews or has brewed the local gin (pito) for commercial purposes before. This gender specific business survives on wood and water as main inputs, aside the guinea corn grains. Several piles of wood are required to keep the business going. Juxtaposing the population of women in the district and the consumption of fuelwood per head for both domestic and commercial use, then it is a good guess that there is no future for biodiversity and livelihoods in the district.
Pito is a delicacy drink for almost everybody in the area. It has its fermented and unfermented forms. It is made from millet, guinea corn or maize grains. Almost every household is engaged in this commercial business. It takes three days to complete a process of the local gin brewing. The brewing starts in the evening when the floor

of guinea corn is soaked in water and boiled for several hours until it is fully cooked. The content is fetched into earthenware pots and fermented till the following morning. It is again boiled mildly before sieving the mush out. The sieved liquid content is then put on fire to boil almost the whole day for the water content of it to evaporate. By evening the gin is partially ready, unfermented. At this time, it taste like Guinness malt drink. Mostly, people do not like it without fermentation. It is then fermented from midnight by adding yeast to it. By the following day, the third day, it is ready for use. The essence of this narrative is to drive home the amount of fuelwood and water required in a single process and in the entire process of gin production.

1.2 Tradition and Forest Conservation

The expressed cultures of societies in Ghana reinforce biodiversity depletion by the resources that are made requisite for celebrations at gatherings. The traditional norms and values of northern Ghana, as in marriage, funeral and other festival rites call for brewing of Pito in larger quantities. There is also a popular patronage at gatherings and most other celebrations across Ghana. The way of life of the people as in this regards is fulfilled with a cost on biodiversity, unless alternative power sources are found.

However, cultural traditions are capable of solving vegetation conservation challenges that defy legislative checks (Abbo et al. 2010). If societies get effective conservative leaders, there could be positive changes towards forest preservation (Fullan 2002). The district is blessed with streams of varying lengths, depths and sizes as well as quality of water, especially in the raining seasons. This water resource stand greater risks of extinction, if this deliberate acts of humans are allowed to combine forces with the inevitable emergence of climate change. Trees that formed boundaries and provided canopies over the water bodies have not been spared by these activities. According to the traditional leaders, the activities of the timber contractors and fuelwood suppliers have continued despite their continuous warnings and threats of sanctions. They only succeeded in imposing and enforcing bylaws on the surrounding vegetation and are monitoring their conservation. Narrating further, they showed evidence of protected areas around their communities where even roots of shrubs were uprooted for fuelwood. Upon the institution of the bylaws, the areas have grown into thicker growths. Communities like Jilik, Kombatiak, Bimbagu, Najon No. 2 and others have evidences of pockets of these growths.

1.3 Seasonal Fires and Vegetation Depletion

Fire is a known cause of vegetation depletion (Rogan and Yool, 2001). The build-up of any amount of organic matter is constrained by regular burning of crop residues after harvesting (Nopharatana et al. 2007: Farming Futures, 2009). Residents engage in communal hunting that is always characterized by bush burnings seasonally. However, the major cause of vegetation depletion in the district has links with human subsistence. The increasing use of trees for fuel, animal feed or building purposes without replanting those paints a blur future for human survival. For instance, residential roofing materials are largely thatch materials from grass and wood. Due to lack of community-government collaboration in the management and control of reserves and off-reserve forests as was stipulated in the 1994 forest act (Act 493 of 1992 republican constitution of Ghana), the area is gradually losing the remains of the savanna vegetation and in its place, an encroaching desert vegetation conditions. This is very threatening to life and is likely to pose several risks to livelihoods in the district.

1.4 Focus and limitations

Generally the study examined and described the extent of change in the vegetation cover within Bunkpurugu-Yunyoo District. Specifically, the study sought to use Remote Sensing software to identify the state of the vegetation in the Bunkpurugu-Yunyoo district between 2000 and 2015. It further determined the extent of change in the vegetation in the Bunkpurugu-Yunyoo district within the specified time period explained the contributory factors for the change in vegetation cover within the specified environment.

The study was of the view that findings of this paper will serve a multipurpose function in the resource management and conservation in the district, and the entire country in general. It highlighted the extent of damage caused to the vegetation in the area and pointed out the likely causal factors to inform intervention actions in the area.

This study is delineated to the Bunkpurugu-Yunyoo district of the northern region of Ghana. It further focused on the Bunkpurugu township and other areas stretching to Nakpanduri area. It looks at the variation in the vegetation cover of the area in question as is influenced likely by livelihood drive of the households and any other driver like settlement and bush burning. Data for the study is limited to the satellite images of 2000 and 2015 (LandSat 7). It relies on the Landsat 7 images derived from the thematic Mapper data of 2000 and 2015 on the Bunkpurugu-Yunyoo district for the analysis and determination of the changes in vegetation cover for the

area.
Some limitations with the study were that, it did not include the opinions and viewpoints of the people of the area as to the contributions of other drivers to the prevalence of the menace. The pictures of images could be limited in telling the actual story as to the real change in vegetation cover and causes to the change. The processes leading to the capture of the images were very tedious, and so the study had to engage the services of personnel from the Department of Geography, University of Ghana.

2. Change detection

Studies have indicated that the world's biodiversity is in a constant decline yearly (Coppin and Bauer, 1996). The change in the vegetative cover needs regular monitoring using the multispectral satellite derived data. Regular monitoring will help detect, identify and map changes in the vegetation cover (Coppin and Bauer, 1996). Change detection is the process of identifying differences in the state of an object or phenomenon by observing it at different times (Singh 1989), cited in (Xiaodong, 2006). Technological resources like the aerial photographs and LandSat together with others have aided the works of forest managers and security operatives in detecting and monitoring events across space. The advent of aerial photographs in the 1930s and LandSat-1 in 1972 (Coppin and Bauer, 1996) made it possible to study trends in vegetation variability as well as crop infestation. These helped to administer remedies at appropriate times.

2. 1 Remote Sensing and GIS and Change Detection

Change detection involves the application of multi-temporal datasets to quantitatively analyze the temporal effects of the phenomenon. The adoption of these technologies has the tendency to providing advanced data on impending or eminent trends that may negatively impact on the environment (Coppin and Bauer, 1996). It also helps to provide suggested remedies of curbing the menace (Barker 2007).
The theory and use of Remote Sensing for vegetation damage assessment are summarized very well in papers by Murtha (1978) and Heller (1978). Many studies have relied on these softwares to discuss land cover and land use changes in arid, semi-arid and agricultural productive land. Literature reveals several studies on land use change in African semi-arid areas and also agricultural lands with remote sensing and GIS tools (Change & Change 2010). Studies have therefore demonstrated the effectiveness of Landsat images in the studies of change detection over the years now. Likewise, some studies by Lambin and Ehrlich (1996) sought to assess and analyse land cover changes in African continent within the period 1982 and 1991 with the conviction that the use of a variety of normalized difference vegetation indices data (NDVI) are capable of detecting vegetation change. This study detected a continual one-way pattern of change process which on about 4% of the lands around the sub-Saharan regions of Africa (Lambin, & Ehrlich, 1997).
Aerial photographs are also useful in the study of land cover change, as was used by Rembold, et al, (2000) in the study of Lake Region of Central and Southern Ethiopia. In furtherance, the study by Rembold, et al, (2000) pointed out that the biodiversity of a place is a factor of the vegetation and socio-economic characteristics the region. Thematic mapper data from the Landsat 5 images are very effective for the study of changes in vegetation, explaining its adoption by Rembold and others from 1972 to 1994 (Rembold et al, 2000). The review also show that "Palmer and Van Rooyen (1998) used Landsat TM data to explore the impacts of land management policies on vegetation structure in two study areas in southern Kalahari desert in South Africa in the period 1989–1994".

2.2 Gendered Livelihood Strategies and Vegetation Depletion

Gender connotes the relations between men and women in roles as a perceptual construct of a society (FAO, 1997: cited in Ogato et al, 2009). The study by FAO (1997) observed that the perceptive gender relations vary across societies and cultures, classes, ages and during different periods in history. Gender has also been explained as a socially and culturally constructed and assigned attribute, traits and roles expected of a male or female as active members of a society (Ogato et al, 2009). Gender issues are crucial in the consideration of rural poverty, for women are particularly at risk of being poor. FAO (1997) pointed out that gender is not determined biologically, as a result of sexual characteristics of either women or men, but is constructed socially. It therefore sees it as a central organizing principle of societies, which often governs the processes of production and reproduction, consumption and distribution' (FAO, 1997). From the FAO's definition, gender issues focus on women and on the relationship between men and women, their roles, access to and control of resources, division of labour, interests and needs. .
Gendered roles can be explained as socially constructed traits, behaviors and attitudes expected of male and

female members of a society. Pito business is one of the most dominant livelihood strategies for women in all the three northern regions of Ghana. Gender-specific roles and responsibilities are often conditioned by household structure, access to resources, specific impacts of the global economy, and other locally relevant factors such as ecological conditions (FAO, 1997). These roles define the livelihood strategies and activities of women, which are largely natural resource based. According to Benshoff and Griffin (2011), the stereotypical gender roles are enforced within the societies through movies, books, magazines, video games and advertisements. The 2010 population and housing census reports that the majority of rural women rely on land and its resources, especially forest resources for their livelihood sustenance (GSS, 2010).

As it is the case for many developing regions, most people in the study area depend on crops and livestock for their livelihood, and rely on nearby forests (including National Park forests) for thatch, reeds, fodder, fuelwood, timber, and other products to support their agricultural lifestyles (Sharma 1990). The approaches that humanity adopts in search for solutions to life challenges are in most cases the problem to the environment (Bearer et al. 2008). United Nation Food and Agricultural Organization (FAO) estimates that if the destructions on rain forests continues unabated, the forests will be completely removed by 2050, with Africa losing about 50% of its rain forests (Turner et al, 2003). Studies also show that fires are destructive to agriculture land; fodder intended to feed the domestic animals as well as biodiversity (Rogan and Yool, 2001).

2.3 Biodiversity and Energy Supply

Fuel wood as source of household and commercial energy supply presents worries of widespread nature. Studies show that several households in African rely heavily on wood products for their energy needs. According to Turner et al, (2003), more than half of the earth's original rain forests are gone, cleared for pasture, timber, fuel wood, and farming. This over dependence on forest for fuel requirement has frustrated several measures of seeking solutions to depletion of biodiversity (Kituyi, 2002; Mwampamba, 2007). Domestic use of energy accounts for most of the energy deficits in the urban centres (Ghana Statistical Service, 2014) that tend to provide effective market, and fuel wood is the most frequently used (DFID, 2002). Available documentations estimate that over 90% of the people in Africa depend on either firewood or charcoal for cooking, while a few depend on other heat applications (Kituyi, 2002; Temu, 2002 cited in Erakhrumen et al., 2010: Erakhrumen, 2008).

Mwampamba (2007) was much particular of the impact of charcoal production on the environment. In many parts of Africa the natural resource base is over exploited because of extreme poverty (Carter and May, 1999). Most households in the sub-Saharan Africa depend on sale of fuelwood for household incomes in rural Ghana (GSS, 2014). A study conducted in the Upper West Region on 500 commercial charcoal producers and 50 charcoal buyers indicated that wood products constitute the main livelihood sources as well as income generation ventures (Agyeman et al, 2012).

2.4 Conceptual Framework

The study adopted a framework by Kinkeldey, (2014) to guide the study in very smooth and sequential flow. This framework was used to inform change detection and analysis using geovisualization. This framework was judged effective and efficient for its simplicity and ease of use.

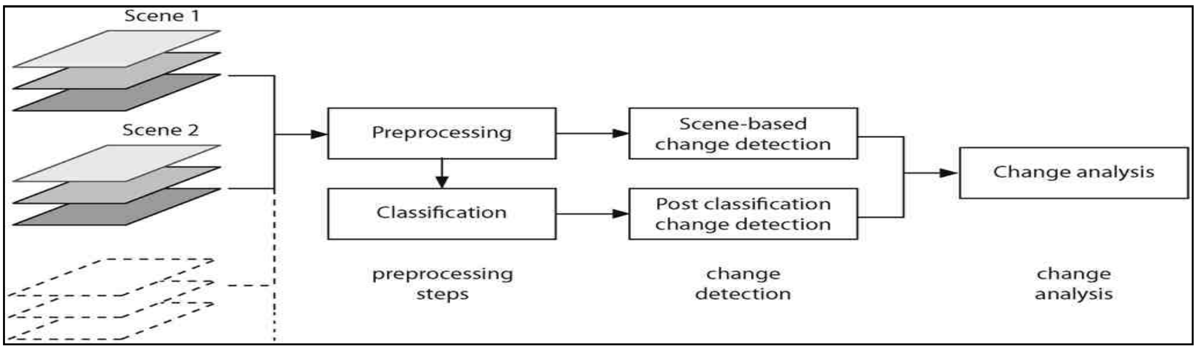

Figure 1: Conceptual Framework on Change Detection (Kinkeldey, C. 2014)

Framework indicates the primary tasks of data acquisition using LandSat 7 images from Thematic Mapper Data of 2000 and 2015. These data are initially processed to get rid of distortions like noise, haze or any other obstacle that might not be relevant in the data. From the framework, this initial operation can be used to detect some changes in the vegetation since the images can be analyzed visually. On the other hand, the pre-processed data is taken through another round of processing operations. The images are classified and taken though post-classification operations to actually detect the change involved. In the case of this study, the post classification operations included the statistical calculation of change detection using both the ENVI and ArcGIS softwares (see data analysis).

3.1 The Study Area

Bunkpurugu Yunyoo District is one of the 26 districts in the Northern region. It was established by Legislative Instrument (LI) 1748 in August 2004 as part of the government's efforts to further decentralize governance. The district is located in the north-eastern corner of Northern Region. It shares boundaries with Garu-Tempane district to the west, the Republic of Togo to the north and east. It is bordered to the south-west by East Mamprusi district, and to the South by Gushegu district and Chereponi District to the south-east. The district has an estimated total land size of 1,257.1square kilometers which is 2% of the land size of northern region.

3.1.1 Physical Features and Climate

The District occupies an area of 1,257.1 square kilometers with a population density (crude) of approximately 98 persons per square kilometers. The District experiences a single rainfall regime in April to October after which it comes under the influence of the tropical continental air masses (the harmattan). The mean annual rainfall is between 100mm to 115mm. The annual range of temperature is between 30°C to 40°C. The landscape is generally gently rolling with the Nakpanduri (formerly, Gambaga) escarpment marking the northern limits of the White Volta tributary in sandstone Basin. Apart from the mountainous areas bordering the escarpment, there are very little run-offs when it rains. This implies that for a greater part of the District rainwater seeps into the ground (GSS, 2010).

3.1.2 Soil, Drainage and Vegetation

Two main types of soils are found in the district. These are the Savannah Ochrosols and the ground water literates. The Savannah Ochrosols, which covers almost the entire district, is moderately well drained up land solids developed mainly on Voltain Sandstone. The texture of the surface soil is sandy-loam with good water retention for crop use. Savannah Ochrosols has high potential for wide range of crops. Some areas do not appear to be fully utilized although they are under considerable pressure in the district.
The White Volta enters the District from the north-east and more or less serve as the boundary between the District and the Garu/Tempane District. The Nawonga and Moba rivers also drain through the south – western part. The District lies in the interior woodland savannah belt and has common grass vegetation with trees such as sheanut trees, baobab, and acacia. There is a strip of forest belt along the escarpment and its valleys through to the Republic of Togo. This used to attract animals like elephants from the game reserves (Dapaongue Forest Reserve) in the Republic of Togo. Grasses grow in tussocks and can reach a height of 3 meters or more.

Figure 2: Bunkpurugu Yunyoo District

3.2 Research Design

The study adopted a cross-correlation Analysis as a design for the study of change detection. Cross-correlation Analysis is a change detection method that measures the differences between a past land cover image and a recent land cover image (Koeln & Bissonnette, 2000). This method is good at eliminating the problems associated with radiometric and phenological differences that are so readily experienced when performing change detection (Blaschke T., 2010). According to Blaschke, this mixed-method for land use change is very appropriate, and that no single technique is best suited for vegetation change detection.

3.3 Techniques of Data Collection

The study made use of satellite-derived data from the Thematic Mapper (TM) data acquired by Landsat-5 2000, and 2015, in the Bunkpurugu-Yunyoo district. It also reviewed literature on the possible drivers to vegetation depletion. This data was to help explain some of the reasons for the change that has been detected.
The rationale for this paper was to investigate and explain the changes in vegetation cover in northern region with Bunkpurugu-Yunyoo District as a focal area. It adopted Remote Sensing as a technology with ENVI tool for analyzing the LandSat 5 images from the Thematic Mapper (TM) data. This data was further used as input data in geographic information system (GIS) technology. It adopted ArcGIS software to analyse the data for the change detection. The study adopted the softwares, especially the ArcGIS with the purpose of mitigating some of the challenges of Remote Sensing in processing images for change detection in vegetation. It also used NDVI software to construct histogram graph as a crosscheck for the results that was obtained with the first two softwares. The incorporation of the GIS-functionality into the image analysis showed much clearer images for the analysis as in the data analysis.

3.4 Analysis of Findings

The analysis was displayed in two formats. This includes the analysis of the qualitative data from the reviews about the drivers to vegetation depletion, and the challenges emanating from it. This was done with the help of NVivo software. It was used to estimate some relationships that might have linked the major drives of the vegetation depletion. The quantitative data was also analyzed using the twin softwares of GIS and Remote Sensing.

4. Findings

Techniques of data analysis were the ENVI and ArcGIS softwares. Studies show that the use of a Geographic Information System (GIS) allows further spatial analysis of the data derived from remotely sensed images, and also, an appropriate tool for the analysis of the extent of land cover change. This explains why the study adopts a mixed method for land use change study. NDVI software was also used to cross examine the results given by the first two ones. The image data on the other hand was gathered from the district of interest and analyzed using Remote Sensing software. The processed images were further analyzed using ArcGIS to arrive at the land use change over time, for the period (ranging from 2000 to 2015). The study used NVivo software to test relationships between parameters.

4.1 Some Drivers to Vegetation Change

The review showed that there are many drivers to the continuous depletion of the biodiversity. Humans lead in these destructive acts, despite their awareness of the importance of the biodiversity to their livelihoods sustenance and survival. It identified some of the serious drivers of vegetation destruction as attitudinal characters, gendered related drives and quest for development, urbanization, ineffective bylaws and the prevalence of extreme poverty. These motives have influenced human actions and inactions, leading to the destruction of the already fading guinea savanna vegetation of Bunkpurugu-Yunyoo district, just like others in the same vegetation belt.
The review demonstrated strongly that the commercial activities of women as in fuel wood and charcoal businesses are some the prominent factors that cause vegetation depletion. Using NVivo to query for link between fuelwood use and women population of the district (30,709), a minimum fuelwood consumption estimated was two medium-sized trees per week for domestic use. This gave an estimate in the neighbourhoods of 61,418 trees. Discounting the population for the sake of those who might not reside in the area and others who are not directly engaged with domestic chores, say 40% using the wood, it gave 24,567 trees per week. This rate of depletion is very alarming for the endangered vegetation district.

4.2 Extent of Vegetation Change

ArcGIS was also used to further process the images and to also calculate the extent of change statistically, using bar graph as a tool of data analysis. The images for the two years are examinable by their pixel counts of the various colours. The differences in the pixel values indicate the extent of changes in the features – settlement, vegetation, barren land and burnt land. Figures 3 and 4 give pictorial view of the extent of change, while table 1 gives in-depth explanations of the extent of change in the vegetative cover of the district.

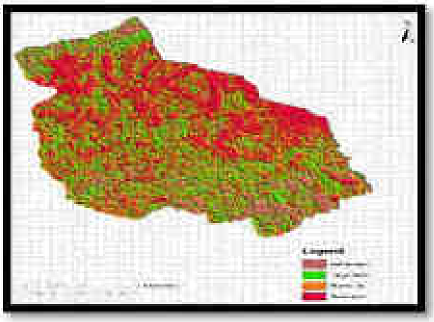

Figure 3: Vegetation As At 2000

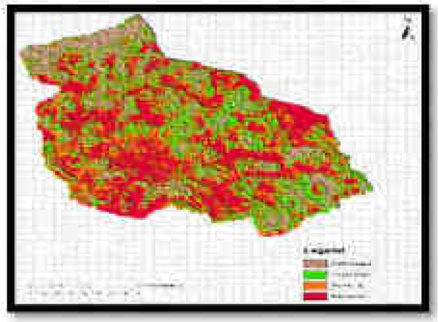

Figure 4: Vegetation As At 2015

Table 1: Extent of Change in Vegetation in the District within 15 Years (2000 and 2015)

S/N	Feature	2000	2015	Change	% Change
1	Settlement	17.01318	18.87349	**1.860308**	**10.93451**
2	Vegetation	26.02161	19.4775	-6.54411	**-25.1488**
3	Burnt Up	26.81521	27.62442	**0.809216**	**3.017749**
4	Bare Land	30.15	34.02459	**3.874589**	**12.85104**

The amount of vegetation cover was measured in pixel count. A pixel is explained as the smallest discrete component of an image or picture. Table 1 shows corresponding increases in the pixel counts for settlement, burnt up and bare land areas. The level of increases in the pixel counts of these variables rather varied significantly with maximum of 12.9 percent increase in Bare Land areas. Human induced drivers as in settlement related drivers showed 10.9 percent change. However, pixel count for vegetation reduced, while others record marginal increases over the period. Table 1 therefore showed a 25 percent reduction in vegetation cover over the 15 year period. The pixel count of the vegetation reducing by a margin of 6.544 is very serious.

This trend in vegetation change could have been caused by several factors including activities like bush burning, deforestation due to settlement expansion and the consequent encroachments of bare lands as literature review purported. The trend posed by the table shows an inverse relationship between the increases in the pixel values for settlement, burnt areas and bare land, and the reduction in the vegetation cover. Human actions explain settlement development and some causes of bush fires. Bareness of land cannot be assessed as causatively human. However, long run feedback of human activities cannot be exempted from the menace of land bareness.

The study also used the NDVI software to further determine the extent of the change in vegetation in Bunkpurugu-Yunyoo district. The software was used to construct histogram graphs on the two sets of data to determine the real change by feature transformation. The vegetation features like forest vegetation is seen to have transformed into grassland, while the grassland moving into barren land features. Per the outcome of the analysis of the images, there was a drastic reduction in the vegetative cover of the district. The following graphs (histogram) display the extent of the deterioration in the vegetation.

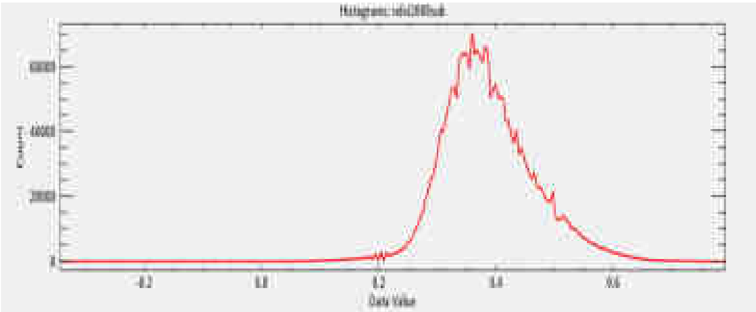

Figure 5: Histograms from NDVI for 2000

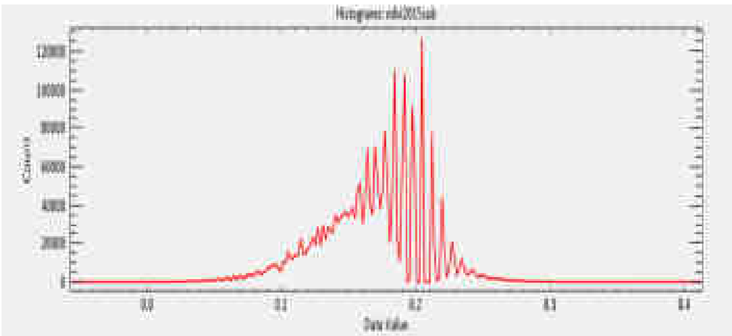

Figure 6: Histograms from NDVI for the 2015

The outcome of the analysis indicates that the year 2000 showed the presence of substantial amount of forest vegetation in the district. The range stretching from 0.2 to 0.6 indicates a mixture of savanna and forest vegetation in the district (see table 2). The forest cover might not have been evenly distributed across the district. Maybe, the entire region was made of savanna vegetation with several pockets of forested areas across the district. The data showed that the area was largely grasslands and shrubs. It also indicates a minimal distribution of bare lands across the district.
The nature of the 2015 values generally indicates a significant change in the amount of vegetation cover for the district. The peak range is 0.1 to 0.25, with low pixel count values. The implication for this outcome is a reduction in the vegetative cover of the district. There is an increase in the size of bare lands and disappearance of the pockets of forest vegetation in the district. The reduction in the pixel values also indicates a reduction in the vigor of the vegetation in the district. The results from both the Remote Sensing and the GIS software used in the data analysis point to the same change impacts on the quality of vegetation in the district.

5. Summary

The paper intended to look at vegetation change in the Bunkpurugu-Yunyoo district of the northern region of the republic of Ghana. The district is located in the guinea savanna vegetation zone and borders the Republic of Togo in the north-eastern corner of Ghana. Bunkpurugu-Yunyoo district has experienced lots of deforestation and bush burning for several decades before now. Also, the extent of settlement and its patterns in the wake of urbanization, as well as the growing demands for livelihood sustenance, have driven the rate of biodiversity depletion to some alarming hikes.
The study adopted two software technologies that are best known for their efficiencies in examining change detection in vegetation. The ENVI and NDVI softwares were used progressively in complementary mix to get the right results for the change in vegetation of the district for 2000 and 2015 year range. Both the literature review and the results of the data analysis have shown a collaborative response pertaining to the nature, drive and extent of change in the vegetative cover of the district.
The study was aimed at determining the nature of vegetation in each year, and to determine the extent of vegetation change within the two year range. Both softwares have demonstrated these using pixel counts and detailed statistics of percentage change, as well as the real vegetation change – from forested to savanna and from savanna to barren land. The extent of vegetation change was detected as 25 percent of the 15 year period.
The study also was to provide explanations to the change, by indicating the prime drivers of the vegetation depletion. The review identified human actions as leading cause. The gendered roles of women, the domestic and commercial businesses like brewing of the local gin (pito), constituted one of the main drivers. Empirically, the

contribution of this driver was strengthened by the high demand for local gin for all cultural activities like funerals, festivals and wedding ceremonies in the area. The review also cited drive for modernization and development as other reasons for the depletion of the vegetation in the district. The images obtained, coupled with the analysis of the data have confirmed that settlement and bushfires played major contributory roles in the declining vegetation cover of the district.

5.1 Conclusion

Deducing from the analysis of the data gathered for the study, the study draws a conclusion that the vegetation of Bunkpurugu-Yunyoo district has gone through a drastic change within a short period of 15 years. The change in the vegetation detected at 25% is enormous and unacceptable for a young and growing district like Bunkpurugu-Yunyoo district. The vegetation stress is from the activities of humans, especially gendered livelihood pursuits and urbanization. The gendered livelihood approach had marginal impacts on the level of biodiversity depletion in the district.

5.2 Recommendations

First the study suggests that another study be conducted using mixed design approach to determine the real causes of the change in the vegetation as well as the impact of this change on the future of the district. Secondly, the study recommends for a district level development planning, with much emphasis on climate change and biodiversity sustainability. Lastly, the study recommends that the district assembly in collaboration with stakeholders should fashion out alternative power supply especially for the local gin producers. This should be done with district-community-household participation.

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Appendix A

Table 2: Pixel Count Values and Associated Vegetation Types

S/N	Data value	Type of feature	Remarks
1	0.2 and below	Barren land, sand, snow, etc.	Desert land
2	0.21 – 0.40	Shrubs, grassland, etc.	Savanna vegetation
3	0.41 – 1.0	Tropical rainforest	Forest land

Appendix B: Educational History

Yamboar Laarbik; M. Phil Geography and Resource Development, 2017 – University of Ghana; M. Ed in Education, 2012, University of Cape Coast; Post Graduate Certificate in HRD, 2012 - University of Ghana; B. Ed Social Sciences, 2007 –University of Cape Coast; Teacher’s Cert A, 2000, -E. P. College of Education, Bimbilla; Senior Secondary School Certificate Examination, 1993, Bunkpurugu Sec. Tech. School.