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Declining Rainfall and Biophysical Degradation In Benin Center Cotton Zone

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Abstract

Benin center cotton zone under goes a significant drop of annual rainfall which induces a significant impact on agricultural yields and vegetation health. The issue of adaptation and resilience to rainfall variability is needed as a priority. This study is subject to answer the se preoccupations a mid compréhention different situations mentioned. Field work, satellite image processing, and statistical analysis led to a better diagnosis. Indeed, rainfall is ohyets decrease, and the aggressiveness of major rains favored stripping surface horizons. The ironoxide takes place, and the soil redness index significantly decreases. This favored the emergence and proliferation of Sahelian species whose ***Cyanotis Lanata*** *on eroded soils. Indeed, a bio-climate change gradually moved. Frequent drought and water stress cause rapid drying up of the leaves, which explains the scope of increasing importance of vegetation fires in the dry season. In a word, the chlorophyll density on the landscape is declining. It is urgent to take significant steps.*

Keywords: *Benin center; Cotton zone; significant impact; aggressiveness; CyanotisLanata*

1. INTRODUCTION

In many parts of the world, land resources suitable for cultivation are becoming scarce (Erlangung, 2008). The world's climate is continuing to change at rates and projected to be unprecedented in recent human history (IPCC, 2001). Rapid urbanisation is expected to continue in developing countries, and the global demand for live stock products continues to increase significantly in the coming decades (Delgado et *al*., 1999). Surface water is fundamental for many sectors in West Africa, including agriculture, power generation and fisheries (Bélières et *al*., 2011).

The drought conditions occurring in West Africa in the 1970s and 1980s cause the drop of -50% in fisheries production, resulting in a loss of about USD 20 million per year (Neiland and Béné, 2008). Cotton has been produced in West Africa since the French colonial period (Bassett, 2001). During its formative years following independence in the early 1960s, the West African cotton sector was able to substantially increase production by rapidly introducing new agricultural technology (Lele, 1992). West Africa is now the second leading exporter of cotton in the world, trailing only the U.S. in world marketshare (Baquedano, 2010). Agriculture has a great and social meaning in Benin (West-Africa). Agroecological zone 5 is reserved to produce cotton in Benin center. Indeed, Cotton farming is the most profitable cash crop in benin eeconomy. Agriculture accounted with 37% for the second largest part of the gross domestic product in 2000 whereby, cotton realised 82% of the exports (Doevenspeck, 2004). Recent studies have demon strated, how-ever, the potential of newer sensors, like MODIS, and methods, respectively to derive relevant biophysical features (Richters, 2005). Thus, one main task of this search is to investigate the potential use of input data derived from remote sensing. For a grarian studies remote sensing has been broadly applied to obtain information about yields or the performance of crops on different spatial scales (Ferencz et *al*., 2004 ; Voß, 2005 ; Salazar et *al*., 2007).

The detection of various degradation levels from space is known to be feasible with remote sensing and recent sophisticated image processing techniques applied to Lands at data have also shown very encouraging results (Hill and Mégier, 1994). The analysis of changes performed on the radiometrically rectified time series is based on computation of the classical vegetation index. A part from images recorded shortly after humid periods, the NDVI showed little variations. This is not surprising as the typical step pic vegetation of the area is mostly non-green (Floret, 1982). Two other indices have been applied to the data : the brightness index and the colour or redness index (Escadafal et *al*., 1994).

The rededge the difference between the reflectance maximum at near- infra red region and corresponding minimum at visible red region typical for all green vegetation due to chlorophyll absorption is meant (Leckie et *al*., 2004). Rededge related indices such as normalized difference vegetation index (NDVI) is applied (Leckie et *al*., 2004).

2. MATERIALS AND METHODS

2.1 Material

The material used in the present work consists of Landsat 8 satellite image OLI (January 2014), MODIS image Fire (January 2014), SRTM DEM image Radar 2011, software (ArcGIS 10.1, Envi 5, Excel, SPSS 21, Global Mapper 15), a Global Positioning System Garmin brand, and a photo camera.

2.2 Method

The first step is acquisition of satellite imagery (Landsat, Modisfire, and Digital Elevation Model) on the site of the United States Geological Survey (www.earthexplorer.usgs.gov). The next step is devoted to the pre-treatment of the stripes and the image processing. The spatial interpolation by empirical kriging bayesien helped design rainfall is ohyets, and algorithm of images differentiation have served to reveal the spatial decrease of rainfall is ohyets between the two periods.

Image reclassification method has been exploited for spatialized surface altimetry after translation radar images to TIM (Tagged Image file). Wildfires are identified after decoding ModisFire images, while index redness and NDVI (Normalized Difference Vegetation Index) are calculated from their different formulas applied to the Landsat 8 image with the mathematical environment of Arcgis 10.1 in spatial analysis.

The three-dimensional model is realised Global Mapper software. The collection of ground control points is performed taking in to account a bare soil, water, and vegetation cover through a longitudinal transect. The reality check of land held account of the identification of plant species Sahel origins belonging ***Combretaceae*** family.

3. DISCUSSIONS

The global average surface temperature increased by about 0.6 °C during the twentieth century (IPCC, 2001). A recent FAO report, Live stock’s Long Shadow, focused on the effects of live stock on the environment (Steinfeld et *al*., 2006).

In recent decades West-Africa has seen major changes in land use, with strong impacts on run off (Wittig et *al*., 2007).Main reasons are increasing space requirements due to growing population numbers and expanding land consumption. Climate change additionally affected agro-ecological conditions and thus, directly influence food production (IPCC, 2007).

During the period of technological change, development in the West African cotton sector achieved primarily through crop intensification, rather than the traditional approach used by African farmers where by production is increased by land-extensive means (World-Bank, 2004). The degradation of the natural resources itself damages the biophysical production basis, decreases yield, and leads to further impoverishment stimulating by expansion on marginal areas (Lüdeke et *al*., 1999, Petschel et *al*., 1999). Thus, a main future challenge will be to guarantee food security without degrading land and water resources under expecting transformations of man-nature agrarian systems (Eswaran et *al*. 1999). Land degradation is a diminution up to loss of the biological or economic productivity and complexity of land processes caused by human activities (Eswaran et *al*., 1999 ; Graef, 1999 ; Stocking and Murnaghan, 2001). Water erosion and fertility loss are probably the most wide spread types and in particular severe in southern, north-western and northern areas (CENATEL, 2002).

Climate change, in particular increased temperatures and levels of atmospheric carbondioxide, as well as changes in precipitation and the occurrence of extreme climate events, is having notable impacts on the world's vegetation health (Moore and Allard, 2008). Increased temperatures may relieve forest stress during colder seasons but increase it during seasons. Impacts of increased temperatures vary widely among different climatic zones (Moore and Allard, 2008). Climate change has both direct and indirect impacts on vegetation health (Moore and Allard, 2008).

4. RESULT

The following figures characterize the spatial relationship between surface altimetry, annual rainfall, vegetation fires, redness index and NDVI.

Figure 1 shows that wild fires are mainly between 31 and 216 meters. They are scattered sin the south of the cotton zone at lower altitudes and are concentrated at medium altitudes, especially in the center-west of the zone. Altitude is then a determinant of bush fires spatial distribution in the cotton zone of Benin.-center.

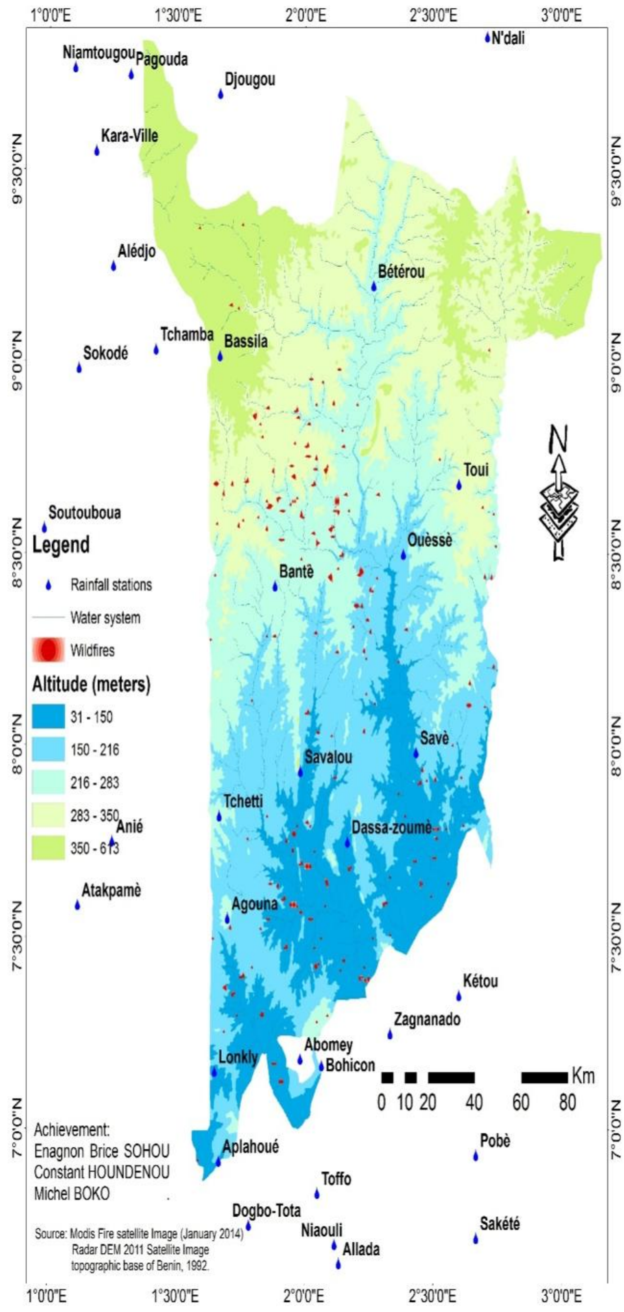

Figure 1: Wildfires and Surface Altimetry.

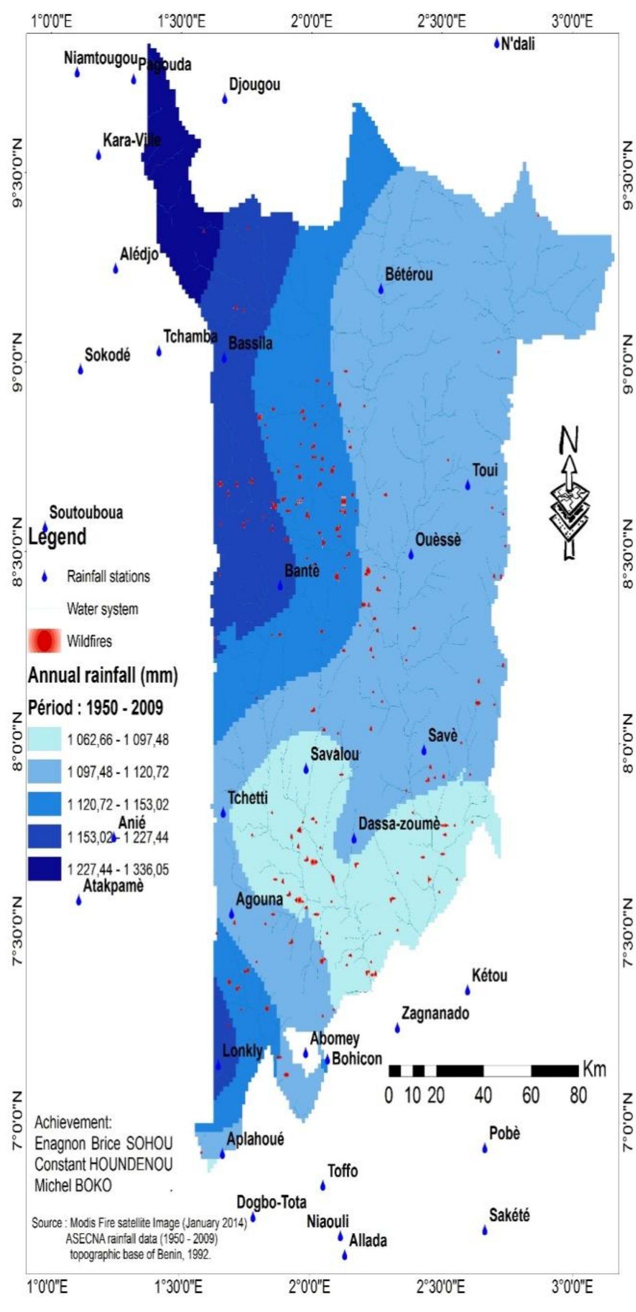

Figure 2 : Wildfires and Annual Rainfall.

According to Figure 2, vegetation fires are concentrated in means rainfall is ohyets values (1120 mm) at the center of the cotton area and dispersed at low rainfall is ohyets values rainfall (1062 mm). Spatialization of rainfall height then is a key to the distribution of vegetation fires in the cotton zone of Benin center.

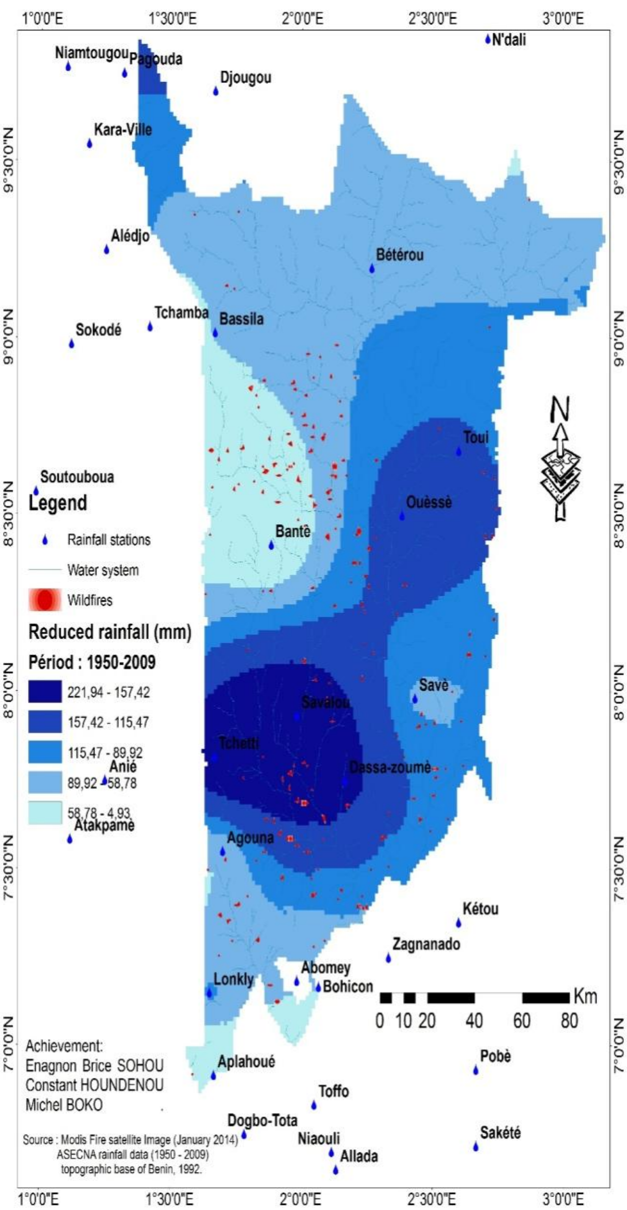

Figure 3: Reduce Drainfall and Wild Fires.

From Figure 3, we note that the dominance of wild fires is observed in the vicinity of where the rainfall has decreased the most. Reduction of annual rainfall while a determining factor in the spread of wild fires in the cotton zone of Benin center.

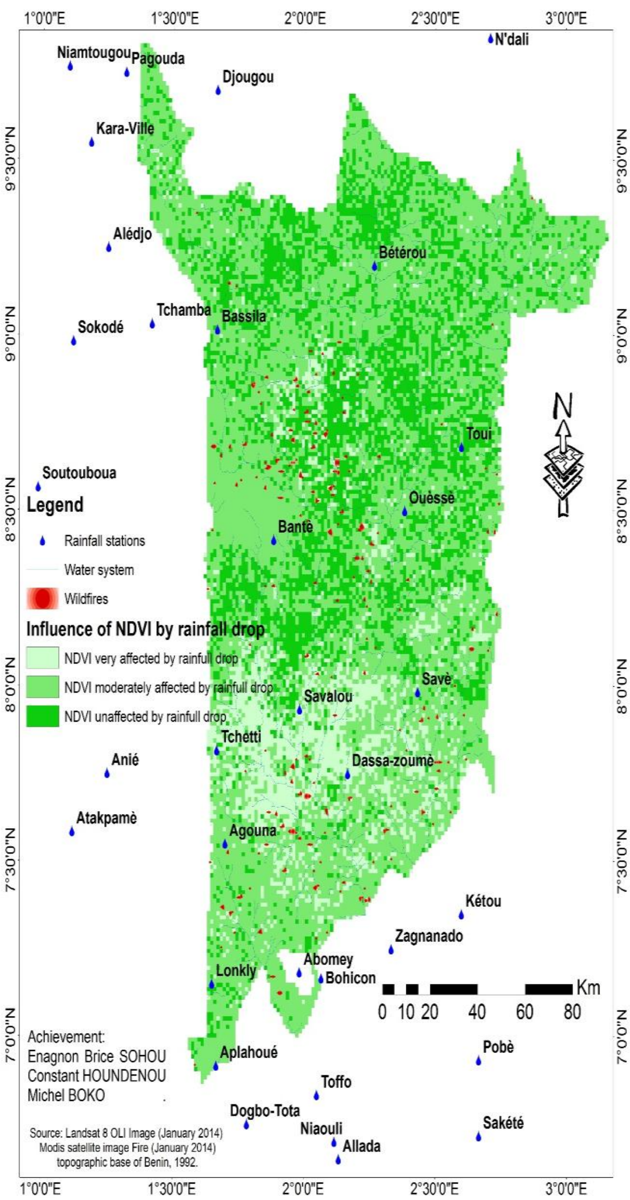

Figure 4: Influence of NDVI By Rainfall Drop and Wildfires.

From figure 4, we can retain the places where the NDVI is affected by rainfall's decrease are near wild fire. So the decline in rainfall-induced decrease of chlorophyll on the land scape with a disparity of vegetation by wild fires.

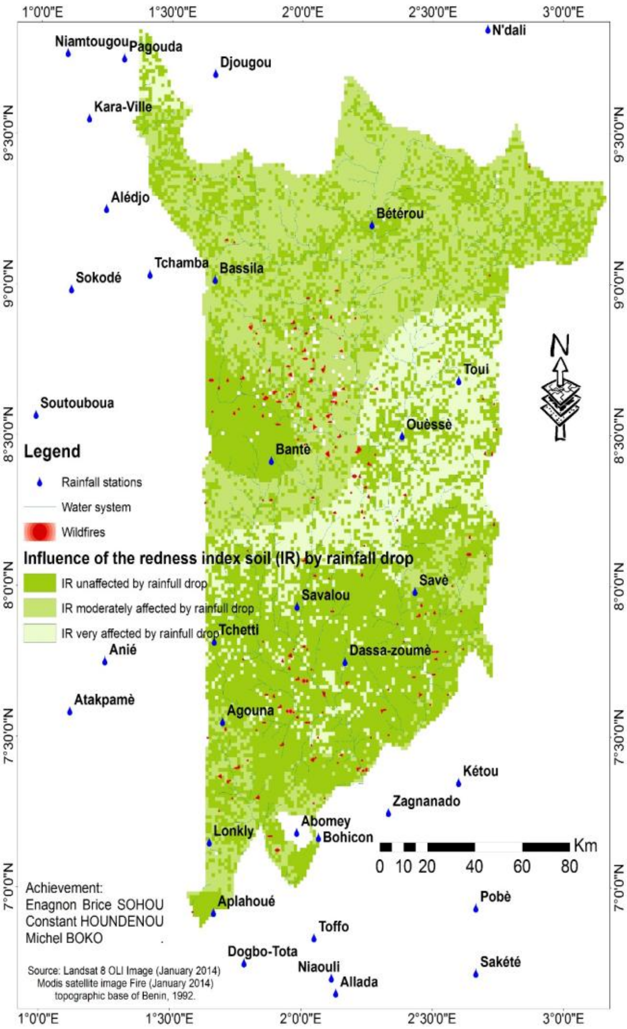

Figure 5 : Influence of Redness Index by Rainfall Drop and Wildfires.

Figure 5 confirms a spatial co-dominance between areas where the redness index is affected by the rainfalling and wild fires. However, the redness index decreases. This confirms that water erosion stacks gradually stripped surface horizons to make the impoverished and lowhumidity to the dominance of ironoxides oil. All these conditions, confirm that the sahelisation is favored.

5. CONCLUSIONS

The present study confirms the existence of a real climatic deterioration in Benin-center cotton zone. Annual rainfall has greatly regressed and vegetation health is threatened. The aridity increases, and water erosion has favored Sahelian plant species proliferation. Anti-erosion management must be implemented in Benin-center cotton zone for the sustainability of cash crops. Bio-climate change is becoming more and more in Benin-center. Policy makers must take propersaction accordingly to degraded soils. Vegetation is stressed, rainfall is continuing to decline, famine ain crease and poverty takes flight. Where are we, if not decline?

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BIOGRAPHY WITH PHOTO

The next picture is a view of a plant species called ***CyanotisLanata*** (Sahelianorigin) whish proliferates in the of South Benin Center cotton zone. That confirms a slow and gradual sahelisation in heavily eroded areas.

Photo1: **CyanotisLanata**, Sahelianspeciesfounded in southeast of cotton-zone (Dassa-Zoume*)*