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Rubber Tree, Derived Savannah and Compromised Guinea Savannah in West Africa

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Abstract: *The earliest report on the loss of the northern portion of the Rain Forest in West Africa dates back to the 1950s and desertification of the West African Guinea Savannah has been reported. It is believed that the loss of vegetation and trees in particular was due to climate change making it difficult for cultivated land to regain its tree component even when left fallow indefinitely. This led to increased aridity as control of moisture and temperature provided by trees was lost such that the Sahel Savannah was extending southwards to consume the erstwhile Guinea Savannah. In addition, the Guinea Savannah was extending southwards leading to the concept of derived savannah as the portion of the Rain Forest degraded by loss of trees assumed the status of grass land. This development has caused severe social dislocation evident in loss of arable land, reduced economic power of the natives, vulnerable population, inter-communal conflicts, migration etc. Rubber cultivation in non-traditional areas, degraded land, its potential for climate change adaptation/small holder farming schedules have been reported. The concern of 'irreversible' loss of trees if left to nature, can be addressed through rubber tree based farming schedules to ensure community based, eco-friendly, profitable and sustainable forest management. The objective of this paper was to present the scenario of the loss of Rain Forest to grassland and even the Guinea Savannah to Sahel in West Africa and how to use rubber tree based farming system to ensure sustainable tree culture.*

Keywords: *Hevea, climate change, deforestation, reforestation, agroforestry.*

INTRODUCTION

Climate change defined as irreversible change in weather factor(s) in an environment has assumed global dimension (Omokhafe, 2017a) and the consequence is not localized. In 2018, wild fire beyond known levels was reported in the state of California, US (Shugerman, 2018). In Spain, heat wave of immense proportion was reported (Wilson, 2018). In both cases, unusual high temperature was the main factor implicated. Climate change may be as old as creation, but since the evolution of higher plants and forests in particular, trees have played significant role in moderating the level of carbon dioxide in the atmosphere. It was reported that in the Aquitanian era on the geologic time scale, widespread forests slowly drew in massive amounts of CO_2, gradually lowering the level of atmospheric CO_2 from 650 ppm (v/v) down to around 100 ppm (v/v) and even caused the preindustrial CO_2 concentration of 280ppm (Marzocchi, 2015; https://en.wikipedia.org/wiki/Geologic_time_scale#cite_note-Royer-37). In recognition of the role of trees in moderating climate change, the United Nations declared International Day of Forests to encourage planting of trees (UN, 2012).

Desertification has been reported in many countries in West Africa including all the rubber producing countries in West Africa. This includes the loss of trees in the Rain Forest leading to the concept of derived savannah (Omokhafe, 2017b). The derived savannah has also been reported in America, Asia and Australia (Ludwig and Tongay, 1995; Sharma and Sharma, 2016; WER, 2009). Sometimes, the derived savannah is described as the 'Guinean-forest-savannah mosaic' of forest-savannah ecotone (https://www.worldwildlife.org/ecoregions/at0707).

The use of the rubber tree to ameliorate land degradation and cultivation in sub-optimal/non- traditional areas was reported as early as the 1980s in several rubber producing countries (Pushparajah, 1983; Priyadarshan, 2003; Priyadarshan et al 2009). Examples are cultivation of the rubber tree in North East India (Priyadarshan, 2003), North Cote d'Ivoire (Dea et al, 1997), South China (Zongdao and Yanqing, 1992), etc. Some international agencies are offering support for large scale reforestation of degraded Rain Forest in Colombia, Thailand and Malaysia (SPCAM, 2011; Pinniam et al, 1993; OISCA, 2009).

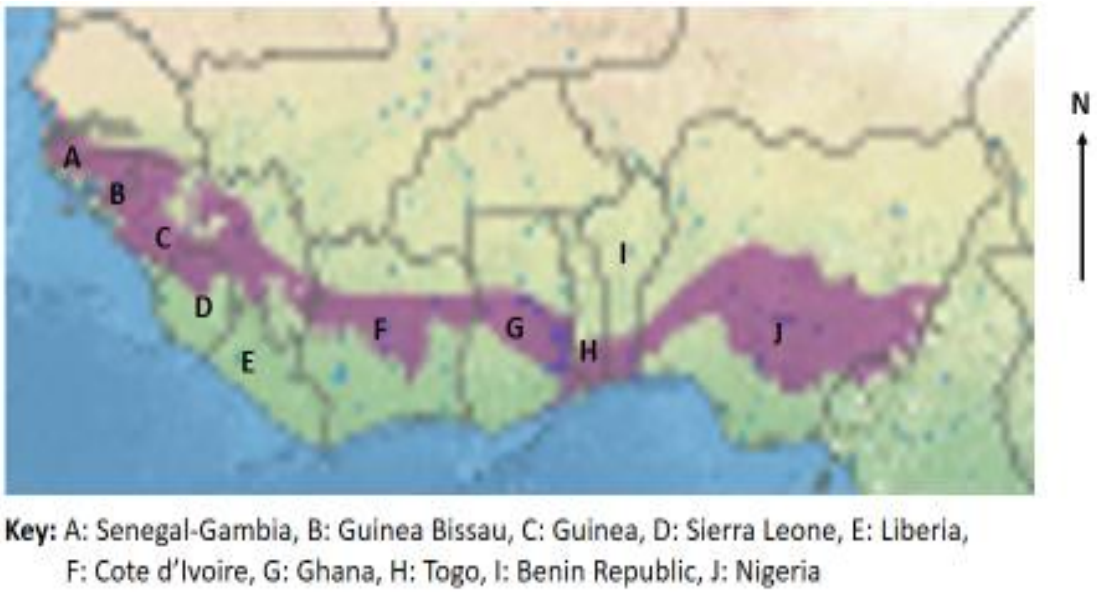
In order to check further loss of trees and reduce desertification, there are successful trials and plantations of the rubber tree in the southern Guinea Savannah of Nigeria, a non-traditional area for rubber cultivation, (Omokhafe and Eguavoen, 2014). The use of economic trees for climate change adaptation is well advocated (Omokhafe et al, 2017a). The advantage of the economic trees in climate change adaptation is for double advantage of enhancing tree cover as well as providing income for resource poor and vulnerable populations. The objective of this paper was to highlight the potential of rubber tree for reforestation of the derived savannah in West Africa.

Response of *Hevea brasiliensis* to rainfall

A major weather factor that is closely associated with vegetation zones in West Africa is rainfall. Omokhafe and Emuedo (2006) reported highest yield of 26.26g/t/t at mean monthly rainfall of 140.59mm in October – December, which marks the onset of the dry season in West Africa. This was followed by 25.83g/t/t in June – September at 397.62mm mean monthly rainfall. The least yield was obtained in January – May at 19.46g/t/t with mean monthly rainfall of 141mm. It is this attribute of yield in a wide range of rainfall conditions that makes *Hevea brasiliensis* suitable for cultivation in areas of lesser rainfall than the typical range of 1400 – 4000mm per annum (Priyadarshan, 2003). Lesser rainfall figure of 1000mm per annum was reported for cultivation of *H. brasiliensis* in non-traditional zones (Priyadarshan et al., 2005). The Guinea Savannah has rainfall of 1000mm – 1400mm per annum. The derived savannah being the northern limit of Rain Forest degraded to savannah has mean annual rainfall 1300mm per annum. The rainfall in the derived savannah and even the Guinea Savannah therefore presents potential for cultivation of *H. brasiliensis* in these zones. There is successful cultivation of *H. brasiliensis* in Guinea Savannah in Nigeria (Omokhafe and Eguavoen, 2014).

The derived savannah in West Africa

The derived savannah in West Africa is about 67.3million ha stretching from the west coast in Senegal through Gambia to Guinea-Bissau, Guinea, Sierra Leone, Liberia, Cote d'Ivoire, Ghana, Togo, Benin Republic and Nigeria (https://www.worldwildlife.org/ecoregions/at0707; Fig 1). It is noteworthy that the derived savannah is extending southwards such that it has advanced to the coastline in Togo and Benin Republic.



Key: A: Senegal-Gambia, B: Guinea Bissau, C: Guinea, D: Sierra Leone, E: Liberia, F: Cote d'Ivoire, G: Ghana, H: Togo, I: Benin Republic, J: Nigeria

Figure 1. The derived savannah (shaded portion) in West Africa

The derived savannah has been described as follows:

i. An endangered zone due to increased loss of vegetation (https://www.worldwildlife.org/ecoregions/at0707).
ii. Characterised by inter-communal conflicts due to struggle for land resources depleted by increased aridity (Cabot, 2017; Olaniyan et al, 2015; Cook, 2011; McGregor, 2017)
iii. Migration to seek means of survival (Rigaud et al, 2018) and climate refugees as described by Lane (2018)
iv. Vulnerable population leading to high profile crimes (Osagie, 2018)
v. Low productivity due to change in weather condition (Sharma and Sharma, 2016)
vi. Avoidance by social service personnel (Omokhafe, 2017b)

Restoration of the endangered guinea-forest-savannah mosaic is necessary to contribute to climate change mitigation/adaptation, as a global issue. The volatile population due to the fragile ecosystem is a time bomb that can lead to humanitarian crises. As it is said, prevention is better than cure. A World Bank report has given signal to such crises and suggested empowerment for higher or sustained productivity as an early response mechanism (Rigaud et al, 2018).

The rubber tree for reforestation of derived savannah

Farmer focused reforestation is recommended for sustainable forestry. This has the advantage of providing income for the natives to be less vulnerable with economic and social security. Afforestation programmes in the past have focused on use of tree species without considering the economic value of the trees. This erstwhile practice led to abandonment as soon as the funding was withdrawn. As these tree species were not resilient enough to survive without conscious effort of maintenance, many of the afforestation schemes failed. Use of economic trees will ensure the continued maintenance of the trees as the community famers will derive their livelihood from it. The potential for rubber tree based amelioration of degraded land has been demonstrated with cultivation of rubber in the southern Guinea Savannah in Nigeria and the North East India which are non-traditional zones for rubber cultivation (Omokhafe and Eguavoen, 2014; Saikia, 2018).

The cultivation of rubber tree in the derived savannah in West Africa will involve rubber tree based agroforestry, which is an accepted practice in many of the rubber producing countries world-wide. Various authors have reported rubber tree based agroforestry in Nigeria (Anegbe et al, 2017), India (Jessy et al, 2017),

Indonesia/Thailand (Penot et al, 2017) and Brazil (Alvim and Nair, 1986). The advantages of the rubber tree in reclamation of degraded land is as follows:

i. There are several rubber tree based agroforestry models that can be deployed
ii. Intercropping will provide income before tapping maturity
iii. With adequate spacing, even at tapping maturity, several economic trees can thrive with the rubber trees
iv. At tapping maturity and canopy closure, mixed farming can be practiced to enhance protein intake of the communities and provide additional source of income
v. Labour intensive to engage idle labour
vi. Tapping and hence income for at least ten months in a year. This is another peculiarity of the rubber tree unlike other tree crops with short harvesting season in a year. The rubber tree provides income for the farmers almost all through the year
vii. The robust plantation provides adequate sink for green-house gasses
viii. An abandoned rubber tree plantation has the ability of persistence for the following reasons:
    - The seeds are viable without any special treatment
    - In the event of trunk breakage, the stump can sprout and regrow the tree
    - The abandoned plantation presents multi-storey rubber plants consisting of herbaceous rubber saplings, shrub immature rubber trees and the mature rubber trees. This attribute is peculiar with rubber tree because of the viable seeds produced annually.
ix. Tapping of wild groves which are resilient, even with limited maintenance.

The scenario of Rain Forest (Fig. 2a), degraded to derived savannah (Fig. 2b) and the possible rubber tree based reforestation (Fig. 2c) is presented in Fig. 2. It is necessary to change the situation of Fig. 2b which is the derived savannah to Fig. 2c of enhanced tree population.

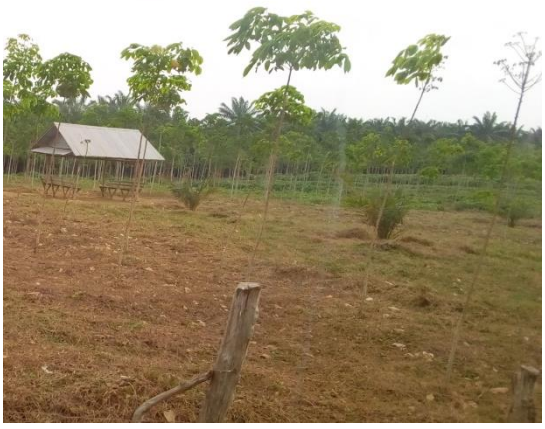
A. Rain Forest **B. Derived savannah** **C. Rubber tree plantation**

Figure 2. Tree population in Rain Forest, derived savannah and rubber plantation

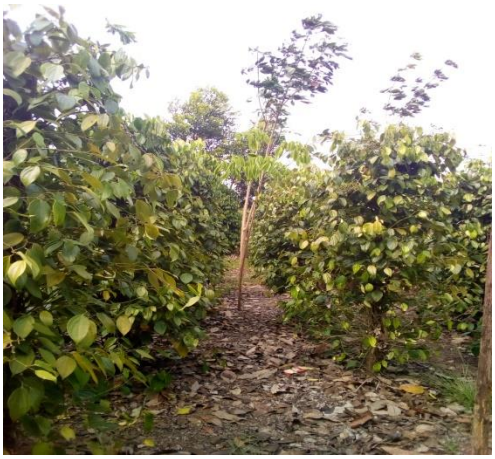
Examples of intercropping are presented in Fig. 3 while examples of mixed farming are presented in Fig. 4.

A [Immature Rubber (*Hevea*) + Banana (*Musa spp.*]

B [Immature Rubber (*Hevea*) + Sugar cane (*Saccharum* spp.]



C [Immature Rubber (*Hevea*) + Oil palm (*Olaeis guineensis*)]



D [Immature Rubber (*Hevea*) + Black pepper *Piper nigrum*)

E [Immature Rubber (*Hevea*) + Cacao (*Theobroma cacao*) + Banana (*Musa* spp.)]

F [Immature Rubber (*Hevea*) + Maize (*Zea mays*)]

Figure 3: Rubber tree based intercropping

A. Mature Rubber (*Hevea*) + snail pens (*Archachatina* spp.)

B. Mature Rubber (*Hevea*) + apiary (*Apis* spp.)

Figure 4. Rubber tree based mixed farming

In conclusion, the rubber tree based agroforestry is suitable for reforestation of degraded Rain Forest and to fortify the southern limit of Guinea Savannah. Funding agencies are hereby invited to offer necessary support for rubber tree based agroforestry for reclamation of the degraded Rain Forest now referred to as derived savannah. Rubber producing countries facing the threat of desertification may adopt the rubber tree based agroforestry. There is the potential for sustainability based on the nature of the rubber tree and the attendant economic potential. The resource-poor and vulnerable communities will be empowered. In addition, it has the potential to address the desertification suffered by the Guinea Savannah and degradation of the Rain Forest. Rubber tree based agroforestry will be contributing to the potential of trees as sinks for green-house gasses and contribute to temperature mitigation in the face of rising temperature occasioned by climate change

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