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Research Article

Changing Pattern of Eucalyptus Population in Bali Sub-Division and Implications for Sustainable City Planning In Cameroon

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Abstract: Eucalyptus is an important plant grown in cities in Cameroon because they perform specific functions such as draining of wetlands to increase available land area for housing construction to accommodate the bourgeoning urban population. To investigate the changing patterns of eucalyptus plants in Bali sub-division and its implications towards sustainable city planning in Cameroon, a blend of information collected from published and primary sources were used. Analysis of collected information was done with the help of cartographic and descriptive techniques including maps, tables and percentage and cumulative percentages. The results showed that the eucalyptus population in Bali sub-division has significantly evolved over time and space from 3.39km^2 in 1990 to 9.47km^2 in 2017. There is a significant decline in the zone occupied by the plant from mostly the urban or build-up area between 1950 and 1990 to mostly peri-urban and rural areas in 2017 due mainly to accelerated urbanisation, rapid population growth and counter-migration to rural areas to seek large farm sizes for eucalyptus cultivation. These are indicators that favour medium and long term sustainable planning policies by city and town planners towards attaining sustainable cities in Cameroon through the relocation of saw mills from urban to peri-urban and rural areas thereby preventing noise and sound pollution in cities; reduce damage to buildings and other urban infrastructures by the long spreading roots of the eucalyptus plants; rehabilitate watersheds and put in place appropriate municipal water management plans to increase water supply in cities and the planting of shade and other multi-purpose tree species in the place of the declining eucalyptus population in order to help reduce overheating, provide greening, urban aesthetics and municipal parks and botanic gardens.

Keywords: Eucalyptus, changing pattern, sustainable city planning, Bali sub-division, Cameroon.

INTRODUCTION

Due to the myriad of socio-economic benefits it holds, eucalyptus is the most widely planted tree type around the world today, especially in South America (mainly in Brazil, Argentina, Paraguay and Uruguay), Africa, Australia, India and Portugal amongst many other countries (Demel, 2000). Throughout the tropical zone where Cameroon is found, eucalyptus plantations cover at least 12 million hectares, 90% of which have been established since 1955 (Turnbull, 1999). The eucalyptus trees have an advantage that they grow fast, are easily self-propagated and can spread very fast. They also serve as an important cash crop through both fuel wood and timber. They are also used for plywood, pulpwood, fencing and harvesting of essential eucalyptus oil (Kituyi *et a*l., 2001). In addition, the eucalyptus trees can develop under poor soils and water conditions. It has formed the backbone of the emerging commercial forestry sub-sector where many large and medium scale land owners are turning to it as the cash crop of choice (Kenya Forest Service, 2009).

In Africa, eucalyptus covers over 1.7 million hectares, with Angola standing second in plantation area under eucalyptus (135 000 hectares) after South Africa (FAO, 2003), all situated in Sub-Saharan Africa where Cameroon is also found. After gaining independence in 1960 and 1961 from the French and British respectively, colonial influence still prevailed in Cameroon, especially in farming practices. Colonization originally was to gain vital trade itineraries but early settlers especially missionaries also found a suitable environment for certain exotic plant species, one of which was eucalyptus. Eucalyptus was introduced to Cameroon by the Colonial rulers and missionaries in the 1900's (Musa, 1995). The aim was to solve the problem of wood shortage in the tropical

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vegetation region "the Bamoum Highlands" of the country (Aubréville, 1953).

In the North-West Region of Cameroon, eucalyptus is not uncommon as areas like Bui and Donga Mantum Divisions have since about 1905 used eucalyptus cultivation as a poverty reduction strategy (Lukong, 2000). In Mezam Division in particular where Bali sub-division is found, eucalyptus cultivation is a major economic activity. Here, besides individuals, the government also owns eucalyptus plots in Mendankwe and she is currently reforesting the Bali-Ngemba Forest Reserve with eucalyptus plants through the Ministry of Forestry and Wildlife (MINFOF). Following the steps of Donga Mantum and Bui Divisions, eucalyptus was introduced in Bali by Reverend David H. O'neil, the first principal of Cameroon Protestant College (CPC) Bali in 1950. This was in a bid to show proof of effective occupation of the land that had been allocated for the school. Since then, eucalyptus has seen a continued and steady increase in surface area under their cultivation over time and space.

In spite of the ever increasing terrain under their cultivation and the diverse socio-economic importance that they hold to the inhabitants, the plant has been studied only to a limited extend in the North West Region of Cameroon in general and Bali sub-division in particular. A few studies on the subject have focused on Nkambe (Tata *et al.*, 2013) and the Mbum plateau (Ngala and Amawa, 2014). Globally, some studies on the plant have also focused on its cultivation, evolution and spatial distribution **(**Musa, 1995; Poore and Fries, 1985; Morales, 2007; Louppe and Depommier, 2010; Aubréville, 1953; Kidanu *et al*., 2005; Zacharin, 1978; Ngala, 1992). Others have studied eucalyptus utilization **(**Doughty, 1996; Garrett, 2016; Maundu and Tengnans, 2005; Njilin, 2009; Bennett, 2010; Dessie and Erkossa, 2011; Esmail, 2017; Kenya Forest Service, 2009). Some authors have equally dwelled on the plant's environmental threats **(**Ngala and Amawa, 2014; Poore and Fries, 1985; Casson, 1997; Otieno, 1998; Tata *et a*l., 2013; Chin, 2006; Lane *et al*. 2004; Espinosa *et al.*, 2007; Zhang *et al.*, 2012; Dadkhah, 2013; Belnap *et al.*, 2012; Riffell *et al.*, 2011).

There is the deficiency of publications on the implications of the changing pattern of eucalyptus population on sustainable city planning in Bali in particular and Cameroon in general. There is need therefore to study the changing pattern of eucalyptus population in Bali sub-division and its implications for sustainable city planning in Cameroon. It is important that our city and town planners and policy makers understand the changing pattern of eucalyptus population in Bali sub-division for sustainable city planning in Cameroon. This study was therefore aimed at investigating the changing pattern of eucalyptus population in Bali sub-division and its implications for sustainable city planning in Cameroon. Specifically, it sought to (i) determine the eucalyptus species grown by the inhabitants of Bali (ii) examine their evolution or changing pattern over space and time, and (iii) examine the implications of the changing patterns of eucalyptus population on sustainable city planning in Cameroon as a whole. The results obtained may help influence medium and long term urban planning policy towards attaining sustainable cities in Cameroon.

MATERIAL AND METHODS

This study was conducted in Bali sub-division in Mezam Division of the North West Region of Cameroon. Bali is one of the 32 municipalities of the North West Region and is located some 25km to the South East of the regional capital Bamenda. Bali sub-division is situated at the geographical coordinates of longitude $7^{o}40E$ and $10^{o}E$ and latitude $5^{o}50N$ and $5^{o}59N$ (Bali Rural Council, 2012). Bali sub-division is bounded to the northwest by Bamenda Central, to the south by Batibo sub-division, to the West by Ngembou village, to the East by Pinyin and to the south east by Santa sub-division (Fig. 1).

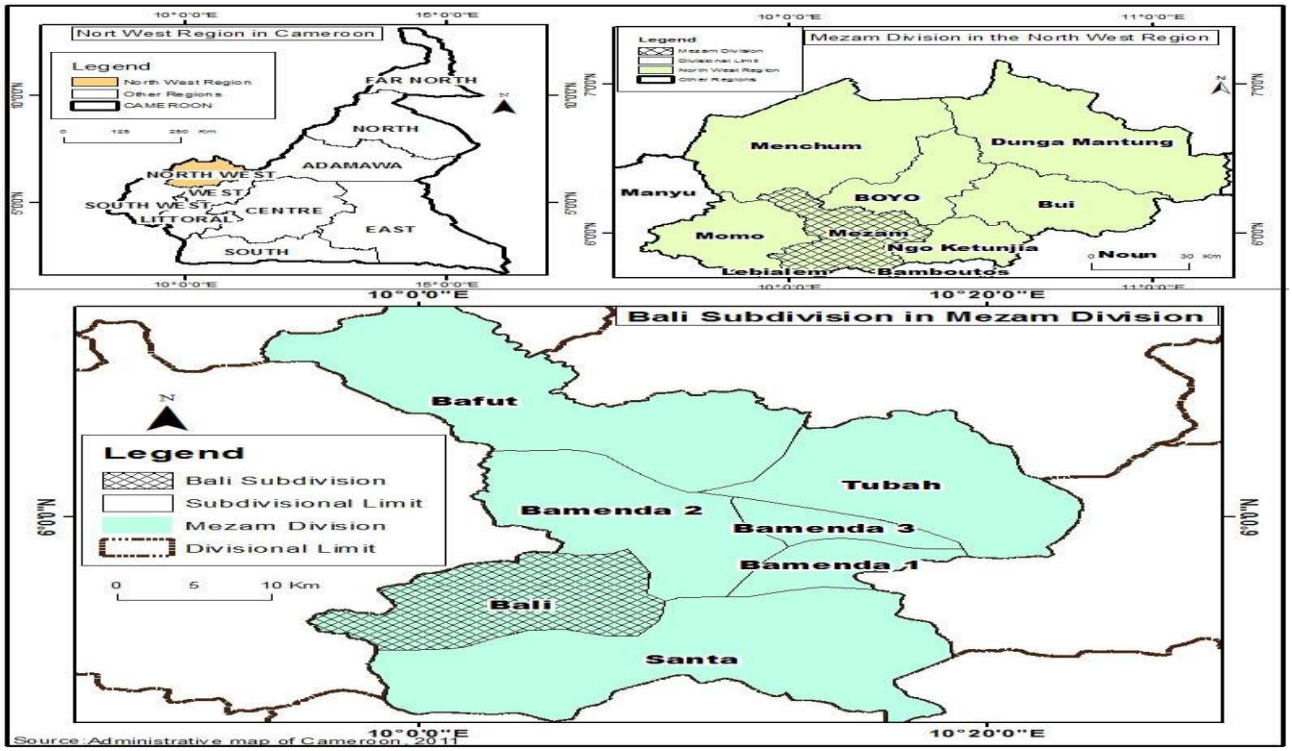

Fig.1. Location of Bali sub-division in the North-West Region of Cameroon
Source: Adapted from Administrative map of Cameroon (2011)

The physical milieu of the area such as climate, relief and drainage and geology and soils are a real asset for eucalyptus growth. Concerning climate, the area is characterised by 2 main seasons-rainy and dry seasons. The rainy season runs from mid-March to mid-November with annual average rainfall of 2000-3000mm recorded while the dry seasons last from mid-November to mid-March with a minimum temperature of 12^{o}C recorded (Sub Divisional Delegation of Agriculture for Bali, 2012). The relief comprises of a collection of hills, valleys and plains perforated by fresh water springs and other fast flowing rivers. Being a continuation of the volcanic plateau of the Western Highlands, the Bali area is composed of volcanic soils (Neba, 1999). The soils are black and/or brown in colour derived from ancient basalts which stretches into Momo Division (Bamenda). Other soil types here include tropical sandy clay soil and some laterites as a result of leaching from prolonged rains. These are all favourable natural conditions for the growth of eucalyptus.

The population of the area has also been increasing over the years further justifying the need for eucalyptus growth as a survival strategy as well as provides ready market. In 1985, the population of Bali stood at some 29,500 inhabitants with a population density of 106p/km^2. Census result of 2005 in Cameroon published in 2010 put the population of Bali sub-division at some 30,370 inhabitants with a population density of 188p/km^2 (National Institute of Statistics-NIS, 2017). The area is also inhabited by people from 3 ethnic groups, namely, the Widikum (Moghamos or Ngembas), Bali-Nyonga (Chambers) and the Bamilekes (Bawocks) fragmented into 17 quarters/villages with varying population sizes and density practicing agriculture as main occupation. While a large part of the population is involved in peasant agriculture mainly for subsistence, about 15% is involved in small scale plantation agriculture in crops like eucalyptus and pineapples. Besides agriculture, other economic activities in the area include arts and craft, transportation and banking and communication services found especially in the urban millieu.

RESEARCH METHODS

Data Collection

This study was a blend of published sources and field work. The published sources made use of maps from the geo data base and Landsat image 4, 1990 and Landsat image 8, 2017 for Bali sub-division for 1990 and 2017 respectively in order to show the changing patterns of the eucalyptus population. These images enabled a comparative evaluation of the spatial-temporal evolution or dynamism of the eucalyptus plants in Bali sub-division with the help of the Garmin V Global Positioning System (GPS) receiver. More so, public libraries such as those of the Geography Department of the Higher Teachers' Training College (HTTC) Bambili, the main library of the University of Bamenda and the Bamenda City Council Library and institutional archives such as that of the Bali Council were all consulted where relevant information on the

subject was obtained from unpublished sources (dissertations) and published (end of year reports, journal articles and textbooks) sources. Also, various internet websites constituted a major source of information through e-books and journals.

Field work that was undertaken over a period of 8 months (September 2017 to April 2018) employed direct field observations, interviews, sampling procedure and questionnaires. The interviews brought on board 3 institutional actors: agricultural extension workers of the Bali Sub Divisional Delegation for Agriculture and Rural Development, the conservator at the Bali-Ngemba forest reserve and staff of the Delegation for forestry and wildlife for Mezam Division. More so, random sampling was ensured with some of the inhabitants who cultivate eucalyptus plants to sample their opinions on its dynamic pattern. This was complemented by the administration of 200 questionnaires in 13 quarters (Table 1) to 2 stakeholders: eucalyptus farmers (65 or 32.5%) and the local population (135 or 67.5%). These are quarters in which the growth of eucalyptus is most prominent within Bali sub-division. The schedule method of questionnaire administration was used. A 100% response rate was registered for the questionnaires.

Table 1. Stakeholders and Questionnaires Administration in Bali Sub-Division

S/N	Quarter	Eucalyptus farmers	%	Local population	%
1	Bawock	5	7.7	17	12.6
2	Beisen	5	7.7	13	9.7
3	Bossa	5	7.7	6	4.4
4	Gungong	5	7.7	10	7.4
5	Koppin	5	7.7	6	4.4
6	Mantum	5	7.7	16	11.6
7	Mbatmandet	5	7.7	14	10.5
8	Mbeluh	5	7.7	8	6
9	Mbufung	5	7.7	6	4.4
10	Mudum	5	7.7	4	3
11	Wosing	5	7.7	20	14.8
12	Kutadnchi	5	7.7	5	3.8
13	Naka	5	7.7	10	7.4
Total	**13**	**65**	**100**	**135**	**100**

Data Analysis

Collected data was analysed by help of cartographic representations to show the spatio-temporal dynamics or changing patterns of eucalyptus population in Bali urban and rural between 1990 and 2017. This was accompanied by other descriptive methods of data analysis such as tables, percentages and cumulative frequency representations.

RESULTS AND DISCUSSION

1. **Eucalyptus species grown in Bali sub-division: A conducive physical millieu**

Two eucalyptus species are predominantly grown in Bali sub-division: *Eucalyptus grandis* and *Eucalyptus camalduleniss*. These are locally referred to by the Bali inhabitants as the 'white' and 'red' eucalyptus respectively. Unlike *Eucalyptus grandis* which is ubiquitous all over the sub-division, *Eucalyptus camaldulensis* in Bali sub-division dominate the northern to the central portion stretching around the Nakah River and passing through villages like Wosing, Beissem, Bosa, Bawock, Nitap, Mbufung and Bali central. These areas are plains which stand as the agricultural cornucopia of Bali but unfortunately are under threat from an ever increasing population and surface area under eucalyptus cultivation. The ubiquitous nature of *Eucalyptus grandis* in the region on its part is due to the hilly topography of Bali characterised by peaks of about 1300-1500m of average altitude above sea level, especially at Olulu and Koblah along the Bali-Mbuh highway and Koppin, Kubat, Mucha, Ngwadikang, Gwejang, Kutan and Ntankoh along the northeast and south west of Bali; Mbad Ntankoh (1348m), Mbad Gawela and Mbad Gwejang in the west towards Momo Division (Fig. 2). The slopes of these hills are heavily employed for eucalyptus growth.

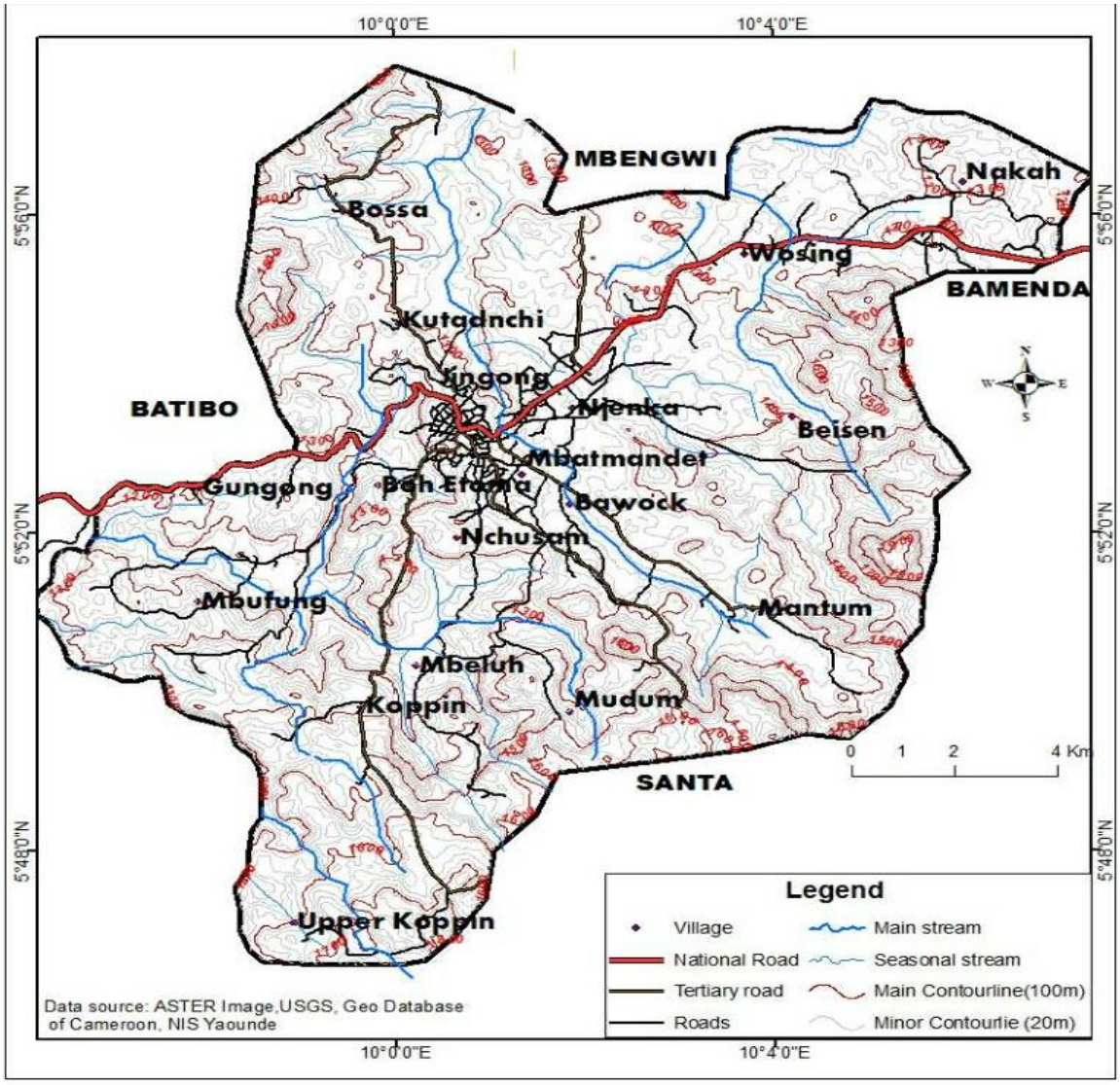

Fig. 2: Relief and drainage map of Bali sub-division
Source: Geo data base of Cameroon (Modified 2018)

Of the two species, *Eucalyptus grandis* is the dominant eucalyptus specie grown by 66.2% of eucalyptus farmers in Bali sub-division (Table 2). This is closely followed by 18.5% who grow both *Eucalyptus grandis* and E*ucalyptus camaldulensis* while only 1.5% grows solely *Eucalyptus camaldulensis.* Another 13.8% of the eucalyptus farmers surveyed were clueless or had no idea on the specie they grow.

Table 2. Eucalyptus Species Grown By Farmers in Bali Sub-Division

S/N	specie	Frequency	%	Cumulative %
1	*Eucalytus grandis*	43	66.2	66.2
2	*E. grandis and E. camaldulensis*	12	18.5	84.7
3	*Eucalyptus camaldulensis*	1	1.5	86.2
4	No idea (clueless)	9	13.8	100
	Total	**65**	**100.0**	

Source: Field Work (February, 2018)

Amongst the more than 800 species of eucalyptus existing in the world, it is no coincidence that two of them; *Eucalyptus grandis* and *Eucalyptus* C*amaldulensis* are the major ones being grown in Bali sub-division. This is because the physical milieu of Bali sub-division conforms with climatic, geology and soil and relief and drainage conditions for their growth as recommended by the Kenyan Forestry Service (2009).

2. **Space-Time Dynamics or Changing Pattern of Eucalyptus Population in Bali Sub-Division**

The eucalyptus plant was introduced in Bali sub-division around the 1950s. By this time, it had only one function; serving mainly as a boundary marker and so its cultivation was mainly concentrated around residential areas. The distribution of eucalyptus population in Bali sub- division before 1990 is presented in Figure 3.

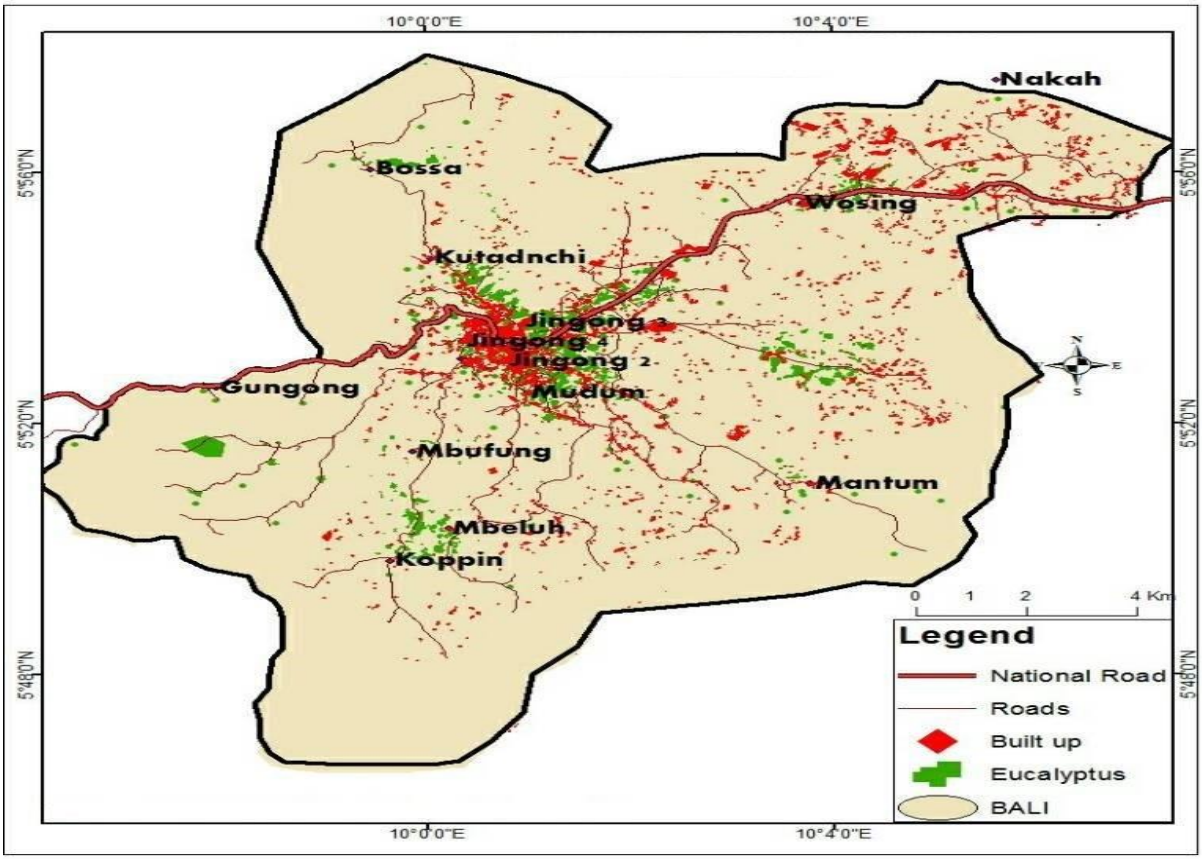

Fig.3. Eucalyptus cultivation in Bali sub-division before 1990
Source: Adapted from geo database of Cameroon (2005) and GPS based field survey (February, 2018)

Figure 3 reveals that the eucalyptus population was highly concentrated around Bali urban, notably in neighbourhoods like Jingong 1, 2, 3 and 4. Also, acquired land sat images of the eucalyptus plant by 1990 showed that eucalyptus occupied 3.39km^2 of the total land surface of Bali. Twenty seven years later (1990-2017), satellite images further reveal that the eucalyptus had witnessed about a threefold increase (9.47km^2) in the total surface area covered by the plant in Bali in 1990. Satellite images of 2017 equally highlights that there has been a significant decline in the zone occupied by the plant from mostly urban or built-up areas between 1950 and 1990 to mostly rural areas in 2017 (Fig. 4) such as Wosing, Bosa, Mbeluh, Koppin, Mbufung and Mantum away from the buildup areas of Bali urban. The extension of *Eucalyptus camaldulensis* in Bali Division as observed in 2018 from around the Nakah River stretching to Wosing and other villages Beissem, Bosa, Bawock, Nitap, Mbufung and Bali Central affirms earlier observation by Louppe and Depommier (2010).

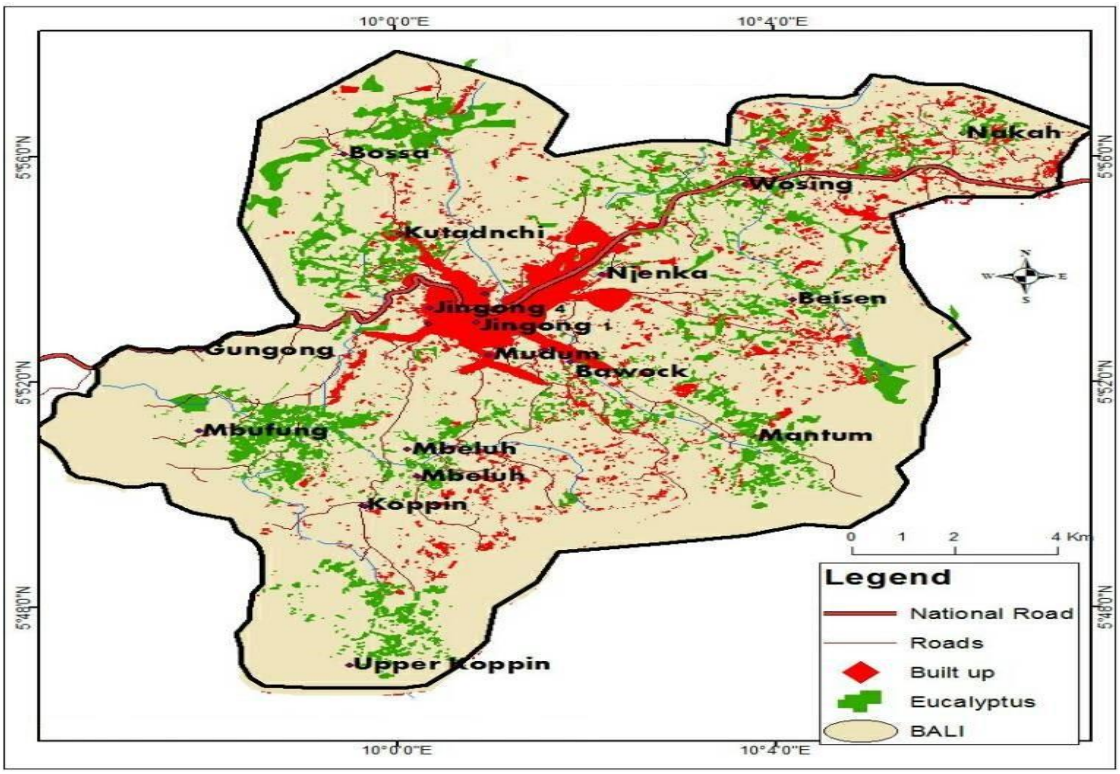

Fig4. Eucalyptus cultivation in Bali sub-division in 2017
Source: Adapted from geo database of Cameroon (2017) and GPS based field survey (February, 2018)

Several reasons accounted for the shift in eucalyptus growth from the build-up (urban) to the rural areas in Bali sub-division at the dawn of the 20th Century. The first is accelerated urbanisation characterised by rapid population growth. As a result of the growing population, there was out migration from urban into rural areas in Bali which is the same with the eucalyptus farms as most of the farmers previously in urban areas moved with their "eucalyptus culture" to the villages with abundant land and a low population density. This trend can also be attributed to the high consumption of the eucalyptus wood in the urban area for diverse purposes, amongst which include infrastructural development such as in the construction of houses, bridges, schools, warehouses, stores and telephone poles. More so, the shift was also because some of the urbanites believe that the eucalyptus trees are a threat to their well-being through the excessive water and soil nutrient intake required for their growth. Finally, the shift was due to the need for large farm sizes for their growth which was readily available in the rural areas (Table 3). For instance, as we can observe from the Table 3, some 55.4% of eucalyptus farmers in Bali rural own farms with surface area greater than 10.000m^2. In a rapidly urbanizing setting like that of Bali sub-division, such large expanses of land under eucalyptus growth can only be obtained and at a cheaper cost in the rural areas where we find vast expanses of unoccupied or unused country side.

Table 3. Sizes of eucalyptus farms in selected villages of Bali rural

S/N	Farm size (m^2)	Frequency	%	Cumulative %
1	0-4000m^2	7	10.8	10.8
2	4001 – 8.000	19	29.2	40
3	8.000 – 10.000	3	4.6	44.6
4	> 0.000	36	55.4	100.0
	Total	**65**	**100.0**	

Source: Field Work (February, 2018)

3. Policy implications of declining eucalyptus population in urban or build-up areas towards sustainable city planning in Cameroon

Though eucalyptus is vital in urban areas as they perform specific functions such as draining of wetlands to increase available land area for housing construction for the bourgeoning urban population, its decreasing pattern in Bali urban as highlighted in this study is a blue print indicator for sustainable city planning not only in Bali, but in the other Cameroonian cities and town. Their decreasing pattern in urban areas gives an opportunity for urban planners to better plan the cities because eucalyptus is limited in many sustainable city planning operations. The opportunities

that accompany sustainable city planning associated with the decreasing pattern of eucalyptus in Cameroonian cities and towns are as follows:

1. Saw mills which used to concentrate in densely settled neighbourhoods of cities and towns to process the eucalyptus plants into timber for household and factory (backery) use will now be pushed to the peri-urban and rural areas thereby reducing noise and sound pollution in the cities.
2. Again, it will help to reduce damage to buildings by the roots of the eucalyptus plants which usually cause problems for home owners. The roots of the plant spread up to 100 feet out and in cities and towns, and so they can grow into urban infrastructures such as ditches, plumbing pipes, foundations of houses and septic tanks, thereby cracking and damaging them.
3. It will also enable city planners and policy makers to rehabilitate watersheds for sustained water supply in cities and towns and put in place in the municipalities a water management plan to increase potable water supply. This is because eucalyptus is a heavy water feeder that competes for water with other species and has been reported to contribute to water scarcity and other environmental problems in several cities and towns.
4. Furthermore, it will enable city and town planners to plant shade trees such as *Cordial Africana* and small ornamental street trees in urban centres in the place of the decreasing eucalyptus plants. This is because eucalyptus plants grow too tall (about 45m). What we need in our cities and towns are short plants with broad leaves that have a micro-climate that keep the climate cool. We should therefore plant shade plants instead of eucalyptus to help reduce overheating (urban heat island) due to climate change.
5. More so, it will give urban planners more interest in multi-purpose plants that give greening, provide shade and urban aesthetics. This is something that the eucalyptus plants in cities and towns do not give. This is imperative because modern cities are planned with aesthetics to make them sustainable. Eucalyptus is limited in its aesthetic role and only good for agro-forestry that only gives timber for household and community use. The eucalyptus in the urban milieu is detrimental to other plants as well, and its seeds are light and usually propagated by wind.
6. Finally, declining eucalyptus population in cities and towns will make it easier for town planners to create parks and botanical gardens for recreation which otherwise would not have been controlled with the uncontrolled expansion of the eucalyptus plants.

CONCLUSION AND RECOMMENDATIONS

Besides some of its socio-economic benefits such as a source of fuelwood for households, building/construction material and income generation, eucalyptus plants are detrimental to the urban environment and infrastructures such as buildings and foundations, ditches, septic tanks and water pipes which criss-cross neighbourhoods. Their declining pattern from the urban to the peri-urban and rural areas as is the case in Bali sub-division in the Northwest region should therefore be seen by city and town planners as a blueprint for sustainable city planning in Cameroon. This is because it may help reduce noise and sound pollution in cities, prevent damage to buildings by the wide spreading roots of the eucalyptus plant, rehabilitate watersheds and appropriately plan municipal water management schemes for sustainable water supply to cities and the growing of shade trees and other multi-purpose plants that provide urban aesthetics and help create municipal parks and botanical gardens for urban recreational purposes which are all sustainable city indicators. It is recommended that urban planners and policy makers exploit the declining pattern of eucalyptus in urban or build-up areas in Cameroonian cities and towns as a blue print for improved sustainable planning options and set appropriate medium and long term goals which significantly favours the emergence of sustainable cities in the country.

REFERENCES

1. Aubréville, A. (1953). « Editorial: Il n'y aura pas de guerre de l'Eucalyptus à Madagascar ». *Bois et Forêts des Tropiques*, N° 30, pp 3-7.
2. Bali Rural Council Archives (2012). Consulted 2017/2018.
3. Belnap, J., Ludwig, J. A., Wilcox, B. P., Betancourt, J. L., Dean, W. R. J., Hoffmann, B. D., & Milton, S. J. (2012). "Introduced and invasive species in novel rangeland ecosystems: Friends or foes?" *Rangeland Ecology &Management 65*(6): pp 569-578.
4. Bennett, B. M. (2010). "The El Dorado of forestry: The Eucalyptus in India, South Africa, and Thailand, 1850-2000". *International Review of Social History, 55*(S18), pp. 27-50.
5. Casson, A. (1997). The controversy surrounding eucalyptus in social Forestry programs of Asia. The Australian National University, Australia.
6. Chin, O. (2006). Rising preference for Eucalyptus poses dilemma in Eastern Africa, In: Eastern and Central African Policy Brief, 2006, ICRAF, 2p.
7. Dadkhah, A. (2013). "Allelopathic effects of sugar beet (*Beta vulgaris*) and eucalyptus (*Eucalyptus camaldulensis*) on seed germination and growth of Portulaca Oleracea" *Russian Agricultural Sciences 39* (2), pp. 117-123.

8. Demel, T. (2000). The ecological effects of Eucalypts: Ground for making wise and information decision. Paper presented at the workshop "The Eucalyptus Dilemma", 15th Nov. 2000, *Ghion Hotel, Addis Ababa*,45p.
9. Dessie, G., & Erkossa, T. (2011). "Eucalyptus in East Africa: Socio-economic and environmental issues." Forestry Department and Agriculture Organization of the United Nations. Working Paper FP46/E. 5P.
10. Doughty, R. (1996). "Not a koala in sight: Promotion and spread of Eucalyptus". *Ecumene: A Journal of Cultural Geographies 3* (2), pp. 200-214.
11. Esmail, A. (2017). "The pharmacological and therapeutic importance of Eucalyptus species grown in Iraq", *Journal of Pharmacy*, Vol. 7, Issue 3, Version.1, pp. 72-91.
12. Espinosa-Garcia, F. J., Martinez-Hernandez, E., & Quiroz-Flores, A. (2008). "Allelopathic potential of Eucalyptus spp plantations on germination and early growth of annual crops" *Allelopathy Journal* 21(1), pp. 25-30.
13. FAO. (2009). Eucalyptus in East Africa, the Socio-economic and Environmental Issues, FAO,Addis Ababa.
14. Kenya Forest Service. (2009). A Guide to On-Farm Eucalyptus Growing in Kenya, 36p.
15. Kidanu, S., Mamo, T., & Stroosnijder, L. (2005). "Biomass production of *Eucalyptus* boundary plantations and their effect on crop productivity on Ethiopian highlands vertisols" *Agroforestry Systems, 63* (3), 281-290.
16. Kituyi, E., Marufu, L., Wandiga, S. O., Jumba, I. O., Andreae, M. O., & Gunter, H. (2001). "Biofuel availability and domestic use patterns in Kenya". *Biomass and Bioenergy 20* (2), 71-82.
17. Kluthe, G., & Brandy, M. (2016). Eucalyptus in Kenya; Impacts on Environment and Society. *Theses and Dissertations*. 1661. http://scholarworks.uark.edu/etd/1661
18. Lane, P. N. J., Morris, J., & Ningnan, Z., (2004). "Water balance of tropical *Eucalyptus* plantations in southeast China", *Agricultural and Forest Meteorology* 124(3):253-267.
19. Louppe, D., & Depommier, D. (2010). Expansion, research and development of the eucalyptus in Africa wood production, livelihoods and environmental issues: An unlikely reconciliation? A communication given at the FAO/MEEATU Workshop "Eucalyptus in East Africa the socio-economic and environmental issues", Bujumbura, 31 March-1 April, (2010) 9p.
20. Lukong, J. (2000). Cultivation of eucalyptus: Its socio-economic significance and environmental implication in Vekovi. Higher Teacher Training College Annex Bambili, *University of Yaounde,1*, 88p.
21. Maundu, P., & Tengnas, T. (2005). Useful trees and shrubs for Kenya. Technical Handbook No 35, Nairobi, Kenya: *World Agroforestry Center (ICRAF-ECA)*.
22. Morales,V. (2007). The economic impact of the forest sector in Uruguay: A cost-benefit analysis. Master Disst., University of Georgia, 158p.
23. Musa, P. (1995). "Eucalyptus in Cameroon". *Ecodecision*, (18), 8-9.
24. National Institute of Statistics of Cameroon. (2017). Statistical yearbook of the North West Region 2015, 315p.
25. Neba, A. (1999). Modern geography of the Republic of Cameroon, 3rd Edition, Neba publishers, *Bamenda, Cameroon*.
26. Ngala, H., & Amawa, S. (2014). "Environmental degradation and the emergence of agricultural frontiers in the North West of Cameroon". *Journal of Sustainable Development, 7* (5), 1-17.
27. Ngala, P. (1992). Afforestation: the growth and exploitation of eucalyptus in Nkambe Sub Division. DIPES II Dissertation, Higher Teacher Training College Yaounde, *University of Yaounde*, 74p.
28. Njilin, A. (2009). The socio-economic impacts of the heifer international sponsored milk production project in Bali sub-division. BSc dissertation, *University of Buea*. 59p.
29. Otieno, J. (1998). Tobacco under contract: Agricultural development and environmental change in Kuria district, Western Kenya. Ph. D Thesis, *University of Illinois at Urbana-Champaign*.
30. Poore, M.E.D., & Fries, C. (1985). The Ecological Effects of Eucalyptus. FAO Forestry Paper No. 59, Food and Agriculture Organization, Rome, 87p.
31. Riffell, S., Verschuyl, J., Miller, D., & Wigley, T.B. (2011). "A meta-analysis of bird and mammal response to short-rotation woody crops" *GCB Bioenergy 3*(4), pp. 313–321.
32. Tata, N., Umaru, B., Achankeng, E., & Tsalefac, M. (2013). Land and water resources management in Nkambe highlands of Cameroon: Challenges and perspectives. Joint proceedings of the 27th Soil Science Society of East Africa and the 6th African Soil Science Society, *Nakuru, Kenya*, 8p.
33. Turnbull, J. W. (1999). "Eucalyptus plantations" *New Forests 17*, 37-52.
34. Zacharin, R. F (1978). Emigrant eucalypts: Gum trees as exotics, Carlton South, *Vic.: Melbourne University Press*.
35. Zhang, W. J. (2012). "Did eucalyptus contribute to environment degradation? Implications from a dispute on causes of severe drought in Yunnan and Guizhou, China". *Environmental Skeptics and Critics, 1*(2), pp. 34-38.