

The Environmental Implications of Socio economic development In Sangmelima Town, South Region-Cameroon

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ABSTRACT: Debates on the implications of socio-economic development on the environment constitutes one of the major challenges facing many societies at the dawn of the 20th century. This study seeks to analyze the negative impacts of socio-economic development on the physical environment of Sangmelima town. The hypothetico deductive method facilitated the collection of data from questionnaires, interviews and on-the-spot appraisals. A time series analyses through Landsat images of Sangmelima (2001, 2011 and 2019) were used to analyse landcover/landuse changes. Landcover and landuse analyses revealed that forest cover has reduced by 12.67% as a result of urban infrastructural development and increase in fuel wood demand leading to forest fragmentation and biodiversity loss. The one-time physical environment of Sangmelima that knew little or no stress in the 1960's has seen the progressive replacement of its pre-existing vegetation with buildings of varying qualities following unprecedented rates of socio-economic. These impacts are glaring on the environment of Sangmelima and includes poor waste management practices, pollution (water, air and soil), loss of biodiversity and erosion. Water pollution, manifested through floating wastes has caused eutrophication in certain parts of River Lobo, open waste dumps constitute the main drivers of soil pollution while uncontrolled burning of wastes have opened up flood gates for air pollution. Such inconsistencies are due to limited/inadequate budget allocated for waste recycling and treatment, (90% of budget dedicated to waste management is allocated to collection and transportation and just 10% for treatment and recycling). Limited human and technical capacities, the reluctance and incivility of the population are inflexible to respond to environmental issues with a commensurate speed and agility thereby rendering the actions of local actors in environmental management issues epileptic, opening flood gates for environmental decay.

Keywords: Implications, socio-economic, development, environment, Sangmelima

I. INTRODUCTION

Despite the benefits derived from the environment (raw materials, food, shelter, and pharmaceuticals) and efforts to establish sustainable environmental management, the environment continues to degrade. Increasing human populations and the quest for better life through socio-economic activities have led to negative implications for environmental management especially in the developing world. The level of concern and state of urgency has reached new levels both at the local, national and international strands. The extent of environmental degradation varies across countries and regions of the world (Holtz-Eakin and Seldon, 1995). According to Kalipeni (1992), poverty is the major cause of the depletion of natural resources and environmental degradation in Africa. In the Asia Pacific region both rapid population growth and continuous economic development are major causes of environmental pollution (Dewaram 2007). In the United States, where population density is much lower than in India, the main cause of environmental degradation is the extremely high per capita consumption of resources and the consequent high carbon emissions (United Nations 1997). Smyth (2008) conducted a study on the relationship between growth and environmental issues in China and concluded that high rate of economic growth leads to high rates of pollution. This is because population growth and the resulting economic activities generate pressure on the natural environment. This is visible through the rapid decline in tropical forests, global warming and environmental pollution (United Nations, 1992).

Based on the above issues raised so far, debates on the implications of socio-economic development on environmental management have gained significant traction in contemporary research. Klarin (2018), noted that the aspirations of developed countries to improve the socio-economic and ecological situation of developing countries gathered scientists, economists and humanists from ten countries in Rome in 1968 to discuss the current problems and future challenges (limited natural resources, population growth, economic development and ecological problems) of humankind. The world environmental conference that took place in Stockholm in 1972 drew world attention to the inextricable links between development and the environment (Okonkwo, 2013). Since 1972, the twin issues of economic development and environmental protection have engaged the attention of scientists and non-scientists alike all over the world (Okonkwo, 2000). In 1983, the United Nations World Commission on Environment and Development (WCED) was established to develop a global change program aimed at raising awareness and concern about the negative impact of socio-economic development on the environment (Drexhage and Murphy, 2010). In 1987 a Commission of 19 delegates from 18 countries published a report 'Our Common Future', better known as the 'Brundtland Report', where the concept of sustainable development was introduced (Drexhage and Murphy, 2010). This report analyzed and provided a clear overview of the conditions in the world (socio-economic development, environmental degradation and population growth) and elaborated the concept of sustainable development. As a new approach, it aimed to respond to future challenges; achieving balance between socio-economic development and the environment, reducing environmental degradation and the exploitation of natural resources, WCED (1987) cited in Klarin (2018). The terms such as "development and environment", "development without destruction" and "development in accordance with the environment" were increasingly used in publications (Klarin, 2018).

Although cities serve as 'engines' of growth as they drive most economies by creating wealth, enhancing socio economic development, providing employment, education and ready markets for industrial and agricultural product and, therefore, focal points for economic growth (UN 2011), unprecedented socio-economic development can also create breeding grounds for environmental degradation. A recent world development report observed that "cities in Africa are not serving as engines of growth and structural transformation. Instead, they are part of the cause and a major symptom of an environmental crisis that have enveloped the continent" (World Bank 2000). High urban populations, therefore, place enormous stress on the physical urban environment and impose 'ecological footprints' on the peri-urban areas (Rees, 1992; Rees and Wackernagel, 1994). The question that arises is whether the current trend in socio economic development is sustainable. Adequate planning is, therefore, necessary to reap the potential benefits of socio-economic development and lessen its costs and negative side

effects. In a bid to ensure environmental sustainability, the Cameroon government has instituted a battery of legal/regulatory instruments (Ndi et al, 2017). This includes Law No. 94/01 of 20 January 1994 to lay down forestry, wildlife and fisheries regulations and the Law No 96/12 of 5th August 1996 relating to Environmental management which outlines the general legal framework for environmental management in Cameroon.

The impact of socio-economic development on the environment has been widely discussed in environmental studies, emphasising on the impact of population growth on environmental conditions. These studies are concentrated in big cities while small towns which are still at an embryonic stage of development, like Sangmelima have had less attention. This observation thus indicates the importance of examining the environmental implications of socio-economic development in Sangmelima. Based on this, this paper examines the trend of socio-economic development in Sangmelima in a bid to diagnose the negative footprints on its physical environment. Diagnosing, therefore, the causes and measures to curb these impacts on the environment is of paramount concern.

II. STUDY AREA

Sangmelima is found some 200km South-East of Yaounde and 105km from Ebolowa. It is the head quarter of the Dja and Lobo division of the South Region of Cameroon. It is located between longitude 11°55' and 12°15' E and latitude 2° 45' and 3°02' N and covers a surface area of 2931 km² (figure 1).

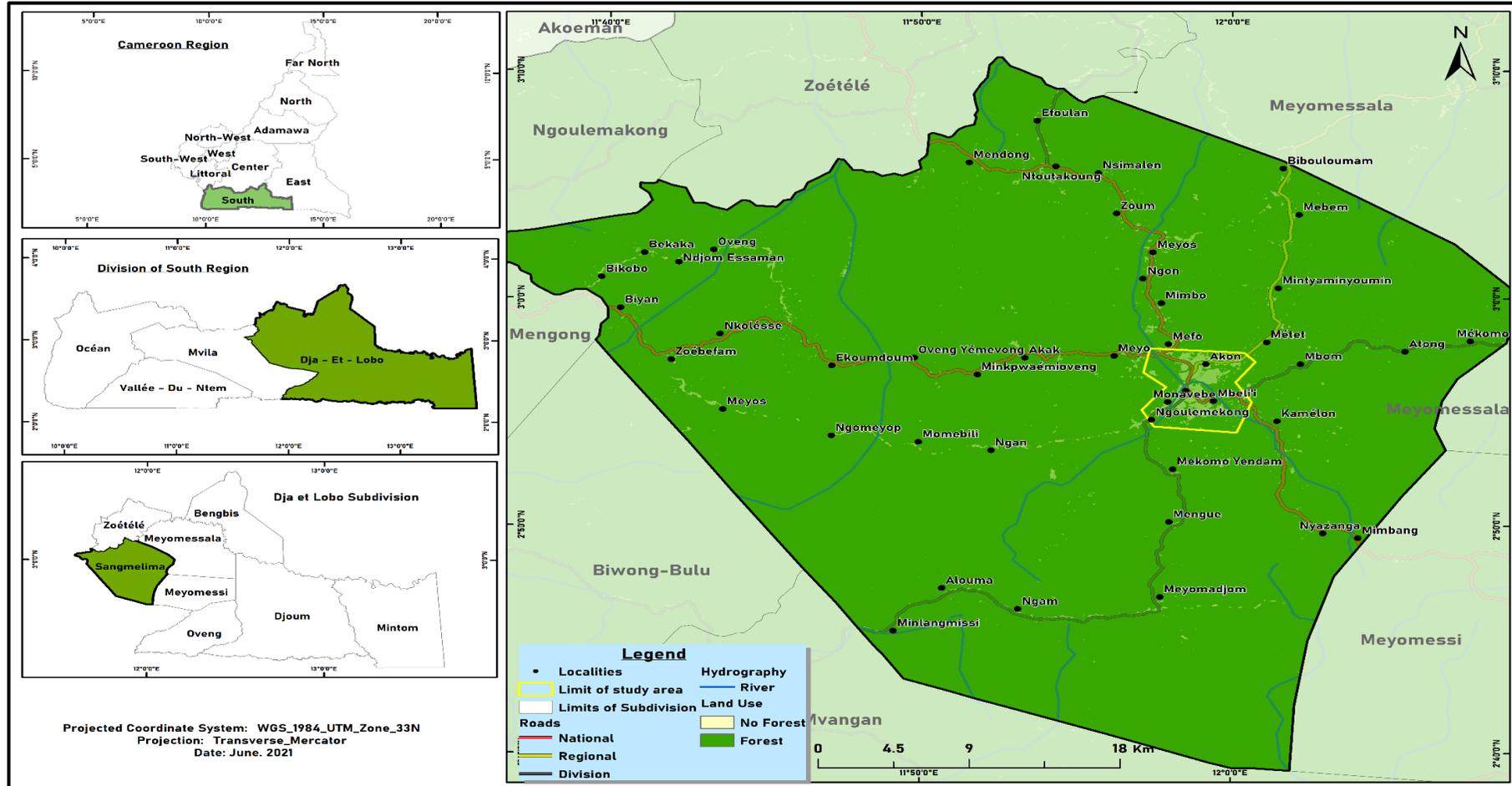


Figure 1: Location of Sangmelima in the Dja and Lobo Division, South Region of Cameroon

The town of Sangmelima is situated in the vast south Cameroun plateau with an altitude varying between 600m-700m above sea level (Council Development Plan, 2015). On a whole, Sangmelima has a relatively accidented relief which is undulating, consisting of peneplains and valleys which intermingle with hills. In some areas, convex hills with narrow valleys are common (Council Development Plan, 2015).

III. MATERIAL AND METHODS

In order to examine the implications of socio-economic development on the environment of Sangmelima, primary and secondary data were sourced. Primary data sources constituted data gotten through interviews, on the spot observations and questionnaire administration. The observatory phase was done on two fronts; general observation and observation in situ. General observation targeted the natural environment and the evolution of socio-economic activities in Sangmelima via the use of remote sensing and geographic information system techniques. Observation in situ consisted of direct observation of the natural environment and the action of the population vis à vis the environment. Questionnaires were administered to households in some sampled neighborhoods. These questions probed into the generalities on the trend of socio-economic development on the environment of Sangmelima town. Interviews were granted to some potential resource persons saddled with environmental management like the Hygiene et Sûreté du Cameroun (HYSACAM) Sangmelima, the head of hygiene and sanitation department in the municipal council of Sangmelima, the divisional delegation of the Ministry of Environment, Nature's Protection and Sustainable Development in Sangmelima and the divisional delegation of the Ministry of Forestry and Wildlife as well as the divisional delegation of Small and Medium Sized Enterprises, the Divisional Delegations of Basic and the secondary education. For stakeholders saddled with environmental management, interviews granted probed on environmental practices and management by local actors, waste production and management, economic situation of the town and the degree of collaboration between urban management stakeholders. For the analyses and treatment of maps, Landsat 7 and 8 images with 30m resolution respectively were used. For the time series analyses, 3 set of images were used; 2001, 2011 and 2019. The treatment of these images was done using remote sensing and GIS softwares (ENVI and ArcMap).

IV. FINDINGS AND DISCUSSIONS

4.1-The Trend of Socio-economic Development in Sangmelima

Cities are one of humanity's most complex creations as they exhibit an incredible diversity in their historical origins, characteristics and patterns of growth. Their evolution is determined by the ascent into greatness or descent into decline. They are thus the past, present and the future (UN Habitat, 2008). The spatial evolution of Sangmelima town, therefore, is not uniform. Sangmelima has not grown in a precise/concise manner but has been characterized by periods of slow and rapid growth both in the vertical (population) and horizontal (spatial extension) dimensions. Such a relentless/dramatic growth, inimical to the environment of Sangmelima town for several decades now, has been inevitable and irreversible creating a chaotic urban landscape. This had contributed and will continue to contribute to a series of environmental implications to the various stakeholders charged with the management of Sangmelima. In the 1950s the town of Sangmelima emerged as the largest urban center in the Dja and Lobo division, south region of Cameroon. It was a typical service center with a relatively high position in the regional urban structure in terms of its areal extent and socio-economic activities. After independence in 1960s, the town further experienced a remarkable growth in the social and economic domain and thus became the head quarter of the Dja and Lobo division in the South region of Cameroon.

4.2-Economic Domain

Sangmelima portrays a mosaic of economic activities which have over the past years contributed to its development. Sangmelima's economic vocation was consolidated in 1953 with the construction of the Sangmelima-Ebolowa road which brought a boom in economic activities. The Dja and Lobo division was then the

largest cocoa producer in the country and the effects of cocoa farming were felt in Sangmelima in particular through the existence of stores for storing/selling cocoa and the presence of expatriates involved in the cocoa trade.

The lunch of important building and construction projects like the Sangmelima referral hospital, the Interstate University and the Sangmelima Municipal market have attracted workers, scholars, researchers and business people into the town. Migrants in and out of the country were thus attracted into Sangmelima for business and employment opportunities as the town was transformed into a “*new eldorado*” in the south region of Cameroon. Prior to 2019 only two markets existed in Sangmelima, but today, there exist 3 markets. Informal activities like motorbike transport, mobile telephone kiosks, roadside shops, roadside restaurants, fish and palm wine sellers have a multiplier effect on the economic activities of Sangmelima. Though with this avalanche of informal sector activities, the formal service sector has, however, gained ground with the opening of branches of formal banking institutions such as the Credit Communautaire d’Afrique (CCA), the Societe Cameroun de Bank Cameroon (SCB) and the Banque Internationale du Cameroun pour l’Epargne et de le Credit (BICEC). These financial institutions have played a fundamental role in revitalizing and diversifying the socio-economic function/activities of the town.

The secondary sector of Sangmelima is replete with small scale industries involved in processing agricultural raw materials, arts and craft as well as some processing facilities for wood extracted from neighboring forests. Besides, drinking water and energy production units, artisanal or semi-artisanal transformation of food and wood as well as metallic objects are not left out. Work of arts and crafts are common as evidenced with the presence of workshops, painting, screen printing and drawings. Other industries such as a cassava processing plant, factories for various art objects and concrete block factories are common. The hotel industry is also evident with the presence of a multitude of hotels including Hotel l’Afamba, Hotelle Prive, Sabella Hotel, Onos Hotel, Motel Jupiter and Nouheumi Hotel. Also, small inns which are more or less informal operate in Sangmelima. Such a high degree of diversification in the socio socioeconomic sector is attributed to urban expansion due to population growth, its educational, administrative and health care services.

4.3-Social Domain

In the social domain, schools, recreational centres/facilities and health centres/hospitals (for example Sangmelima Referral hospital, Centre de Sante Léproserie de Sangmelima, Hôpital de district de Sangmelima, Centre de Sante Intégré de Sangmelima, Centre de Sante Militaire de Sangmelima, Centre de Sante Intégré de Monazang and Dispensaire Mission Catholique d’Akon) are common in Sangmelima. Before the year 2000, Sangmelima counted 7 primary schools. In 2010, the number of primary schools increased to 12 and by 2020, Sangmelima counted 26 primary schools (for example, Government Bilingual Primary School Sangmelima (4), Ecole Privée la Rosée du Sud, Ecole publique d’application (5), Alfred and Sarah Bilingual academy, Ecole Catholique Bilingue Saint Rossaire, Grace Bilingual School, Royal English school, Ecole Catholique Saint Joseph and Ecole Catholique Sacré Cœur) 10 secondary schools (Table 1) and 5 higher vocational institutions (Table 3).

Table 1: Distribution of some Secondary Schools in Sangmelima

Name of School	Neighbourhood	Status	Enrolment
Lycée Bilingue de Sangmelima	Sangmelima village	Public	1343
Lycée Classique et Modern de Sangmelima	Ebolenbwang	Public	3153
Lycée Technique de Sangmelima	Otoakam	Public	1381

Lycée de Monavebe	Monavebe	Public	1119
Collège Immaculée Conception	Nkolguet	Private	575
Alfred & Sarah Bilingual college	Sangmelima village	Private	313
Collège Notre Dame du Sacré Cœur	Sangmelima village	Private	447
CETIC de Sangmelima	Otoakam	Public	1113
CETIF de Sangmelima	Ebolengbwang	Public	518
CODJAL Sangmelima	Lobossi	Private	227

Source: Divisional Delegation of Secondary Education 2020 and Field work (2020)

These secondary schools (Table 1) which are both general, technical and professional are located in both urban and semi urban areas of the town. Such a mix system offers diverse fields of study for students who want to continue their studies as it plays a crucial role in shaping students' intellectual, social, and personal development. It equips them with the knowledge, skills, and competencies necessary for success in higher education, the workforce and life by giving them a strong academic foundation. Higher and vocational institutions (Table 2) which to date are public entities have played a fundamental role in training many inhabitants within and out of Sangmelima.

Table2: Distribution of Higher Vocational Institutions in Sangmelima

Name of Institution	Neighbourhood	Status (private/Public)
Sangmelima Vocational Training Center	Nkolguet	Public
Ecole des Technicien d'Agriculture	Nkolguet	Public
Ecole des Infirmiers Diplômés d'Etat	Nkolguet	Public
Université Inter Etat Cameroun-Congo	Nkolguet	Public
ENIEG de Sangmelima	Mbeli'i	Public

Source : Fieldwork(2022)

These vocational institutions (Table 2) which are all government owned equip students with targeted/specific skills and knowledge tailored for entry into a specific trade or profession and make them real professionals in their domain of specialization. These institutions further prepare students for immediate employment by equipping them with practical skills which facilitate a smooth transition into their chosen profession as they enhance hands-on and practical experience.

4.4-Political Domain

Sangmelima is a medium-sized city which developed on an administrative unit whose primary function was to bring together the essential services of the administration closer to the citizens. The presence of a panoply of divisional and sub divisional delegations of different ministerial departments/sectors have acted as a pull factor, attracting people into the town. This is statistically confirmed as the town alone shelters 52.57% of the total population of the Dja and Lobo division (CDP, 2015). The transfer of civil servants to state deconcentrated ministerial departments and local services, who in some cases move with their families, the movement of people in search of employment opportunities as well as markets to sell their products have a multiplier effect on Sangmelima. New services develop, new economic activities take root, new exchanges happen and with the

increasing population new infrastructures surface to respond to the demand. As a result of developments in the socio-economic sector, the town shelters a cosmopolitan population from all over the Cameroon. The population is composed mainly of the Bulu ethnic group with the principal tribes including; the Yembong, Yen jock, Yendam, Yekombo, Esse, Yemfek, Yemveng, Yemvack, Mbidabane, Yemenvong and the Essaman. Nonetheless, the town counts an important population of the Bamileke, Bamoun, Ewondo, Eton, Hausa, Maka, Bassa and Bafia.

The population of Sangmelima has undergone a remarkable growth over the past years. Results from the National Population and Housing census show that Sangmelima had a population of 14700 inhabitants in 1976(Figure 2). In 1987, the population moved to 23,300 inhabitants and in 2005 the population increased more than two folds to 51,333 inhabitants, a triple of that of 1976, and close to a double of that of 1987 with a growth rate of 4.3%. The population according to 2019 stands at 132513.

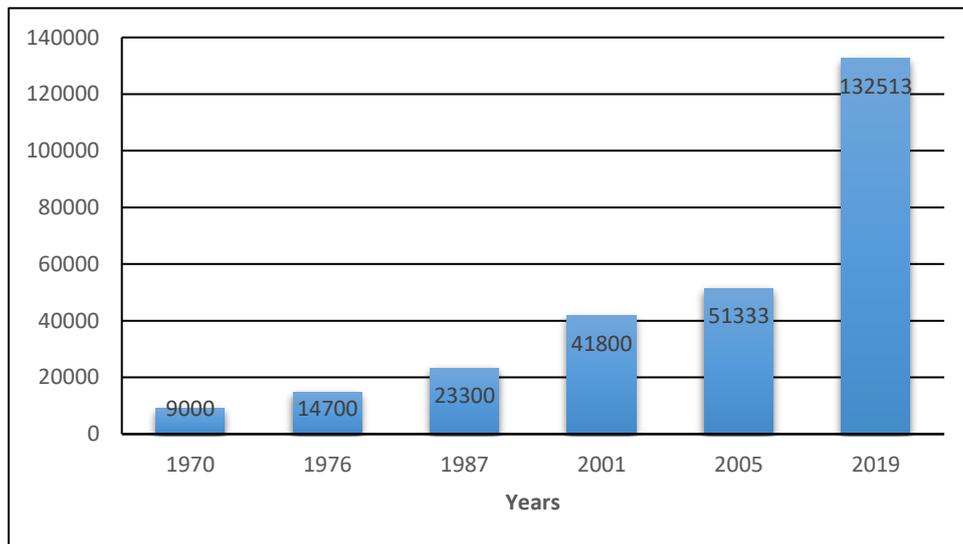
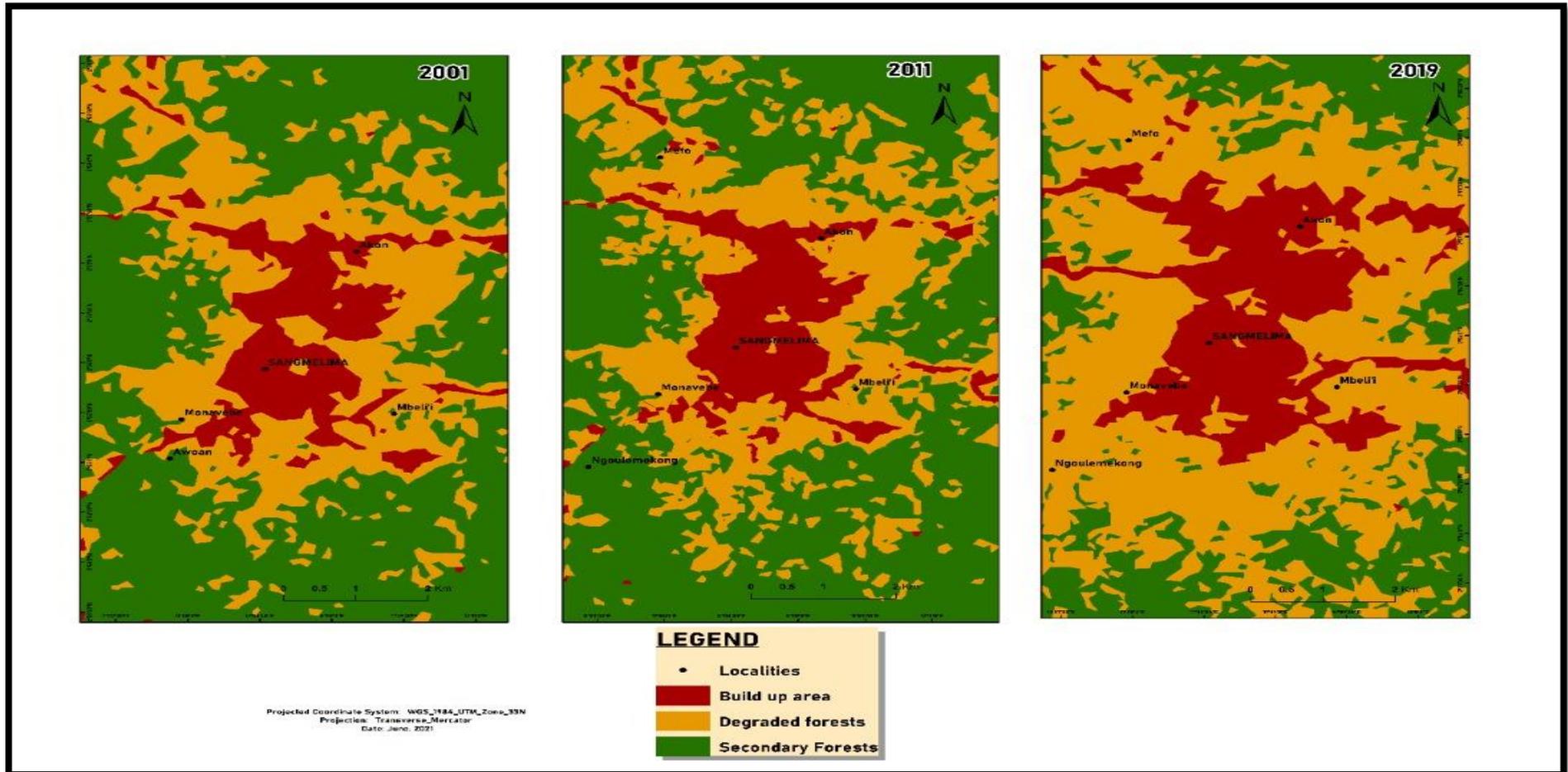


Figure 2: Population evolution in Sangmelima
Source: BUCREP(2005) and Projections (2005-2019)

Sangmelima's population is growing rapidly because of both temporary and permanent migration, borne by socio economic development. All of these have resulted to a diversification of its socioeconomic fabric making it the hear-bit of the Dja and Lobo Division. As a result of socioeconomic activities, the areal spatial extent of the town has increased significantly. Figure 3 illustrates land cover/land use in the town of Sangmelima for the years 2001, 2011 and 2019.



Source: National Institute of Cartography (NIC) and Openstreetmap,2021
Figure 3: Land cover / land use dynamics in Sangmelima (2001, 2011 and 2019)

Table 3: Land Cover/Landuse dynamics in Sangmelima

Year	2001		2011		2019	
	ha	%	ha	%	ha	%
Surface area						
Forest	139465.646	94.17	127663.173	86.2	120686.88	81.5
Built up area	465.41534	0.32	1035.40607	0.7	1707.25767	1.2
Land	8168.25331	5.51	19392.9787	13.1	25705.1837	17.3
Total	148099.314	100	148091.558	100	148099.321	100

Source: Fig 3

In 2001 (Table 3), built up areas covered only 46,541,534ha (0.32%) of the total surface area of Sangmelima and in 2011, it increased to 103,540,607ha (0.7%) of the surface area, almost double of 2001 with a percentage increase of 0.57% (Table 4). In 2019, it further increased to 170,725,767 (1.2%) of the surface area, a triple of that of 2001.

Table 4: Evolution rate of Land Cover/land use dynamics in Sangmelima

2001-2011		2001-2019		2011-2019	
Surface Area	Percentage (%) increase	Surface Area	Percentage (%) increase	Surface Area	Percentage (%) increase
11802.473	7.97	-18778.766	-12.67	-6976.293	-4.7
569.99073	0.57	1241.84233	0.89	671.8516	0.5
11224.72539	8.17	17536.9304	11.88	6312.205	3.7

Source: Fig 3

Between 2001 and 2011, spatial increase was 56,999,073ha in 10 years (56,999,073ha) as shown on Table 4. Between 2011 and 2019, spatial increase was 671,851,6 hectares in 7 years (671,851,6ha) per year. The desire of the town authorities to turn their backs on the past and restore the image of the town and related requirements of urban life (the construction of settlements, commercial grounds, hotels, playgrounds, hospitals and schools) further increased impact of socio-economic development on the environment of Sangmelima.

V. THE ENVIRONMENTAL IMPLICATIONS OF SOCIO-ECONOMIC DEVELOPMENT IN SANGMELIMA

The agglomeration of population into urban areas necessitate the quest for basic facilities to compensate with the demographic structure (Ogundele *et al*, 2011) which negatively impacts on the environment. As the philosopher Spinoza said; “from a determined cause necessarily results an effect and vice versa. if no determined cause is given, it is impossible for an effect to occur” (kwadja, 2020). According to Kan; “all changes occur following the law of connection of cause and effect” and if two elements are correlated, then there is a cause-and-effect link between both - law of causality” (Eric W. 2004). This is the situation that exists between socioeconomic development and the environment of Sangmelima town. From the different interviews conducted, direct field observations and informal discussions held, socio economic development has brought with it an avalanche of environmental headaches on the environment of Sangmelima town including; unsound solid waste management practices leading to different sources of pollution (air, soil, pollution) loss of biodiversity and erosion.

5.1- Unsound Waste Management Practices

Solid waste management is the process of generating, collecting, storing, treatment and disposal of solid wastes in such a way that they are harmless to humans, plants, animals, the ecology and the environment generally. It is

thus the judicious application of a range of options to achieve a broadly optimal system of waste management and resource recovery. Solid waste management in Cameroon is governed by the law no 96/12 of 5th august 1996 relating to Environmental management. According to law;

“Wastes shall be any residue from production, processing or utilization process, any substance or material produced or, more genera any movable and immovable good abandoned or intended to be abandoned” and Waste Management “Shall be the collection, transportation, recycling and elimination of waste, including monitoring of disposal sites.”

Increasing rates of socio-economic development have, however, brought with it problems in the management of solid wastes in Sangmelima. Municipal solid wastes have not only increased in quantity but also in composition (from less organic matter to more paper, plastics, glass, metal and other substances). Sangmelima produces solid material regularly which leads to considerable increase in the volume of waste produced from several sources such as, domestic wastes, commercial wastes and institutional wastes. Quite worry is the fact that most of these wastes are non-biodegradable. This is further exacerbated by low collection rates and unscientific handling methods. Monthly average waste collected in Sangmelima ranges between 1100-1500 tons giving an annual average of 13200-18000 tones (Sangmelima Council, 2020).

Not all the wastes generated in Sangmelima is properly disposed and treated. According to Table 5, 139 households (45%) of the respondents dispose their waste in public bins, 34 households (11%) in nearby forests, 13 households (4%) in rivers/streams, 112 households (37%) in streets, 5 households (2%) burn and 3 households (1%) in gutters. Treatment is done either by recycling through composting or systematic burial in a local landfill.

Table 5: Waste disposal sites and mode of treatment in Sangmelima

Neighborhoods	No of questionnaires (3% sample)	Public bins	Nearby forest	Rivers	Street	Burn	Gutters
Akon 1	27	14	2	1	10	0	0
Akon 2	29	13	2	0	14	0	0
Akon 3	24	8	6	4	6	0	0
Akon x	9	3	0	0	6	0	0
Basse	9	9	0	0	0	0	0
Bissono	22	13	2	0	7	0	0
Centre Adm.	3	3	0	0	0	0	0
Ebolengbwang	14	9	0	0	5	0	0
Lobossi	77	23	12	6	29	5	2
Mbeli'i	7	7	0	0	0	0	0
Monavebe	9	6	0	0	3	0	0
Nkolguet	3	3	0	0	0	0	0
Nylon	20	10	0	0	9	0	1
Campchic	3	2	0	0	1	0	0
Sang. Village	41	7	10	2	22	0	0
Source	2	2	0	0	0	0	0
Otoakam	7	7	0	0	0	0	0
Total	306	139	34	13	112	5	3
Percentage (%)	100	45	11	4	37	2	1

Source: Field work, 2022

Generally, solid waste is disposed in low-lying areas, outskirts of neighborhoods, roadsides and streets, gutters, near-by bushes, in rivers and streams and public dust bins or any vacant place wherever people know that they will not be apprehended. According to field work, just 10% of households sort their wastes before disposal while 90% did not. Waste is usually mixed whether degradable or non-degradable (photo 1).



Photo 1: Open dump with mixed wastes at Akon neighborhood in Sangmelima

Such a system of solid waste management is an environmental problem in Sangmelima because it is rudimentary and unscientific and, therefore, not based on a sustainable strategy. Richardson (1994) warned that such locations where wastes are deposited without proper management may be considered 'remote' today, but may become settlement sites tomorrow. This implies that we are currently burying environmental time bombs that may explode tomorrow to consume thousands of human beings. This is in direct contravention of Section 42 of the 1996 law on environmental management in Cameroon which stipulates that; for sustainability, wastes should be treated in an ecologically rational manner, to reduce its toxic effects on humans, natural resources, fauna, flora and the general quality of the environment. The strategy is thus failing in Sangmelima town because sound management techniques have not been incorporated into the current waste management dynamics. This strongly counteracts the concept of Integrated and Sustainable Waste Management (ISWM) which advocates for the selection and application of appropriate techniques and management programmes to achieve specific and desired waste management objectives and goals. As a result of poor management practices, several types of pollution have surfaced.

5.1.1 Air pollution

According to a report of the World Health Organization (WHO) Expert Committee (1991), about 500 million people in developing countries are exposed to the risks of air pollution in urban areas. Amongst the sources of air pollution in Sangmelima are gas exhausts resulting from the anaerobic fermentation of organic matter. These gases are more or less charged with methane, sulphur or nitrated gases capable of causing explosions.



Plate 1: Incineration of Wastes in Sangmelima

In addition to smoke, the incineration of waste releases mineral fibers (nitrogen, hydrocarbons and hydrochloric acids) which are harmful to the environment (plate 1). Urban waste is being managed through incineration (Plate 1). Such fires emit carbon dioxide (CO_2) as well as nitrous dioxide (NO_2), oxides of nitrogen (NO_x), and ammonia (NH_3), all greenhouse gases (GHG), which contribute to the destruction of the ozone layer.

5.1.2 Soil Pollution

Despite the presence of public bins in Sangmelima, people still dispose waste indiscriminately (on the ground and along the streets) which pollutes the soil and eventually river bodies. The acidification of the soil by toxic non-biodegradable waste leads to the death of many species of plants and animals. The consequences of SO_2 , NO_3 , and CO_2 are not limited to pollution of the atmosphere.



Plate 2: Illegal wastes dump on ground and along a street in Sangmelima

For example, the accumulation of NO_3 in the soil and in crops intended for consumption can affect the entire food chain. Some plants, after assimilation of substances from waste by their roots, contaminate humans. In the neighborhoods of Chic (Photo a) and Akon 1 (Photo b), waste is deposited on the ground despite the presence of a wastereceptacle. 16% of the respondents (Table 6) attributed the presence of waste on the ground to low frequency of waste collection. This could be likened to the chaotic street pattern in certain parts of Sangmelima town. Just a few kilometers of tarred roads exist which are heavily degraded. These roads lack bridges making connections between neighbourhoods and waste collection points difficult. This leads to indiscriminate disposal of wastes on the ground. According to 35% of the respondents, the bins are too high to drop wastes while 49% of the respondents likened the situation to low levels of education and lack of moral values. This, coupled with a generally 'laissez-faire' approach, whereby household waste disposal is masterminded by children has seen the proliferation of unplanned waste disposal sites. As underscored by an informant; "when people go to dispose

wastes and discover that others have dumped theirs on the ground, they do likewise because they do not see why they should walk through the refuse to dump theirs in the container'. This is in direct contravention of article Agenda 21, Chapter 21, Principle 10 of the Rio Declaration which maintains that; "States should facilitate and encourage public awareness and participation by making information widely available." From this, it could be deduced that strategies put in place for educating the public on the impacts of the environmental anomalies of indiscriminate waste disposal in Sangmelima are not adequate to create public awareness. The environmental conditions of Sangmelima in terms of sanity worsens as market places, streets corners and streams are obstructed by huge piles of garbage.

Table6: Respondents perception for waste Disposal on bare ground

Neighborhoods	Questionnaires (3% sample)	Incivility	Bin too high	Waste and litter spread around the bin
Akon 1	27	12	10	5
Akon 2	29	12	14	3
Akon 3	24	13	10	1
Akon x	9	3	4	2
Basse	9	7	0	2
Bissono	22	10	5	7
Centre Adm.	3	3	0	0
Ebolengwang	14	9	5	0
Lobossi	77	33	23	21
Mbeli'i	7	6	1	0
Monavebe	9	5	4	0
Nkolguet	3	3	0	0
Nylon	20	10	9	1
Campchic	3	2	1	0
Sang. Village	41	13	21	7
Source	2	2	0	0
Otoakam	7	7	0	0
Total	306	150	107	49
Percentages	100	49	35	16

Source: Fieldwork, 2020

The accumulation of waste on the ground causes saturation and clutter of the soil in non-biodegradable materials like plastics. Plastics, it should be noted take about 100 to 400 years to degrade. Biodegradable waste when dumped in waste disposal points decomposes under uncontrolled anaerobic conditions. The table below shows the frequency rate of the collection agency in Sangmelima.

5.1.3- Water Pollution

Hazardous wastes are common ills in most urban centers, Sangmelima is no exception. Urbanisation and subsequent urban development have led to an ever-increasing amount of littering and the dumping of wastes on unauthorized sites. This situation is indeed a tragic irony and, therefore, quite worrying because a greater majority of the population of Sangmelima has given a deaf ear on the escalating situation; partly because the municipality lacks inadequate waste disposal facilities. In some neighborhoods, households living in close proximity to streams and rivers get rid of their wastes in these streams and rivers (Plate 3). This is in direct contravention of Section 50, (2) of the 1996 Cameroon environment law which stipulates that; "It is strictly forbidden to deposit waste on state property". According to Section 25, waters are classified as state property and section 28 of the same law prohibits all practices, direct or indirect that are likely to cause the degradation of surface and ground water by

modifying their chemical, physical as well as biological characteristics. These waste produces percolating water called leachate which pollutes groundwater, rivers and streams.



Plate 3: Floating Wastes in river Afamba and river Lobo

Photos 3a and b show floating wastes (cartons, package materials, plastic waste and bottles) along the banks of River Afamba. When all these household wastes are jumbled together, sorting becomes extremely difficult. This practice has greatly contributed to the degradation of the environment in Sangmelima. In the course of the dry season, it is common to see most streams that flow through the town of Sangmelima clogged with deposited wastes. Laboratory tests to evaluate the physico-chemical and microbiological qualities of streams are beyond the scope of this study. However, direct field observation on the physical characteristics of these streams, revealed high turbidity with multi colours, offensive smells, choked with floating non-biodegradable solid wastes. This observation is in line with that of Fogwe et al (2001) who observed a wide variety of solid pollutants, dark colored water, sluggish and heavy-laden stream which reveals advanced stages of stream deadening at the bridge point at the Douala - Edea Highway in the Littoral Region of Cameroon.

I.6- Deforestation and degradation of the forest

Deforestation and forest degradation are direct impact of socio-economic development on the environment of Sangmelima. Deforestation refers to the conversion of forested areas to non-forest land use such as arable land, urban use, logged area or waste land (Giri Tejaswi, 2007). Forest degradation on the other hand is a process which leads to a temporary or permanent deterioration in the density of structure of vegetation cover or its species composition. It is thus a change in forest attributes that leads to a lower productive capacity caused by disturbances (FAO, 2007). These phenomena can be observed in Sangmelima located in a fragile ecosystem and undergoing development. In 2001 (Table 7), forest cover was 139,465,646 hectares corresponding to 94.17%.

Table 7: Forest cover dynamics in Sangmelima for the year 2001, 2011 and 2019

Year	2001		2011		2019	
	Hectares (ha)	%	Hectares (ha)	%	Hectares (ha)	%
Surface area						
Forest	139465.646	94.17	127663.173	86.2	120686.88	81.5

In 2011 forest cover decreased to 127,663,173 hectares (86.2%), with a percentage decrease rate of 7.97% and in 2019, it decreased to 120,686,88 hectares corresponding to 81.5% of the total surface area of Sangmelima.

Table 8: Evolution rate of forest cover in Sangmelima for the year 2001, 2011 and 2019

2001-2011		2001-2019		2011-2019	
Surface Area	Percentage (%) increase	Surface Area	Percentage (%) increase	Surface Area	Percentage (%) increase
11802.473	7.97	-18778.766	-12.67	-6976.293	-4.7

This means that, during this interval (2001-2019), forest lost was 996.613 hectares annually. That is -187, 787, 66 between 2001 and 2019, giving an overall decrease of 1104.633 hectares annually within this interval (18 years) as shown on Table 8.

Amongst the key factors affecting deforestation and degradation in Sangmelima is the rising demand for forest products and exploitable forest resources such as building materials, animal fodder, seeds, fruit, bush meat and medicinal plants, due to increasing population in the rural, urban, and peri-urban zones. The increasing wood demand is also exacerbated by the limited access to alternative energy materials (electricity, solar panels and gas) and alternative non-wood construction materials (steel and concretes). These constraints have forced the population to rely largely on surrounding forests for both energy and construction imperatives. Results from the table above show that 39% of households rely on fuel wood for cooking, 39% and 8% rely on gas and charcoal respectively as main source of energy used in cooking. Added to that, commercial logging contributes significantly to forest loss in Sangmelima (Table 9).

Table 9: Household cooking energy source per neighbourhood in Sangmelima

Neighborhoods	No. of questionnaires (3% sample)	Gas	Wood	Charcoal
Akon 1	27	15	10	2
Akon 2	29	11	18	0
Akon 3	24	9	10	5
Akon x	9	3	5	1
Basse	9	6	3	0
Bissono	22	14	8	2
Centre Adm.	3	2	1	0
Ebolengbwang	14	6	8	0
Lobossi	77	25	45	7
Mbeli'i	7	2	4	1
Monavebe	9	3	6	0
Nkolguet	3	2	1	0
Nylon	20	7	10	3
Campchic	3	1	2	0
Sang. Village	41	8	31	2
Source	2	2	0	0
Otoakam	7	4	2	1
Total	306	120	162	24
Percentages	100	39	53	8

Source: Field work, 2022

Besides, most infrastructural projects such as the Sangmelima-Ouessou road traversed through forested areas, opening up the forest and facilitating logging and trade in bushmeat. This is due to limited surveillance of the forest and the corrupt nature of some state and local agents.

The “Economic Man” (*homo economicus*) seeking to maximize personal satisfaction prefers SED at the expense of the forest. In order to have a habitat land must be available and this ultimately means the destruction of the forest. Fulfilling the resource requirements of a growing population ultimately requires some form of land-use change: to provide for the expansion of food production through forest clearing, to intensify production on already cultivated land, or to develop the infrastructure necessary to support increasing human numbers. All these inevitably contribute to deforestation and degradation of the forest leading to a competition of land use (SED versus Forest). We ask ourselves if we will ever see a parcel of forest in the next 50 years.

1.6.1 Loss of animal species

The loss of animal species is common during the construction of settlements/infrastructures. Socio-economic development through the construction of social and economic infrastructures, like the Sangmelima referral hospital, the Sangmelima Municipal market, the interstate university and road infrastructures, constitute factors of environmental degradation. These activities have resulted in the discontinuity of the natural habitats causing population fragmentation and ecosystem decay, hence, the loss of animal and plant species.



Plate 4: The Sangmelima municipal market (4a) and the Sangmelima Referral Hospital (4b) encroaching into nearby forests

Photos 4(a) and 4(b) show an aerial view of the municipal market of Sangmelima as well as the Sangmelima referral. Both projects have contributed to the complete clearing down of large hectares of forest land which constituted breeding grounds for different animal/plant species. Prior to their construction, this piece of forest land was continuous and constituted a single habitat. With the completion of both projects, discontinuities emerged with the loss of several plants/animal species and population fragmentation putting the remaining forests in danger.

Besides during construction of the Sangmelima-Bikoula road, natural habitats were fragmented and, in some cases, completely destroyed. Large pieces of forest land were cleared especially for the construction of large linear infrastructures constituting a barrier and threat for natural life. Habitats which were continuous become divided into separate fragments (Photo 2)



Photo 2: Habitat fragmentation in Sangmelima

Source: Field work (2022)

Photo (5a) shows the fragmentation and reduction of suitable habitat available for living organisms in Sangmelima following the construction of the Sangmelima-Bikoula road. With habitat fragmentation comes increased competition for limited resources, edged-adapted animals spreading I to other habitats as well as the extinction of smaller vulnerable populations.

1.6.2 Soil erosion and degradation

Soil erosion refers to the wearing away of the topsoil by the natural physical forces of water and wind. It is relatively unnoticed or can occur at an alarming rate, causing serious loss of topsoil. Deforestation as explained above, and the various land uses resulting from it are the main causes of soil erosion in Sangmelima. After deforestation, the landscape is scalded, the soils are naked and vulnerable to the process of erosion (Photo 3).



Photo 3: Gully erosion in Sangmelima

Source: Field work (2022)

Surface runoff and wind on a surface will produce four main types of erosion: splash erosion, sheet erosion, rill erosion and gully erosion. Splash erosion is generally the first and least severe stage in the soil erosion process, followed by sheet erosion, then rill erosion and finally gully erosion (the most severe) as shown on. Gully erosion occurs when runoff water accumulates and rapidly flows in narrow channels during or immediately after heavy

rains, removing soil to a considerable depth. Gully erosion in Sangmelima is caused by massive deforestation for giant projects such as the Sangmelima Municipal Market and the Sangmelima Referral Hospital. These gullies were excavated by runoff in less than two years (Photo3).

VI. Conclusion and Policy Implications

This paper has diagnosed the environmental implications of socio-economic development in Sangmelima. An examination of the trends and traits of socio-economic development and the spatial evolution of Sangmelima town has aptly elaborated some salient issues which have profound bearings on the environment of the town. Sangmelima has transcended from a traditional monocultural village to a complex heterogeneous town offering many services to its inhabitants. The initial impetus for these changes was hatched and amplified by the development of socio-economic and infrastructural facilities. As the town developed, it experienced commensurate changes in its administrative set-up which gave it greater potentials for growth. There was thus a significant evolution/transformation of its spatial layout with implications on the urban landcover/land use and physical outlook. As a matter of fact, the one-time physical environment of Sangmelima that knew little or no stress in the yesteryears has seen the progressive replacement of its pre-existing vegetation with buildings due to unprecedented rates of socio-economic development. As a result of this, waste management issues, pollution (water, air and soil), loss of biodiversity and erosion are glaring. Such environmental inconsistencies are attributed to limited/inadequate budget allocated for waste recycling and treatment as well as limited human and technical capacities. This has rendered the actions of local actors on environmental management issues inflexible and epileptic, opening flood gates for environmental decay. At a time when Cameroon is striving to become an emerging nation by 2035 and has made sustainable environmental management one of the objectives (objective N°3) of its National Development Strategy (NDS30), it is important to adequately address and strengthen actions relating to sustainable environmental management. There is need for an inclusive participation and effective cohesion between various actors on environmental issues so as to ensure environmental management that assures sustainable and inclusive economic growth and social development in Sangmelima. This paper thus advocates for the enshrinement of 'socio-economic sustainability' into concrete policy options. Socio-economic sustainability implies a system of production that satisfies present consumption levels without compromising future needs. The 'sustainability' that 'socio-economic sustainability' seeks is the 'sustainability' of the economic system itself. No doubts, economic, social and environmental 'sustainability' form elements of a dynamic system. It is only by 'integrating' and 'interlinking' economic, social and environmental 'sustainability' that negative synergies be arrested, positive synergies fostered and real development achieved.

REFERENCES

- [1.] Christopher T and Andre T. (2018). Environmental Law policy in Cameroon. www.jstor.org. Retrieved on 12/09/2020
- [2.] Dewaram A.N. (1992). Population growth and environmental degradation in India. *Asia Pac J. Environ Dev*, Volume 14.
- [3.] Fogwe, Z. N, Ndifor, F. and Lambi, C. M (2001): Industrial Water Pollution: The Case of the Ndogbong Industrial District, Douala, Cameroon. In Lambi, C.M (ed): *Environmental Issues: Problems and Prospects*, Unique Printers, Bamenda.
- [4.] Giri T. (2007). In FAO. (2007). *A Manual on Deforestation, Degradation and Fragmentation using remote sensing and GIS*. www.fao.org. Retrieved on 21/10/2020
- [5.] Holtz-Eakin D. and Seldon T.M. (1995). Stoking the fires? CO₂ emissions and economic growth. *Journal of public economics*, Volume 57
- [6.] Jain M. (2007). Mumbai's solid waste management plans expensive, Dangerous. www.downtoearth.org. Retrieved on 20/09/2022
- [7.] Kalipeni E. (1992). Population growth and environmental degradation in Malawi. *Africa Insight*.
- [8.] Katja V. M. (2007). *Linking Socio-economic Development and Environmental Pressures*.
- [9.] Law N⁰ 1996/012 of 5th August 1996 relating to Environmental Management in Cameroon.
- [10.] Law N⁰ 2019/024 OF 24th December 2019 relating to the General Code of Local and Regional Authorities in Cameroon.
- [11.] Ndi R. A, Kometa S.S, and Lambi C.M, (2017). The efficiency of urban planning regulations on environmental management in Bamenda, North West Cameroon. *Journal of Environment and Earth Science*, Volume 7(10)
- [12.] Richard P. (2010) in Tim Evrett et al (2000). *Economic growth and the environment. Defra evidence and analysis series 2*
- [13.] Richardson, N. (1994). 'Making our Communities Sustainable: The Central Issue is Will' in Ontario Round Table on Environment and Economy. *Sustainable Communities Resource Package*, Ontario Round Table on Environment and Economy, Ontario.

- [14.] Roberts J.F. & Grimes P.E. (1997). Carbon intensity and Economic development 1962-1991: A brief exploration of the Environmental Kuznets Curve. *Journal of World Development*, Volume 25(2)
- [15.] Sangmelima Council. (2015). Sangmelima Community Development Plan 2015
- [16.] Smyth R., Vinod M and Xiaolei Q. (2008). Environmental surroundings and personal well-being in urban China. *Journal of Ecological Economics*.<https://www.elsevier.com>.
- [17.] United Nations Environmental Program (1997). *Global Environmental Outlook*. New York, Oxford University Press.
- [18.] United Nations (1987). *Our common future: A report on the world commission on environment and development*.
- [19.] UN-Habitat. (2009). *Global Report on Human Settlements 2009: Planning Sustainable Cities*. London, Earth scan. Accessed 27/4/2013
- [20.] United Nations. (1992). *Human Development Report 1992*. Hdr.undp.org. Retrieved on 05/11/2020
- [21.] World Health Organization (1991). Ambient (outdoor) pollution. www.who.int. Retrieved on 12/08/2020