Canadian Journal of Tropical Geography
Revue Canadienne de Géographie Tropicale
CJTG (Online) / RCGT (En ligne)
ISSN: 2292-4108
Vol. 9 (2):15-21
https://revuecangeotrop.ca

# Housing dynamics and environmental implications in the Santchou corridor, Cameroon

***Dynamiques de logement et implications environnementales dans le tronçon de Santchou, Cameroun***

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**Abstract**:

The rapidly changing landscapes of sub-Saharan Africa are indicative of a number of socio-infrastructural dynamics, including improvements in household living conditions. The context of these changes is also attracting the attention of scientists working on major environmental issues and their context. However, there is a lack of scientific information on housing. This article studies the case of Santchou, a dynamic landscape in Cameroon, with the aim of identifying the issue of housing development and its environmental repercussions. It characterises the typology and model of housing development and assesses the environmental implications. A sample of 151 households was drawn from four communities in Santchou. It was supplemented by interviews with key informants (N=5). The results of the analyses indicate significant changes in housing typology. There are fewer and fewer brick houses along the main roads. This change is indicative of an improvement in household standards. The decision to build in parpins has made it easier to cope with recurrent flooding. The scarcity of land and strong demographic growth explain the shift of the urban front towards the classified forest.

**Résumé**:

Les paysages en transformation rapide de l'Afrique subsaharienne sont indicatifs de nombreuses dynamiques socio-infrastructurelles, notamment l'amélioration des conditions de vie des ménages. Le contexte de ces changements retient de plus en plus l'attention des scientifiques qui travaillent sur les grands enjeux environnementaux et leur contexte. Toutefois, il existe un manque d'informations scientifiques sur la thématique du logement. Cet article étudie le cas Santchou, paysage dynamique du Cameroun dans le but de cerner la question du développement du logement et ses répercussions environnementales. Il caractérise la typologie et le modèle de développement du logement et évalue leurs implications environnementales. Un échantillon de 151 ménages a été obtenu dans quatre communautés de Santchou. Il a été complété par des entretiens avec des informateurs clés (N=5). Les résultats des analyses indiquent l'existence des changements significatifs dans la typologie des logements. On observe de moins en moins des maisons en briques les long des principales voies de communication. Ce changement est indicatif de l'amélioration du niveau des ménages. Le choix de construire en parpins permet de mieux faire face aux inondations récurrentes. La rareté des terres et la forte corissance démographique expliquent le déplacement du front urbain vers la forêt classée

**Keywords / Mots clés**

*Housing typology, cement blocks, evolution, income, culture, floods*
*Typologie du logement, pargaings, évolution, revenu, culture, inondations*

*Article history/Histoire de l'article*
***Received /Reçu**: June 04, 2024* ***Accepted/Accepté**: September 18, 2024* ***Published online/Publié en ligne**: December 25, 2024*

## Introduction

Housing is a basic requirement in every human society. Housing has long been considered an integral factor in the enjoyment of other economic, social and cultural rights (Karamujic, 2015). The world is experiencing an increasing rate of urbanization and over half of humanity now lives in areas described as urban; 70% in Latin America, North America and Europe (UN-Habitat, 2008). UNFPA (2007) reported that the space taken up by urban localities is increasing faster than the urban population itself. The world's urban population is expected to increase to 72% by 2030 while the built-up areas of cities could increase by 175%. The process of urban expansion into the urban periphery a process known as peri-urbanization leads to changes in land use patterns in such environments (Owusu, 2008). The increased rate of urbanization has provided an unparalleled demand for housing which has surpassed supply. The greatest challenge of rapid urbanization in all the world's continents has been the task of providing adequate and affordable housing to all. A significant proportion of the population in the world's urbanizing landscape lacks access to adequate and affordable housing. The UN-Habitat (2016) reported that 55.4% of the population in Sub-Saharan Africa does not have access to adequate and affordable housing, while in West Asia and North Africa, the number without access to adequate housing stands at 30.5%. In Central and Southern Asia, 30.3% lack access to adequate and affordable housing while in Latin America and the Caribbean, the percentage of the population without adequate and affordable housing is 21.4%. In East and Southern Asia, 19.8% do not have access to adequate and affordable housing while in North America and Europe, the number stands at 12.8% (UN-Habitat 2016)

As societies witness socio-demographic changes such as rapid rates of urbanisation which culminate in an increase in the demand for housing dynamics with variation in building space, shape, structure and typology, such changes produce diverse environmental outcomes. Housing dynamics can be viewed as the variation in spatial and vertical occupation by housing structures, typology of houses and the type of materials used in construction. Over time and space, housing structures undergo varied transformations. Housing dynamics in terms of space occupation could be a response to an increase in demand resulting from the demographic exigencies of urbanisation. Kumari (2022) argued that the sudden boost in housing development as a response to the increased demand for housing could cause irreversible damage to the environment.

The negative impacts of house construction on the environment include the loss of biodiversity, and the depletion of natural resources, which could indirectly lead to adverse consequences on economic growth (Kompas et al., 2018). Azad et al., (2016) and Petruccioli, (1995) noted that the quality of space can be affected by buildings in two ways: firstly, the way the housing structures enclose the space and secondly, the way their users interact with space

A considerable body of empirical research is focused on the drivers of housing typology. Worldwide; housing dynamics are the result of major demographic and sociological changes in addition to technological and political interventions (Adel *et al.,* 2016). Turner (1976) argued that vernacular settlement housing has always been a direct expression of the state of know-how, construction techniques, available local construction materials, and climatic and cultural conditions of the local community concerned. Based on the argument put forth by Turner (1976), the community and its particular environmental conditions, are producers of housing typologies. Owens (1992) pointed out that the extensive growth of settlements and subsequent exposure to new construction materials and techniques in addition to increasing top-down political interventions often lead to new development tendencies. Petruccioli (2007) and UNFPA, (2008) noted that the typology is a dynamic process that changes and develops according to the evolutionary paradigms of a particular society that cannot be restricted to one formal scheme. Housing typology is viewed in two dimensions, firstly as a basis for analyzing buildings and cities (analytical typology) and secondly as a basis for designing buildings (generative typology) (Leupen *et al.,* 1997). Douglas (1991) indicated that the spatial configuration of someone's habitat is not limited to what is located within private physical boundaries but how people express their sense of belonging to the domain beyond the territory's border. The spatial and structural change in housing impacts directly on the environment through urban sprawl, deforestation, and landscape degradation. Despite its salience, there is scant evidence about housing typology, its space-time dynamics and how they affect the environment in many parts of Sub-Saharan Africa. It becomes compelling therefore to analyze the diverse implications of housing dynamics, taking Santchou in the West Region of Cameroon as our case study.

The rapid rate of urbanization in Cameroon, like elsewhere in developing countries, has increased the demand for houses. This has consequently resulted in urban anarchy and the occupation of environmentally unsafe zones with emerging problems such as urban sprawl, floods, and landslips. The anarchy observed in most of the urban areas of Cameron is the outcome of either the lack or poor implementation of urban planning policies. While there is significant evidence on housing dynamics in rapidly urbanised settings, the environmental implications linked to the mutations in housing especially along corridor-like settings remain relatively less explored. This knowledge gap stalls progress towards the development of a comprehensive theoretical argument on housing development and the environmental incidence thereof. To address this lacuna, this paper uses the case of the Santchou Corridor to; (a) characterize the typology and pattern of housing development, and (b) assess the environmental implications of such housing mutations.

## Analytical Framework

Housing constitutes a key portfolio of household possessions (Glaeser et al., 2014) in most sub-Saharan communities, especially in Cameroon. However local variations and relationships with environments are salient challenges which warrant scientific attention. In this paper, we present the housing dynamics (Figure 1) first looking at the typology of housing, the spatio-temporal dynamics in housing development, and the key determinants of housing evolution. The second focus is the effects of housing evolution on the environment. In this frame, the analysis presents the dynamic rationale for changes in housing determined by local wages and amenities as well as prices. This also includes the local socio-cultural aspects that shape housing conditions around the area. Housing dynamics is considered to involve housing supply, price and affordability and its complex implications (Wang, 2022). Glaeser *et al.,* (2014) noted that strong persistence in housing growth across decades is powered by demand-driven models in which prices and quantities move symmetrically. It further looks at environmentally friendly construction that reduces negative impacts (El-Hadji et al., 2017).

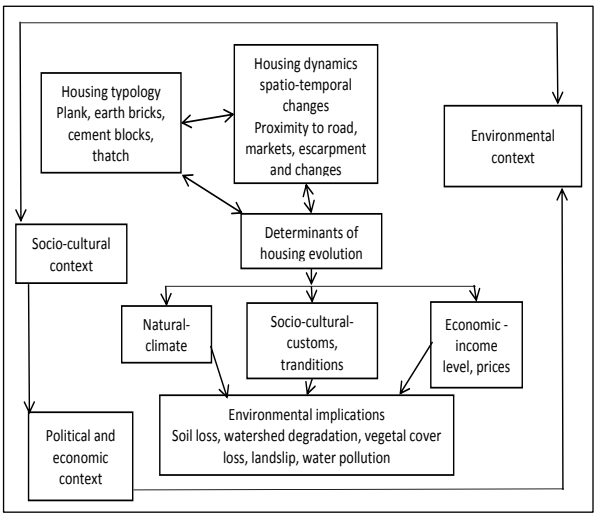



Figure 1: Analytical framework on housing dynamics and environmental implications in Santchou. (Authors' construct, 2024)

The dynamics of housing development is a key focus where housing characteristics in terms of typology are considered. This involves housing types looking at positioning, size and quality, and material used in construction. Housing development thus cuts across the use of plank, earth blocks, cement blocks and thatch, the choice of which is analyzed regarding cultural preferences, income level, climate, and material availability among others. From this base, the housing situation before and now is established to depict the changes over time or the temporal dimension. Moreover, the spatial variation of housing development in the landscape is given a focus to view their different locations such as proximity to the road, proximity to the market and away as well as proximity to the escarpment or not. Determinants of housing evolution are key aspects studied embodying natural, sociocultural and economic determinants. Environmental implications of housing dynamics constitute the last key aspect with a focus on erosion, soil loss, watershed degradation and water pollution, floods, loss of vegetal cover, and landslips among others.

## Study Area and Methods

Santchou is located in the Menoua Division of the West Region of Cameroon. It is located between latitude 5°18'0'' North and 9°54'0'' East. It is located on a plain and it is part of the region known as the Mbo Plain (Figure 2). It is boarded to the north by Mount Manengouba to the south by the Dschang Cliff and to the east by Kekem. Santchou has a population of over 46,249 inhabitants (mostly migrants) with a surface area of 335km$^2$, and a population density of 137 persons/km$^2$. It comprises 60 small villages (Santchou Rural) and 4 semi-urban towns of Santchou Urban (Santchou Council, 2015).

The main instrument used was a household questionnaire, structured into socio-demographic characteristics, housing typology, spatiotemporal dynamics of housing, determinants of housing evolution and effects of housing on the environment.

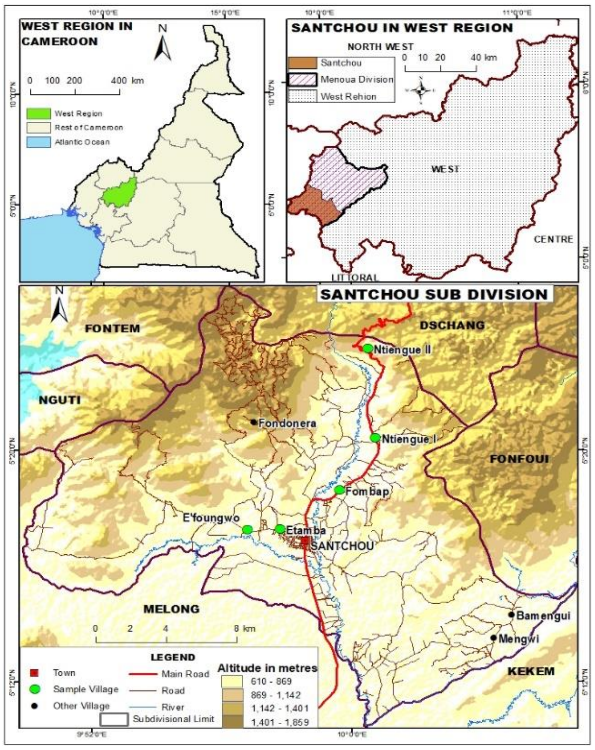



Figure 2: Location of Santchou

Data was collected randomly from 151 households in four neighbourhoods, namely: E'foungo (28), Etamba (54), Fombap (42) and Nteingue (27) (Table 1). Data collection ran from February to March 2024 with the use of a structured household questionnaire. We employed a random sampling approach in which an ad-hoc household numbering process was done to determine the total number of households. From this, we proceeded to carry out raffle draws to randomly select numbers corresponding to the 151 households. The selected numbers guided us to locate the precise household for data collection. In total, a more than 5% sampling fraction was assured for all four communities under study with the level of analysis being the households and the unit of analysis being the household representatives.

| Communities | Number of households | Households sampled | Sapling fraction (%) |
|---|---|---|---|
| E'foungo | 600 | 28 | 5 |
| Etamba | 400 | 54 | 13 |
| Fombap | 742 | 42 | 6 |
| Nteingue | 571 | 27 | 5 |
| Total | | 151 | |

Table 1: Distribution of questionnaires

The questionnaires were captured on the field using the KoboCollect android app (Version 2023). Subsequently, the spreadsheets were downloaded and exported to the Statistical Package for Social Sciences (SPSS Version 25), where frequencies and percentages were calculated. The results have been presented in bar and pie graphs. The household questionnaire was complemented with field observations and key informant interviews with municipal authorities to gain insights on the trends in housing development, the environmental issues linked to such developments and the housing planning strategies to mitigate risk zones for human safety. Change detection of land cover/use was also conducted in this study. The main input data was Landsat images for 2003, 2013, and 2023 were acquired from the US Geological Survey website (Table 2) and processed in QGIS.

| Platform | Sensor | Acquisition date | Cell size | Satellite operator |
|---|---|---|---|---|
| Landsat 7 | ETM+ | 2003/12/15 | 30 | NASA |
| Landsat 8 | OLI/TIRS | 2013/12/31 | 30 | NASA |
| Landsat 9 | OLI/TIRS | 2023/02/25 | 30 | NASA |

*Source: USGS Landsat images, 2003, 2013, 2023*

Table 2: Sources of Remotely Sensed Data

Acquired image scenes were pro-processed for radiometric corrections and later on, subjected to layer stacking and clipping to the study area. A supervised image classification technique was employed in treating the data for different land covers. In this light, land cover/use maps were developed for three periods including 2003, 2013 and 2023 to establish the extent of changes in land uses with much emphasis on settlement land use (housing).

# Results

## *Socio-demographic characteristics of respondents*

The population captured in this study included farmers, private salaried workers, Non-Timber Forest Product (NTFP) collectors, petit traders, state salaried workers, as well as commercial bike riders (Figure 3). Results showed that farmers made up 64.24% of the population, followed by private salaried workers (10.6%), NTFP collectors (9.93%), petit traders (9.27%), state salaried workers (4.64%), and commercial bike riders (1.32%). It therefore holds that this landscape largely harbours an agriculture-dependent population.

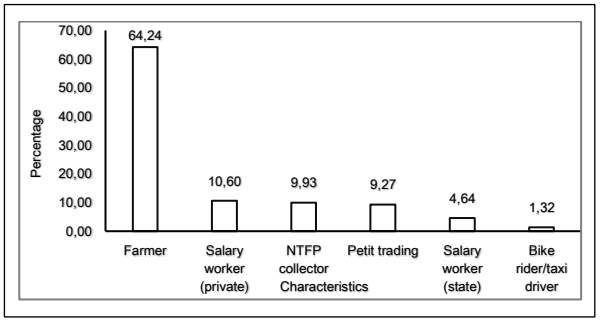



Figure 3: Socio-demographic characteristics of the sampled population

## Materials for housing construction and housing typology

Field evidence indicates that diverse materials have been used in housing construction including sun-dried bricks, cement blocks and thatched materials (Figure 4).

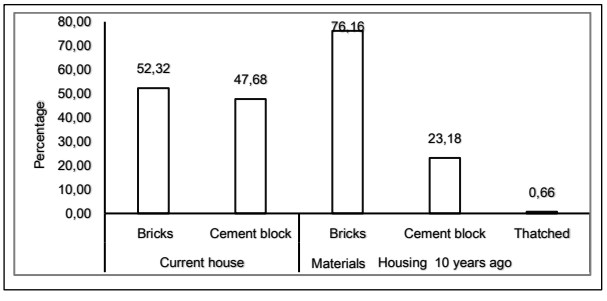



Figure 4: Materials used for housing construction in Santchou

Ten years ago, the dominant construction material was bricks (76.16%), followed by cement blocks (23.18%) and thatched materials (0.66%). As incomes improved, the use of cement blocks for housing construction has skipped to 47.68%, and sun-dried bricks have reduced to 52.32%, while thatched materials are gradually disappearing. The population indicated

that the housing sizes range from two to five rooms. Results indicate that small houses of two rooms were 26%, three rooms (32%), four rooms (24%) and five rooms (18%). The houses are mostly constructed by migrants who do not have stable and secured incomes.

## *Spatio-temporal dynamics in housing development*

Spatio-temporal evolution of housing (Figure 5), reports variations in the housing typology in the past and today. For instance, while most of the houses were constructed as brick houses in the past (10 years ago), there have been significant but varied changes in the housing typology – this is skewed towards cement block houses.

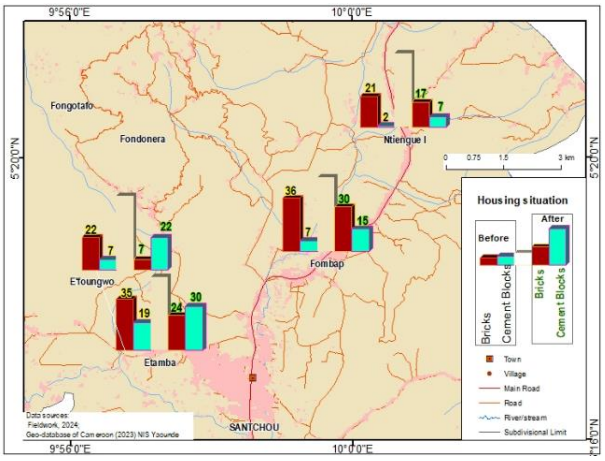



Figure 5. Variations in housing situation (before and after scenario)

In Fombap and Etamba, most of the respondents reported the predominance of brick houses in the past. The most significant evolution from brick to block houses is reported for Etamba and E'foungwo. This is followed by Fombap, a liner settlement whose proximity along the major communication line (road) has triggered further housing development with a focus on modern (cement block) housing.

## *Determinants of housing evolution*

Determinants of housing evolution in the Santchou Corridor include level of income, cultural preference, climatic factors and the availability of materials (Figure 6).

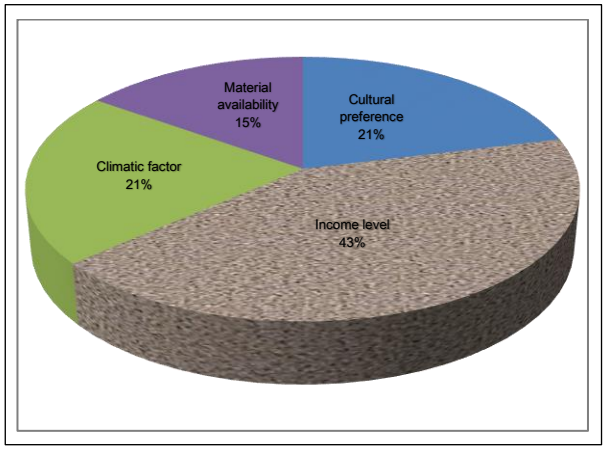
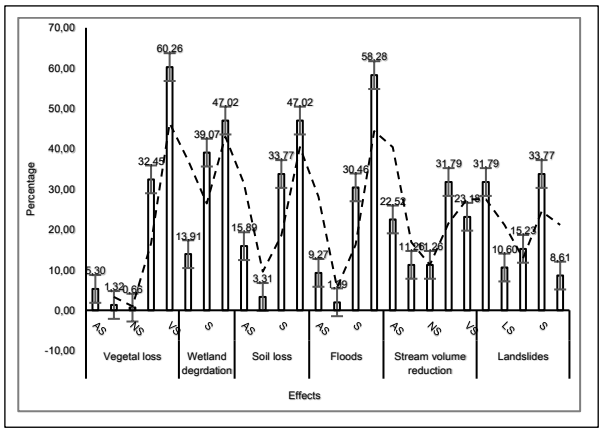



Figure 6: Determinants of housing construction in Santchou

Results indicate that the principal determinant is income (43%). A meaningful housing project requires finances to secure a piece of land, secure authorisation from municipal authorities, purchase building materials and pay for labour. The climate of Santchou (21%) is humid-tropical as it is located at the interphase of the coastal lowlands of Cameroon and the tropical forest-savannah zone. The relative humidity is high, with high temperatures and abundant rainfall. With these climatic elements, housing in Santchou needs proper ventilation for human comfort. That is why houses constructed by low-income earners emphasize ensuring proper ventilation by providing more windows and doors. Only a few houses have air conditioners. Again, most houses constructed in Santchou are in line with cultural preference (21%). Part of the cultural preference is related to the typology of housing found along the Mungo Corridor axis to Bikoko in Douala. Most inhabitants, including migrants simply align with this age-old cultural practice of ensuring proper ventilation and positioning of their houses. Housing construction in Santchou has also been facilitated by its plain-like attribute as well as the presence of natural sand pits and deposits, as well as wood for roofing (15%).

## *Effects of housing construction on the environment*

The effects of housing development on the environment in Santchou include loss of natural vegetation, wetland degradation, soil loss, enhanced floods, reduction in stream volumes and slope instability (Figure 7).




Key: AS: Averagely severe, LS: Less severe, NS: Not severe, S: Severe, VS: Very severe

Figure 7: Severity of environmental effects of housing evolution

These effects have different levels of severity. Results indicate that natural vegetation loss is very severe (60.26%) wetland loss is very severe (47.02%), soil loss is very severe (47.02%), floods (58.28%), reduction in stream volumes (31.79%) and recurrent slope instability (landslides) (33.77%) are equally severe. Therefore, while housing development has triggered a host of environmental effects, the significance of flooding as an environmental repercussion stands out.

## *Land cover in the Santchou corridor*

Land use and land cover (LULC) are dynamic components which depict the expansion of human settlements and their consequences on the environment. Land cover and land use changes for this study were assessed from 2003 to 2023, the period when there has been intensive economic activity in Santchou. The land use/cover classes include the built-up area, dense forest, arable land and secondary vegetation (Table 3, Figure 8). In terms of changes in the last two decades, the built-up area witnessed a more than 94% increase in surface area – it changed from 7.4ha in 2003 to 14.37ha in 2023.

| Land cover/use | 2003 | 2013 | 2023 |
|---|---|---|---|
| Built-up area (ha) | 7.4 | 9.92 | 14.37 |
| Dense forest (ha) | 188.7 | 129.72 | 85.74 |
| Arable land (ha) | 37.30 | 49.36 | 58.21 |
| Secondary forest (ha) | 167.51 | 211.29 | 241.97 |
| Total (ha) | 400.29 | 400.29 | 400.29 |

Table 3: Land cover in the Santchou Corridor (2003-2023)

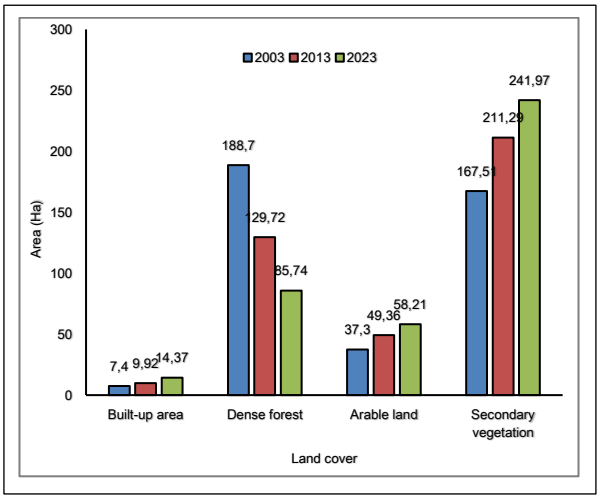



Figure 8: Categories of land cover/use in Santchou (2003-2023)

Considering that land cover and land use are dynamic, there are gains and losses in various categories. The gains in the context of this study include the loss of dense vegetation to other land cover/uses built-up area, arable land and the emergence of secondary forests. In 2003, the built-up area occupied 7.4 ha, dense forest accounted for 188.7 ha while arable land occupied 37.3ha. Additionally, secondary forest accounted for 167.51ha (Figure 9).

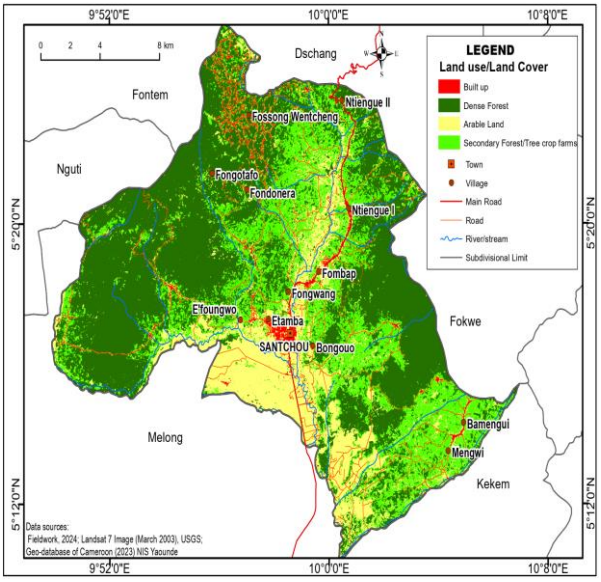



Figure 9: Land cover/use in Santchou, 2003

The relative change in land cover between 2003-2013 was significant, within the ten-year interval. The built-up area had a gain of 2.52 ha, while dense forest loss amounted to -58.98 ha. Arable land on the other hand gained 12.06 ha, and secondary forest also gained 43.78 ha. In 2013, the built-up area had increased to 9.92 ha, while dense forest reduced to 129.72 ha, arable increased to 49.36 ha and secondary vegetation increased to 211.29 ha (Figure 10).

In 2023, the built-up area continued to increase to 14.37 ha, while dense forest reduced to 85.74 ha. Arable land also increased to 58.21 ha and secondary forest increased to 241.97 ha (Figure 11).

Between 2013-2023, the built-up area had increased by 4.45 ha. Arable land also increased by 8.85 ha, together with an increase of 30.68 ha gains in area coverage of 30.68 ha. Dense forests continued to diminish within the same period and amounted to a loss of -43.98 ha. The relative land cover change between 2003 and 2023 saw gains in built-up area, arable land and secondary vegetation (Figure 12).

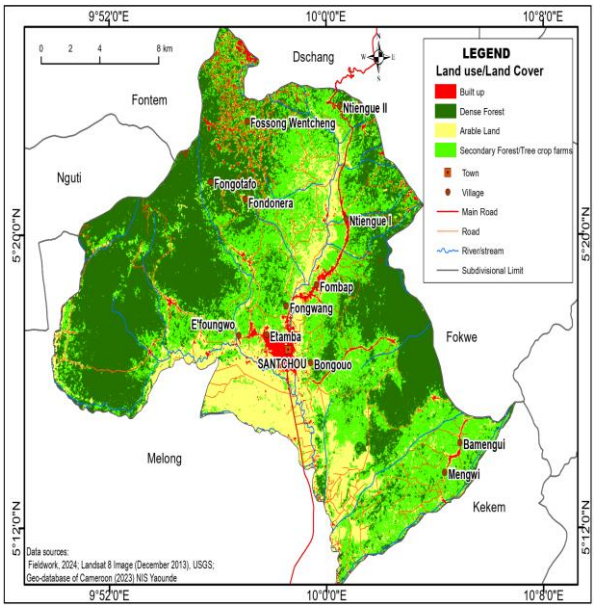



Figure 10: Land cover/use in Santchou, 2013

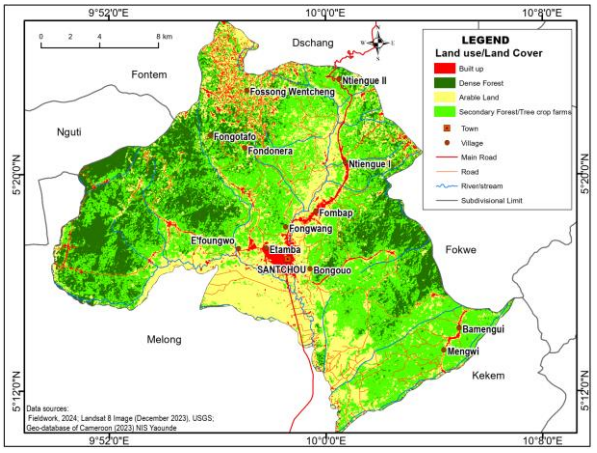



Figure 11: Land cover/use in Santchou, 2023

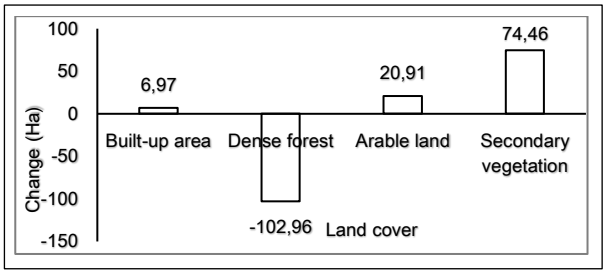



Figure 12: Land cover change between 2003 and 2023

Built-up area gains were 6.97 ha, arable land 20.91 ha and secondary forest 74.46 ha. Dense forest losses amounted to 102.96 ha.

## Discussion

### *Typology and pattern of housing development*

Field evidence indicates variations in terms of the housing typology in the past and today. For instance, while most of the houses were constructed as brick houses in the past, there have been significant but varied changes in the housing typology – this is skewed towards cement block houses. Most settlements that are close to the major communication line (highway) such as Fombap witnessed the most significant evolution from brick to blockhouses. Such a remarkable change is noticed in Etamba

neighborhood with a significant increase in the use of cement blocks. The economy of this landscape thrived in the past on rice cultivation. However, as this activity later on witnessed a standstill, there was a shift towards cocoa and other subsistence crops. The income realised from these activities was not substantial enough to facilitate the construction of modern houses. However, recent trends in the landscape show a rise in the production of cocoa and oil palm which has led to significant increases in the incomes realised by households. Additionally, most households are engaged in income diversification activities linked to NTFP collection and petit trading to supplement household incomes. This explains the rise in the number of buildings with cement blocks. In many African countries, studies have revealed that household wealth (with income as a proxy) is a strong determinant of good housing; middle and rich households have a higher probability of living in good and modern houses as compared to poor households (Iddi et al. 2022).

While the evolution of housing is triggered by several factors, the role of income stands primordial in the Santchou Landscape. Most respondents indicate that it took them a long time to engage in the construction of modern houses with cement blocks because of their low seasonal incomes. The next important element in the landscape is cultural preference – most of the houses are culturally adapted to suit the context of the age-old cultural practice of ensuring proper ventilation and positioning of their houses. Housing development is triggered by socio-demographic changes including rapid urbanisation leading to changing housing preferences in terms of space, shape, structure and typology (Adel *et al.,* 2016). This is also explained by cultural factors (e.g. vernacular) (Turner 1976). In this light, Douglas (1991) reported that housing development is shaped more by how people express their sense of belonging around such settlements. The latter holds for the Santchou landscape where cultural factors play an important role in determining the typology of housing. This view contradicts that of Owens (1992) who rather considered exposure to new construction materials and techniques as a key driver of housing development.

### *Environmental implications of housing mutations*

On the effects of housing construction on the environment, the study affirms that flooding is the most significant effect of housing development in the Santchou landscape. Much of the landscape suffers from inundation for most parts of the year. Housing construction in areas which are poorly drained has further compounded the problem. It is not uncommon to find inundated households for several months in the landscape. Households generally plan their living conditions and activities while factoring in this aspect of flooding. Due to the proliferation of state-subsidized housing for the poor, flooding witnessed a significant increase in Cape Town (Dube et al., 2022). For instance, studies from 10 flood-prone settlements indicate that flood risks are connected to the buildings themselves which are poorly designed and constructed (Pharoah 2014). In England and Wales, Rözer and Surminski (2021) showed that despite the introduction of new regulations to combat flooding, losses emanating from floods remained very high in built-up environments. This is explained by the rapid colonisation of flood-prone areas by building. Such activities go further to exacerbate the flood occurrences. Additionally, floods are linked to neighbourhoods inhabited by the poor. As in the case of Santchou, this witnessed a significant increase between 2008 and 2018. In the Western Cape Province of South Africa, Dube *et al.* (2022) reported a statistically significant increase in flood frequency and consequent losses to human society as a result of housing development and flooding.

Surprisingly, the least effect is the reduction in stream volume as reported by the respondents. This revelation seems to deviate from field observations where most of the streams in the landscape have witnessed a significant reduction in their volumes; others face the problem of stream sedimentation. In parts of South Africa, Ndou et al. (2021) rather showed that indoor air quality parameters, privacy, and visual comfort were among the key challenges linked to good housing. In parts of Bangladesh, Islam et al. (2023) reported that erosion was one of the most significant environmental crises affecting settlements in this area – this has triggered changes in land use and land cover for communities in southern Bangladesh. Conversely, in Rajshahi City in Bangladesh, local temperature increases were reported as the most significant effect of housing development (Al Kafy ., 2021). Here, the study reported that an increase in the surface area covered by paved surfaces and buildings is among the significant influential factors in increasing local temperatures. The land use and land cover (LULC) assessments of Santchou for 20 years showed that the built-up area witnessed a 97% increase in surface area – it moved from 7.4ha in 2003 to 14.37ha in 2023. Additionally, a more than 100% reduction in dense forest was reported as it moved from 188.7ha in 2003 to 85.74ha in 2023. Therefore, significant transformation linked to land use change in the landscape is skewed towards settlement (housing development). This has triggered a significant loss in vegetal cover, leading to other effects including flooding.

## Conclusion

While studies have established the process of housing dynamics in rapidly urbanised settings, the environmental implications linked to such dynamics along corridor-like settings remain relatively less explored. To address this knowledge gap, this paper uses the case of the Santchou Corridor to; (a) characterize the typology and pattern of housing development, and (b) assess the environmental implications of such housing mutations. Based on the analysis, the following conclusions are derived: Firstly, significant variations in the typology of housing are observed for the Santchou landscape; while most of the houses were constructed as brick houses in the past, recent changes have occurred in favour of cement block houses, especially in settlements that are close to the major communication lines. Secondly, while the evolution of housing is triggered by several factors, the role of income and cultural preferences stand primordial in the Santchou Landscape. Thirdly, while housing development has triggered a host of environmental effects, the significance of flooding as an environmental repercussion stands out. In terms of land use and land cover, significant increases in the built-up area have been characterised by a drastic decline in the land cover with an emphasis on dense forest. While this study advances the theorising on housing and the environment, it argues that studies to explore the role of housing policy in shaping the development pathways of housing in the landscape are required.

## Acknowledgements

We are thankful to the research assistants who supported the data collection process. We equally appreciate the anonymous reviewers whose comments helped to improve the quality of the work.

## Conflict of interest

The authors declare that there are no competing interests linked to this study.

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## To cite this article

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Tosam Hycinth Ngong, Banseka JaneFrances Yenlajai, Harry Wirngo Mairomi, Suiven John Paul Tume, Constantine Nwune Alusoh & Jude Ndzifon Kimengsi (2024). «Housing dynamics and environmental implications in the Santchou corridor, Cameroon». Canadian journal of tropical geography/Revue canadienne de géographie tropicale [Online], Vol. (9) 2. Online December 25, 2024, pp. 15-21. URL: https://revuecangeotrop.ca

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