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Mode of Habitation Architectural in the City of Toliara, (Southwest-Madagascar), Factor of Exposure to the Risks of Hydroclimatic Hazards

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Abstract

The housing problem is a universal phenomenon that mainly affects developing countries. Toliara, a city in southwestern Madagascar, is located in a delta. The low elevation of the land is one of the inherent causes of flooding due to the rise of the river and marine submersion. In addition, the method of housing construction and the materials used have further weighed down urban ones. The cartographic approach based on the analysis of maps and satellite photos combined with the field survey method made it possible to assess the dominance of a habitat that does not support the submersion of runoff water and the intensity of the wind. The qualitative and quantitative analysis of the habitats shows the profile of the districts in the dominance of the precarious habitats only on the whole of 72890 inventoried constructions, 39453 are of precarious habitats, and only 33437 are solid constructions (low and story house). Only downtown, with a checkerboard urban plan from 1901, we can see a dominant solid housing, resistant to climatic disturbances. On the other hand, the outskirts have a dominant plant habitat (rush, wood) and corrugated sheets which is very fragile in the face of extreme floods. The rapid spread of the city has a significant impact on urban planning. The strong reception of rural immigrants (Tandroy, Mahafaly, Tagnalagna) since the colonization (1925) to the present day, the economic decline of the population, and the attachment to rural customs and cultures in the urban environment have greatly contributed to the exhibition of Toliara to hydrological hazards.

Keywords: Anarchic Urbanization, Habitat, Type, Toliara, Southwestern Madagascar

1. Introduction

The housing structure is one of the relevant indicators to determine the development or not of a city. In general, the construction of habitat in vegetation is a traditional Malagasy way of development and each region has its model according to the dominant vegetation (Decary, 1957) [6]. The heterogeneity both in the materials used and in the structure of the neighborhoods defines the socioeconomic and cultural inequality of the inhabitants (Razafindrakoto, 2014)^[27] and the city's capacity for climatic hazards (Thouret & D'Ercole, 1996)^[31]; (Reghezza, 2006). The development of Toliara is a type of example that can be used to indicate the lack of urbanization in developing countries, determined by imitation by default. The image of the past, the economic inequalities, and the weak administrative control combine the urbanization of the capital of the Malagasy South-West Region. The ethnic presence in the neighborhood is materialized by their activities: the Vezo fishermen live on the coastal dune belts (Mahavatse, Tsimenatse, Tsianengea, Besakoa Ambohitsabo (Fernand, 2008)^[8], the Masikoro agropastoralists in the interior, and the immigrants in the outskirts. From 1898, the cadastral loan and the plan of Checkerboard urbanism embellish the central area, which become the administrative and commercial quarters today. From 1915 onwards, the settlers fitted out the cultivable land inside the country and recruited rural natives as laborers (Chapus, 1951)^[3].

Despite the development attempts made in Toliara, the urban disorder is found throughout the neighborhoods. Today, the derogatory name "large village" (Hoerner, 1987)^[11]; (Fauroux & Koto, 1993)^[7] and "village district" (Houssay-Holzschuch, 1994)^[12] continue to call the sixth large city of the Island. In addition, the predominance of the neo-urban population is still a big problem for the city's development. The tangential acceleration of illicit land occupation engenders confusion about



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urbanization without examining the nature of the land (Razakamanana *et al.*, 2014) ^[16]. However, the effects of climate change impose Toliara, a coastal town, absolutely exposed to the risks of flooding.

2. Method and material

The study of urban vulnerability concerns the building criteria that make up the risk factors. Moreover, the analysis of urban risks does not escape the examination of biophysical factors: buildings which are the components of urbanization (Thouret & D'Ercole, 1996)^[31]; (Texier, 2009) ^[18]. Indeed, we chose the cartographic approach method based on the architectural digitization of existing housing throughout the coastal plain of Toliara. The typology of buildings, confirmed with surveys, is a method used by various researchers in the study of urban vulnerability to flooding (Creach, 2015)^[5]; (Rakotoarisoa, 2017)^[14]; (Taibi et al., 2017) ^[17]. This method uses raster images from different sources (aerial photos from 1945 and 1959, satellite images, etc.). The digitized data characterization protocol is then processed using ArcGis 10.3 software to define the type of habitat. The results obtained are validated by field surveys with the aim of the final evaluation of housing in vegetation, in corrugated sheets, on the concrete lower and upper floors.

2.1 Objective

The objective is to characterize, according to the construction materials used, the residential houses found

throughout the coastal plain. This method is one of the classic procedures for defining neighborhoods by qualifying their degree of exposure to flooding and the intensity of the cyclonic wind. Defining buildings according to their resistance is also a tool for assessing the level of vulnerability of each neighborhood without having gone into detail about the interior equipment (Gondad-Delcroix & Rousseau, 2019)^[10] (sanitary, comfort, etc.). To do this, the criteria system is based on the typological grouping of housing: those on the first floor (type 4), on the solid lower floor (type 3) in sheet metal, wood (type 2), and in rush (type 1) (Rakotoarisoa, 2017)^[14].

2.2 Presentation

Besides the urban commune of Toliara I, the coastal plain is composed of three peripheral rural communes: Mitsinjo Betanimena, Betsinjaka, and Miary. The outskirts are made up of neighborhoods, groupings of villages, and hamlets in discontinuous formation. The city of Toliara I is the urban center, subdivided into six administrative districts (Mahavatse, Tanambao, Tanambao II TSF Nord, Betania, Besakoa, and Ankenta). It groups together 41 neighborhoods (C.U.T., 2004)^[2]. The city center is also surrounded by the old villages of the Vezo fishermen erected on dune cords, namely Besakoa, Ambohitsabo, Anketrake, Tsongobory, Tsimenatse, and Mahavatse. The former agricultural areas of the East and North (Hoerner, 1987)^[11] are now occupied by immigrants, a phenomenon that has developed since 1945.



Fig 1: The urban development structure of the Toliara coastal plain

3. Findings and interpretation Typology of housing

The analysis by the digitization of the constructions, according to the 2018 statistics, gives the figure of 72,890 houses installed in the various municipalities of the coastal plain. Housing classification is divided into four types according to building materials:

Type 1: construction in aquatic plants (rush) or the Trano vondro under a wooden frame

Type 2: Wood or corrugated iron construction (tragno hazo or tragno kaky)

Type 3: Solid construction (fired brick or concrete) in the form of a low villa, called tragno vato

Type 4: Solid construction, but with floors

In the cartographic presentation of each habitat typology, the color green is used for type 1, garnet for type 2, dark gray for type 3 and pink for type 4.



Fig 2: Typology of constructions in Toliara

The construction inventory (Table 1) shows the dominance of type 3 habitats, which is evaluated at 44.05%, followed by type 2, 30.47%. Type 1 habitat is 23.66%, and type 4 is 1.82%. Type 1 is the most numerous in the outskirts. This type of house is made of a variety of aquatic vegetation "Typha latifolia" or rush. It is abundant in the South and South-West regions of Madagascar. It is found in almost all the marshy water points around the coastal plain, like Belalanda, Ambondrolava, Fitsitike, etc. The sales point for the materials, in prefabricated form, is just on the other side of the right shore of Fiherena, 9 km from town, in Belalanda. These type 1 houses, prefabricated, are set up in less than a day. In addition to the rush, which makes up many materials, the frame and the pillars are made either of a more resistant species of reed locally called "volo" or "phragmites communis" or ligneous wood such as Cedrelopsis grevei or others. These plants are also found in the forest near the town.

The "rush" habitat is identified by its small surface area. The average size varies from 9 m² to 15 m². There is even a six (6) m² house that can accommodate more than five (5)

people. In most cases, the "rush" house base remains uncoated. Only a mat can cover the floor.

Table 1: Quantitative of construction typologies in the Toliar	a
coastal plain, 2018	

Habitat	Type 1	Type 2	Type 3	Type 4	Total
Quantity	17243	22210	32112	1325	72890

Type 2 is one of the overabundant habitats in the Coastal Plain. It takes the second rank of housing in the city, but is also relatively rare in the city center. However, in the outskirts, it is numerous. Unlike the reed house, it is pretty big and is quite decent. Its surface area varies from 9 m² to 50 m². As sheet metal is also among the prefabricated materials (in rolling), the inhabitants use them to cover not only the roof but also the wall.

The house usually has light cement-covered paving, often with no reinforcing foundation. The height of the macadam does not even reach 20 cm and is made of thin gabions covered with cement to protect itself on the ground.



Fig 3: Type 1 and type 2 precarious habitats

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Type 2 designates not only the habitat made of sheet metal but also that whose materials are associated. These are houses where the wall is made of wood (batten), reed, and sheet metal, and the roof is made of corrugated sheet metal. The southern neighborhoods (Mahavatse, Ankiembe, Belarondy, Amboanio, etc.) have a lot of this type of housing. Usually, regardless of the materials used for the wall (batten, reed, sheet metal, etc.), the roof always remains in sheet metal or reed.

Type 3 represents a house built from rock materials, such as cement, stones, sand, clay, etc. It is classified as solid housing not only because of the components of materials used but also the building system insofar as the builder follows the architectural standard. Its construction requires some sort of qualification and a call for specialized workers or the construction company for the rich. Most have sheet metal roofs. Since pure clay is rare and salt is also rich in the area, most people are not very enthusiastic about building a fired brick house.

Type 4 is also a solid building extended in height. Its construction is not frequent in famous and peripheral districts. Most "type 4" houses are varied and have one or more floors.



Fig 4: Solid house model (type 3 and type 4)

4. The spatial characteristic of housing 4.1 Precarious housing

The precarious habitats (types 1 and 2) are found in the peripheral districts of the city. They are characterized by their superficial shapes, but also the dilapidated quality. When moving away from the city center, its presence is very marked (fig 3 and 4). Both types of houses are dominant in the old fishing villages, such as Ambohitsabo, Ankiembe Bas and Haut, Tsongobory, and Mahavatse. They are also numerous in the former immigrant neighborhoods (Besasavy, Ampasignabo, Betaritarika, Ankenta, Ampasikibo, Sanfily, TSF Nord and Tsongobory) but also in

the neighborhoods of indigenous agropastoralists (Mistinjo, Befanamy, Belemboka, etc.). The university domain, which is in the Ampasignambo neighborhood, has a dominance of type 1 habitat because of the squatting phenomenon, which has been very developed, since the 2000s. Around the University campus, there are even pseudo-cities of "rush boxes" which accommodate students who do not have access to university rooms for lack of space. Small remote villages, such as Ankoronga, Belemboka Ampasy, Ankilifolo, Betaindambo, Miary and Betsinjaka, have almost all rush and sheet metal housing.



Fig 5: Reed houses (Type 1)



Fig 6: Construction in wood and corrugated iron (type 2)

4.2 Compliant housing

Solid constructions (type 3 and type 4) are also found across the plain. In the neighborhoods, they mix with any kind of housing except the city center. The Tanambao I and II, Morafeno, Safily, and Ampasikibo neighborhoods are entirely occupied by permanent buildings (lower villa and floor) (Fig 5, 6). The most numerous are the low concrete houses. The latter is also present in large numbers in the remote villages and the immediate peripheral districts of the city center. These areas are occupied by privileged inhabitants who made the urban exodus.

Story buildings are the least numerous (Table 1). They are not much in the periphery than in the only old farm of Befanamy, the buildings of the University. Villages such as Belemboka Ampasy, Ankilifolo, and Ankoronga have not registered this type of house. On the other hand, they are dominant in the central districts and the edges of the roads of the city center. In general, this type is used for administrative and commercial use.



Fig 7: Low concrete housing (type 3)



Fig 8: The solid houses with floors (type 4)

5. Discussion

The geomantic analyzes reveal the characteristic of the development of the city of Toliara. The habitats that use plant materials and corrugated sheets (types 1 and 2) are the most numerous compared to permanent buildings (type 3 and 4). Moreover, construction in plant material and wood (sheet metal) is not governed by the law on urban planning and housing (Clerc, 2018)^[4] but also creates exposure to cataclysms (Reghezza, 2006). The first use of corrugated sheets was by sheds and stands of foreign traders from Nosy-be installed in the beach of Toliara Center at the beginning of the move to the bay of Toliara in 1897 (Chapus, 1951)^[3]. These houses were only temporary construction pending the establishment of the cadastre in Toliara-Centre. Removed from the administrative procedure, the inhabitants of Toliara imitate it until today. The weak economic capacity of the population persists in the generalization of precarious housing in the city center (Fauroux & Koto, 1993)^[7]; (Houssay-Holzschuch, 1994) ^[12]. Although Malagasy people traditionally use plant materials for their homes (Decary, 1957)^[6], construction in the city is managed by specific regulations. Until today, the lack of control of these structures leads to the overflow of the city of Toliara with the presence of shanty towns, and chaotic neighborhoods, etc (Fremigacci, 1981)^[9]; (Hoerner, 1987)^[11]; (Houssay-Holzschuch, 1994)^[12].

In addition, during the years 1901-1930, the opening of the roads linking Toliara with the other regions, in particular the ox cart tracks, from Toliara-Ampanihy in 1906, the calls for rural workers in 1920 to work the fields in the plain of Toliara and its surroundings (Bas Mangoky, Taheza) (Hoerner, 1987)^[11] and zonal climate change (south) due to the attack of "ladybug" insects anticipating drought in the south (Chapus, 1951)^[3] have constituted the causes of the rural exodus in Toliara. Indeed, the increase in immigrants directly reaching the peripheries is unrestricted. However, the inhabitants of the pseudo-villages freely practice rural mores and cultures, creating urban solid sprawl and illicit appropriation of unbuildable zones (Bastié & Dézert, 1991)^[1], such as paleochannels, paleomarsh, evacuation, and irrigation canals.

Table 5: Evolution of the population of the city of Toliara from1897 to 2018

 Years
 1897
 1925
 1932
 1970
 1993
 2001
 2013
 2018

 Number
 2000
 6900
 17000
 46500
 80826
 173784
 277079
 324
 342

 Source:
 Chapus
 1951
 ^[3]
 - Statistique
 RCG
 993
 - Hoerner
 J.M.,

 1987
 ^[11]
 - Koto
 B.
 1996
 - CUT,
 2004
 - Monographie of Toliara

 Fivondronam-pokontany,
 2018.

The city was created in 1898 and had become the provincial capital in 1903, and a communal agglomeration composed of the urban, peripheral, and rural perimeter in 1922 (Fremigacci, 1981)^[9]; (C.U.T., 2004)^[2]. Toliara, a town in the form of a "big village" (Fauroux & Koto, 1993)^[7], is still a town in the process of urbanization. However, it is also a city of very high vulnerability to the risk of flooding and rising sea levels, whereas the majority of habitats are made of rotting materials.

6. Conclusion

The development of urban risk analysis through the characterization of habitats embraces several methods of approach. A resilient city is not only exposed to geophysical risk, but must also have the capacity to resist hazards (Reghezza, 2007). However, for Toliara, the negligence of the administration and the inhabitants is still excessive despite the inherent risks (Fiherena and the Mozambique Channel). Solid construction materials are one of the solutions to resist natural disasters. Poverty is always blamed as the source of incapacity, but administrative laxity and the laissez-faire consensus permission, and slow decision-making always regenerate the evils (Koto, 1997) ^[13].

The semi-arid climate and the wadi state of the Fiherena River still mislead people about the floodability of the plain in the event of climatic disturbance. The rise in the level of the Fiherena bed due to sedimentation facilitates the overflow of water towards the paleomarais and the paleochannels, which are occupied by mostly precarious housing. In addition, this type of habitat does not support the stagnation of diffuse runoff water for several days due to the lack of sanitation networks. International Journal of Advanced Multidisciplinary Research and Studies

7. References

- 1. Bastié J, Dézert B. La ville. Masson, 1991.
- 2. CUT. Plan d'Urbanisme Directeur. Rapport final, Toliara Madagascar, 2004.
- Chapus GS. Tuléar, ville de dune. (S. G. l'Information, Éd.) Madagascar à travers ses provinces, 1951, 295-305.
- Clerc V. Les quartiers informels à l'épreuve de la crise en Syrie:une réflexion inachevé de politique d'habitat et d'urbanisation? Quartiet informels d'un monde arabe en transition-Réflexions et perspective pour l'action urbaine. Agence Française du Développement, 2018, 53-69.
- 5. Creach A. Cartographie et analyse économique de la vulnérabilité du littoral atlantique français face au risque de submersion marine. Nantes: Université. 2015; 1(2).
- 6. Decary R. L'habitation chez quelques tribus malaches. Mémoire de l'ORSTOM. 1957; 18.
- Fauroux M, Koto B. 1996. Cah. Sci. Hum. 1993; 2(29):18.
- Fernand R. Histoire du peuplement de la ville de Toliara à travers les nos de quartier. Talily. 2008; (13, 14, 15):39-51.
- Fremigacci J. Protectorat intérieur et administration direct dans la province de Tuléar 1904-1924, mythes et réalités. Etat et Société en Afrique Noire. 1981; 68(250-253):359-379.
- Gondard-Delcroix C, Rousseau S. Vulnérabilité ét stratégies durables de gestion des risques: Une étude appliquée au ménages ruraux de Madagascar. OpenEdition. 2019; 21.
- Hoerner JM. Contribution géographique à l'étude du sous-développement régional du Sud-Ouest de Madagascar. Madagascar: Université de Saint-Vincent, 1987.
- Houssay-Holzschuch M. La cité sans la ville: Tuléar , Sud-Ouest de Madagascar. Géographie et cultures. 1994; 11:26.
- 13. Koto B. Relations ville-campagne dans le Sud-Ouest de Madagascar: Exemple de Tuléar. Bordeaux 2, Université de Beardeaux 2: Thèse en géographie, 1997.
- 14. Rakotoarisoa MM. Le risque hydrologique dans le bassin versant sous contrôle anthropique: modélisation des aléas, de la vulnérabilité et des conséquence sur les sociétés (éd. Thèse). Angers: Université, 2017.
- 15. Razafindrakoto JL. Résilience des habitations aux inondations en milieu urbain; cas d'Andohatapenaka, un quartier de la ville d'Antananarivo. Etique et économique. 2014; 11(1):13.
- 16. Razakamanana T, Ratsitohaina O, Tovondrafale T, Ramihariso RCD, Mong Y. Géologie urbaine et environnemental dela ville de Toliara, Sud-Ouest Madagascar: Quelles politiques de gestion durable? Eau, milieux et aménagement, une recherche au service des territoires, 2014, 204-223.
- Taîbi AN, Rakotoarisoa MM, Champin L, Fleurant C, Razakamanana T, Guyard S. Méthode d'analyse de la vulnérabilité auxinondation à Toliara (Sud-Ouest Madagascar). Géo-éco-Trop. 2017; 2(41):455-462.
- Texier P. Vulnérabilité et reduction des risques liés à l'eau dans le quartiers informels de Jakarta Indonésie. Réponses sociales, intitutionnelles et non

institutionnelles. Paris VII: Université Paris Diderons, 2009.

 Thouret JC, D'Ercole R. Vulnérabilité aux risques naturels en milieu urbain: Effets, facteurs et réponses sociales. Cah. de Sci. Hum. ORSTOM. 1996; 2(32):407-422.