IPC2025 – Article for oral communication of candidate Papa Gueye Sow

Title: *The role of flooding in urbanization: the reconfiguration of the urban trajectory of Dakar, Senegal*

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Introduction

In the context of the intensification of extreme climate-related events (IPCC, 2022), towns are particularly vulnerable owing to rapid population growth and often to poor urban planning (Monteiro et al., 2022; Quenault et al., 2011). The analysis of climate-related risks in the urban environment has thus become a major issue in scientific research, with numerous studies that have sought to investigate the socio-spatial transformations and policies which result from them (Henderson et al., 2014; Hung et al., 2024).

In the social sciences in particular, the notion of urban vulnerability has been deployed to seek to understand the impacts of climate-related events which have un unequal effect on populations and urban spaces (Allarané et al., 2023; Kita, 2017). The levels of exposure to these events may indeed be disproportionate according to the economic resources of the populations, their place of residence, the types of dwelling and of land use, and the provision of infrastructure (Hsu et al., 2021; Tamru, 2023; Zahnow et al., 2025). Urban vulnerability is also linked to the capacity for response and adaptation to climate-related risk in urban environment, which relates to the notion of urban resilience.

Urban resilience is understood here to mean the actions and practices deployed to mitigate the impact of climate-related events and to adapt sustainably to risk in the towns (Courtial-Sabatier, 2022; Meerow et al., 2016). These actions and practices may be of various forms in function of the urban space and of the actors. In France, for example, the governance of urban flooding risk (Rioust, 2012) has undergone changes in the conception of management policies, progressing from a "fight against" approach to a "learn to live with" approach (Franqueville, 2023 : p.15).

In this perspective, extreme climate-related events may be seen not as isolated phenomena, but as a dynamic whole requiring the implementation of policies of adaptation in the town. These policies which call for new, more resilient forms of urban planning are often materialized as emergency projects for the (re-)development of the urban space (Courtial-Sabatier, 2022), and the resettlement of the populations (Murru & Saïd, 2021). These transformations have an impact on the urban trajectories, understood here as the socio-historical evolution of the spatial, social and economic transformations of a city according to political, economic, environmental, etc., influences. (Pumain, 2021).

Dakar – the capital of Senegal – has seen a recurrence of flooding since the end of the 1980s (Diongue, 2014). A sequence of annual flooding events, some more severe than others, have occurred since the beginning of the years 2000 (Nanitelamio-Charvin, 2021). In response, the public authorities have introduced a succession of policies to combat this phenomenon (Bottazzi et al., 2019). However, these policies which mainly involved one-off and reactive actions such as the pumping out of run-off water in the flooded neighborhoods and the temporary resettlement of flood-impacted inhabitants in public buildings, have proved ineffective (GFDRR, 2014). For the flooding has become more frequent and more intensive, as in the case of the floods of 2005 which resulted in thousands of people being exposed to situations of insecurity and the displacement of hundreds of households in the working-class neighborhoods of Pikine and Guediawaye (Thiam, 2011).

The floods of 2005 marked a major turning point in the governance of climate-related risk in Dakar with the deployment by the State of the Plan Jaxaay. The aim of this program was two-fold: to restructure the flooded neighborhoods in the suburbs (Pikine and Guédiawaye) and to resettle 3 000 flood-impacted households on the outskirts of the city (Keur Massar). In addition to this program of actions, the Plan Jaxaay also constituted a political vision promoted by the public authorities to sustainably solve the problems of flooding, not through one-off reactive actions, but by means of policies for the prevention and mitigation of the risks of flooding (Schaer et al., 2018). This marked a break with the management policies that had been deployed hitherto.

Thus, if it is clear that at Dakar flooding gives rise to new modes of urban planning and land use through policies of adaptation to climate-related risk, the identification of the socio-spatial dynamics on the basis of which they may influence the organization of the urban space

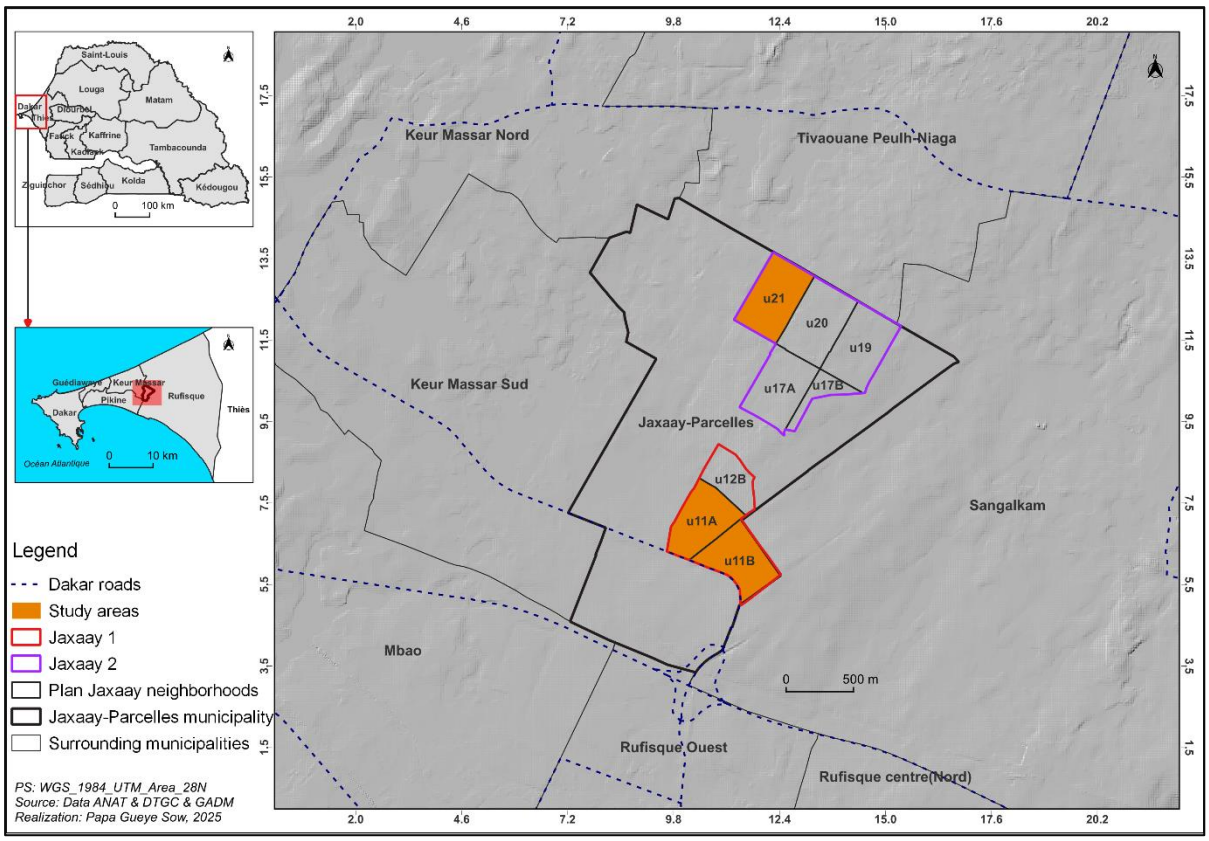
remains obscure. This leads us on to the following question: to what extent do the floods shape the urban trajectories in Dakar? It should be noted that with the Plan Jaxaay, the challenge for the public authorities was not to combat flooding but rather to adapt the urban space to the risks. Thus, the aim of this presentation is to analyze how the policies of prevention and reduction of flood risks influence the urban trajectories in Dakar. In the first part, we shall focus on the transformations of the urban landscapes of the neighborhoods evacuated by the households which have been resettled at Pikine and Guédiawaye. Then, we shall map the changes in the urban dynamics of the municipality of Jaxaay-Parcelles which have benefitted, among other things, from the construction of the Plan Jaxaay resettlement neighborhoods. Finally, we shall analyze the risks of flooding at Jaxaay-Parcelles as consequences resulting from the policy of the Plan Jaxaay.

Methods

1. Tools and methods:

We have carried out field surveys in two phases. The first phase was carried out during the period June to November 2023 and the second during the period June to July 2024.

Map 1: Location of the study areas



The field survey was focused on three (3) of the eight (8) resettlement neighborhoods of the Plan Jaxaay which are in the municipality of Jaxaay-Parcelles in the *département* of Keur Massar in the Dakar region. These are neighborhoods u11A, u11B and u21, represented in orange in Map 1. It should be stressed that the Plan Jaxaay neighborhoods are grouped in two (2) spatial entities: Jaxaay 1 (shown in red) and Jaxaay 2 (shown in mauve). Neighborhoods u11A and u11B are part of Jaxaay 1 and neighborhood u21 of Jaxaay 2. These neighborhoods which were created as part of Plan Jaxaay for the resettlement of flood-impacted households offer a suitable framework for analyzing the influence of the policies of prevention and reduction of the risks of flood on the urban trajectories in Dakar.

This study is based on field work and on cartographical work. For the fieldwork, we carried out observations and surveys. These surveys involve biographical interviews, focus groups, and interviews. The biographical interviews (Demazière, 2007) were organized based on the model of the life story constructed by McAdams (2008) and defined by Bertaux & Singly (1997)[1]. They were carried out with heads or representatives of households, neighborhood delegates, and leaders of local associations/organizations residing in neighborhoods u11A, u11B and u21. The focus groups which constitute collective discussion sessions were held among the inhabitants of neighborhood u11B following the format recommended by Onwuegbuzie et al. (2009). In these two surveys, the two main criteria for the selection of the participants were the fact of having experienced floods and of having been resettled because of flooding. Finally, the interviews were carried out with the heads of technical services departments responsible for urban planning, sewage systems and flood control, and the local authorities.

In all, we have a corpus of 77 people surveyed including 55 people through biographical interviews (Table 1), 18 people through focus groups (Table 2) including 39 people in neighborhood u11B, 20 people in neighborhood u11A and 14 people in neighborhood u21. There were in addition 4 people interviewed at the scale of Dakar (Table 2). The population is composed of 42 women and 35 men. In the biographical interviews, the age range of the people interviewed was 20-34 and 65-79 years old. The 50-64 age range is the most strongly represented (22 people) and the 20-34 age range is the least represented (5 people).

[1] According to the authors, the life story is a subjective reconstruction of an individual's past life recounted in the framework of a sociological investigation, which provides a basis for linking personal experiences and the logic of social situations (Bertaux & Singly, 1997).

Table 1: Demographic characteristics of people interviewed on the basis of life stories.

Life stories	Gender = Female (29)				Gender = Male (26)				Total
	Age = 20 - 34	Age = 35 - 49	Age = 50 - 64	Age = 65 - 79	Age = 20 - 34	Age = 35 - 49	Age = 50 - 64	Age = 65 - 79	
Narrators	1	7	15	6	4	8	7	7	55

With regard to the focus groups surveys and the interviews, age is not an important indicator since in the former case, the conditions and the collective format make this irrelevant, and in the second, age has no influence on the analysis of the information.

Table 2: Characteristics of the persons surveyed in focus groups and interviews.

Gender	Survey type	
	Focus groups	Interviews
Female	12	1
Male	6	3
Total	**18**	**4**

In addition to these field surveys, we carried out observations in the original home neighborhoods of the people resettled at Jaxaay. With two (2) informants, we carried out an observation visit at Médina Gounass, a district of Guédiawaye. This visit enabled us to observe the urban landscapes and to take GPS readings.

2. Data processing:

The qualitative (focus groups and interviews) and quantitative (population) data, the Geographical Information Systems (GIS) and geo-spatial (satellite images) data used were processed in specific ways. For the qualitative data, the various interviews recorded in audio files were transcribed and translated. After the transcription and translation phase, we then proceeded to the coding and analysis of the texts using the software Nvivo versions 14 and 15. For the population data, we used the statistics from the fourth general census of the population in 2013 and those of the fifth general census of the population in 2023 by the ANSD[2]. On the basis of these national demographic data bases, we retrieved the statistics concerning the municipality of Jaxaay-Parcelles and its neighborhoods, including the

[2] The National agency of statistic and demography (ANSD) is the structure in charge of general censuses in Senegal in sectors such as demography. These censuses referred to officially as *Recensement Général de la Population et de l'Habitat* (RGPH) are carried out every 10 year.

resettlement neighborhoods of the Plan Jaxaay. The third census in 2002 was not taken into account here as the locality of Jaxaay did not exist at that time..

We used the 5m digital terrain model (DTM) in open access on the platform GEOSEN with the georeferenced limits of the basins provided by the ANAT for the location of the depressions in which the water reservoirs were constructed after the resettlement of the households. We used the shading tool on QGIS 3.26.1 to show the gradient of the slopes. We adopted 4 classes with a 6m steps to identify the zones with depressions. We based our work on that of Sy (2019) who used a 3m DTM scale to identify the flood-prone low-lying areas at Yeumbeul Nord (Pikine), and that of Diouf (2013) who used a 5m DTM scale relative to sea level to identify the flood-prone areas of Dakar in 2005.

For the geo-spatial data, we used the images Spot and Sentinel from the years 2001, 2011, and 2021 (Spot 4 for 2001; Spot 5 for 2011; Sentinel 2 for 2021). The images Spot 4 and 5 were subjected to radiometric correction to improve the spectral signature, and all the images were geo-referenced to enable them to be superimposed. These dates were chosen to enable comparison of the changes in the classes of land use at Jaxaay before and after the construction of the Plan Jaxaay resettlement neighborhoods (see Table 3). The year 2001 enabled us to observe the initial land use before the Plan Jaxaay; 2011 enabled us to observe the changes at the outset of the Plan Jaxaay; and finally 2021 enabled us to analyze in particular the trends in the urban dynamics at Jaxaay before and after the emergence of the Plan Jaxaay policy. The cartographical work was done using the software QGIS 3.26.1 and ArcGIS Pro. The validation of the results was done using the GPS points recorded in the field in 2023 and images from GoogleEarth Pro.

Table 3: Characteristics of the land use classes adopted.

Class	Description
Urban occupation	Built-up area, residence buildings, infrastructures, publics facilities, roads
Bare land	Bare soil, vacant, unbuilt plots, marshy soil
Farming land	Farming fields, farms
Vegetation	Vegetation cover, trees, grasses, grassy area, natural area

3. Statistical processing:

The calculation of the rate of expansion enabled us to observe the patterns of change in the land use classes at Jaxaay. The rate of expansion (T) allows detection and comparison of the spatial evolution of each land class use for each year.

It is calculated on the basis of the formula: $T = S1 - S2$

Given that S1 represents the percentage of the surface area of a land use class of the most recent year and S2 the percentage of the earliest year. If the value of (T) is positive, that signifies a progression of the land use class; if the value of (T) is negative, that. signifies a regression of the class, and if the value of (T) is close to zero, that signifies a relative stability of the land use class (Aimée et al., 2018). The calculation of these statistics was done using the software Excel.

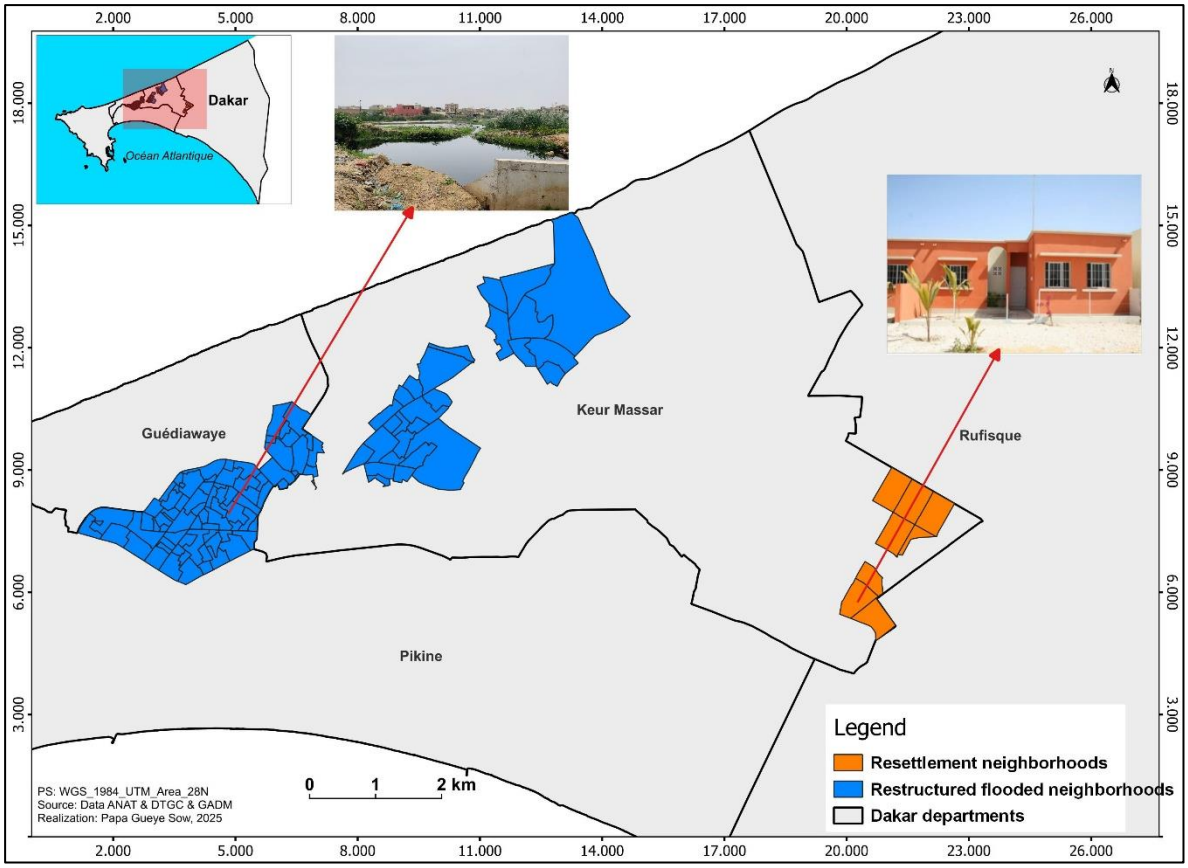
In addition, the calculation of the frequency (population part in percent) enabled us to highlight the difference of weight and demographic growth between the neighborhoods of the municipality of Jaxaay-Parcelles. The frequency (%) calculated here relates to the relative proportion of the population of each neighborhood in relation to the total population of the municipality of Jaxaay-Parcelles for each year. It allows us to highlight the demographic weight of each neighborhood relative to the total population of the municipality. We used the software Excel to calculate the frequency on the basis of the following formula:

$$\text{Frequency (\%)} = \text{Population of neighborhood} / \text{total population} \times 100$$

Results

We may recall that the aim of this study is to analyze the influence of flood management policy on the urban dynamics of Dakar, with a focus on the policy of the Plan Jaxaay. This policy was mainly dedicated to two actions: the construction of eight (8) resettlement neighborhoods at Keur Massar to rehouse the inhabitants impacted by the floods of 2005, and the restructuring of the neighborhoods flooded or at risk of flooding evacuated by these households at Pikine and at Guédiawaye (see Map 2).

Map 2: Location of the neighborhoods concerned by the Plan Jaxaay



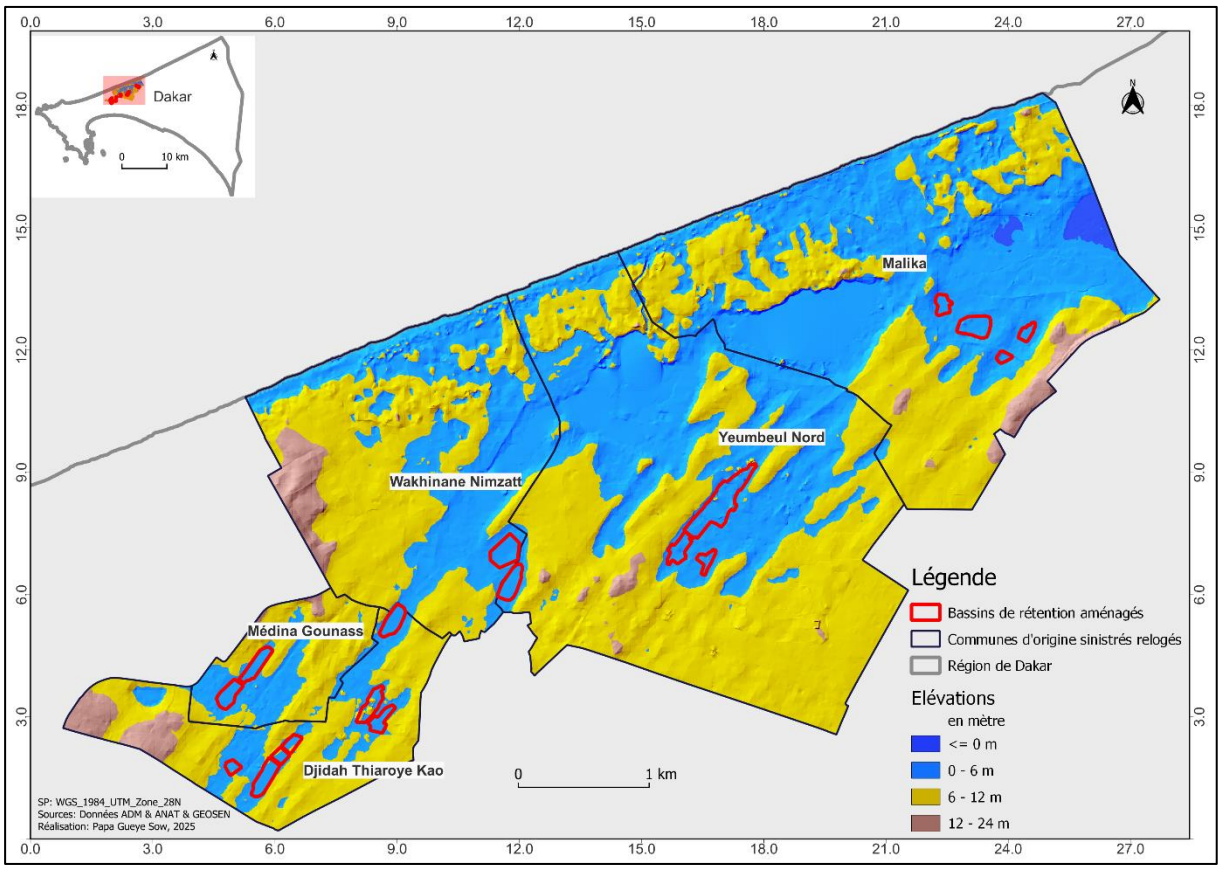
The socio-spatial dynamics analyzed in the following sections will thus concern these two categories of neighborhood (restructured flooded neighborhoods and resettlement neighborhoods).

- **Reconfiguration of the urban landscape in the inhabitants' original neighborhoods**

The restructuration operations in the flooded or flood-prone neighborhoods under the Plan Jaxaay consisted of two main phases: the (re-)development of the flooded areas considered nonetheless as still inhabitable, and the regeneration of the low-lying wet areas of the *Niayes* considered as unsuitable as habitat. The (re-)development operations concerned the rehabilitation of insecure and makeshift habitat with the installation of rainwater drainage systems, the construction of secondary roads (tarmacked or surfaced), public spaces (sports fields, parks), and the regulation of property rights. The regeneration operations for the *Niayes* involved the “de-urbanization” of the low-lying areas which were regularly flooded by means of the resettlement of the inhabitants who lived there, on one hand, and the

construction of dams in the areas thus liberated on the other. These *Niayes* areas were thus restored to their natural function as drainage outlets and catchments for the rainwater.

Map 3: Location of the dams constructed in the original home neighborhoods of resettled disaster households

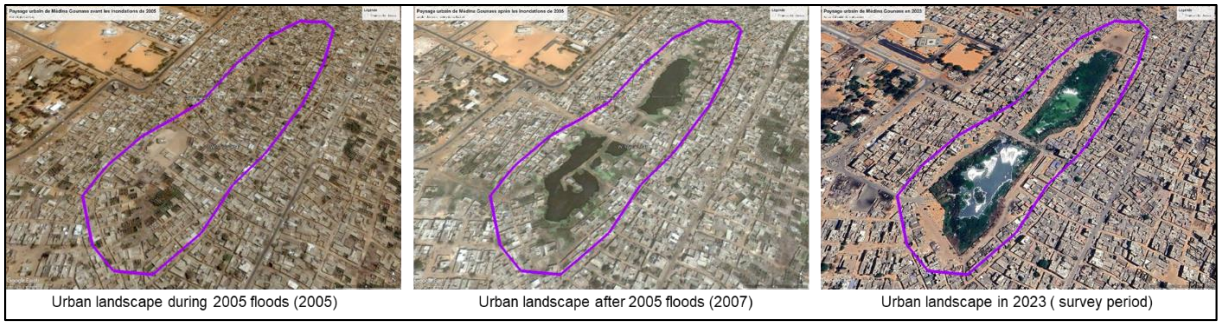


It should be noted that water retention basins were constructed in several municipalities of Pikine and Guédiawaye but here we focus on the home municipalities of the households we surveyed. These are the dams of Medina Gounass, Djidah Thiaroye Kao, Wakhinane Nimzatt, Yeumbeul Nord and Malika which are located in the zone of the *Niayes* with a low-lying topographical profile in the elevation range -0.5 / – 21m. In Map 2, we can see that all the dams were constructed in the low-lying areas in the elevation range of 0 – 6m relative to sea level.

In addition, these restructuring operations reconfigured the urban landscapes, understood here as the entities characterizing the land use of an urban space. We have thus undertaken a case study of Medina Gounass – the main area the flood-impacted households came from. Almost half of the surveyed households, 24 out of 55, said they came from the neighborhoods of Medina Gounass which were located in the regularly flooded low-lying areas. Because of

the floods and the restructuring operations deployed under the Plan Jaxaay, the urban landscapes of these neighborhoods were reconfigured.

Map 3 : Reconfiguration of the urban landscapes of the municipality of Medina Gounass



Urban landscape during 2005 floods (2005) | Urban landscape after 2005 floods (2007) | Urban landscape in 2023 (survey period)

In Map 3, the photograph taken in 2005 shows that the urban landscapes were densely urbanized. But after the floods of 2005, these landscapes underwent a spatial transformation with the disappearance of part of the space hitherto occupied by buildings in favor of a space for the draining off of water with the beginning of the construction of two dams from 2006 (Photo 2 taken in 2007). This reconfiguration of the urban landscapes continued over the years with the increase of the areas of water and the reduction of the built-up areas (Photo 3 taken in 2023, at the time of the field surveys).

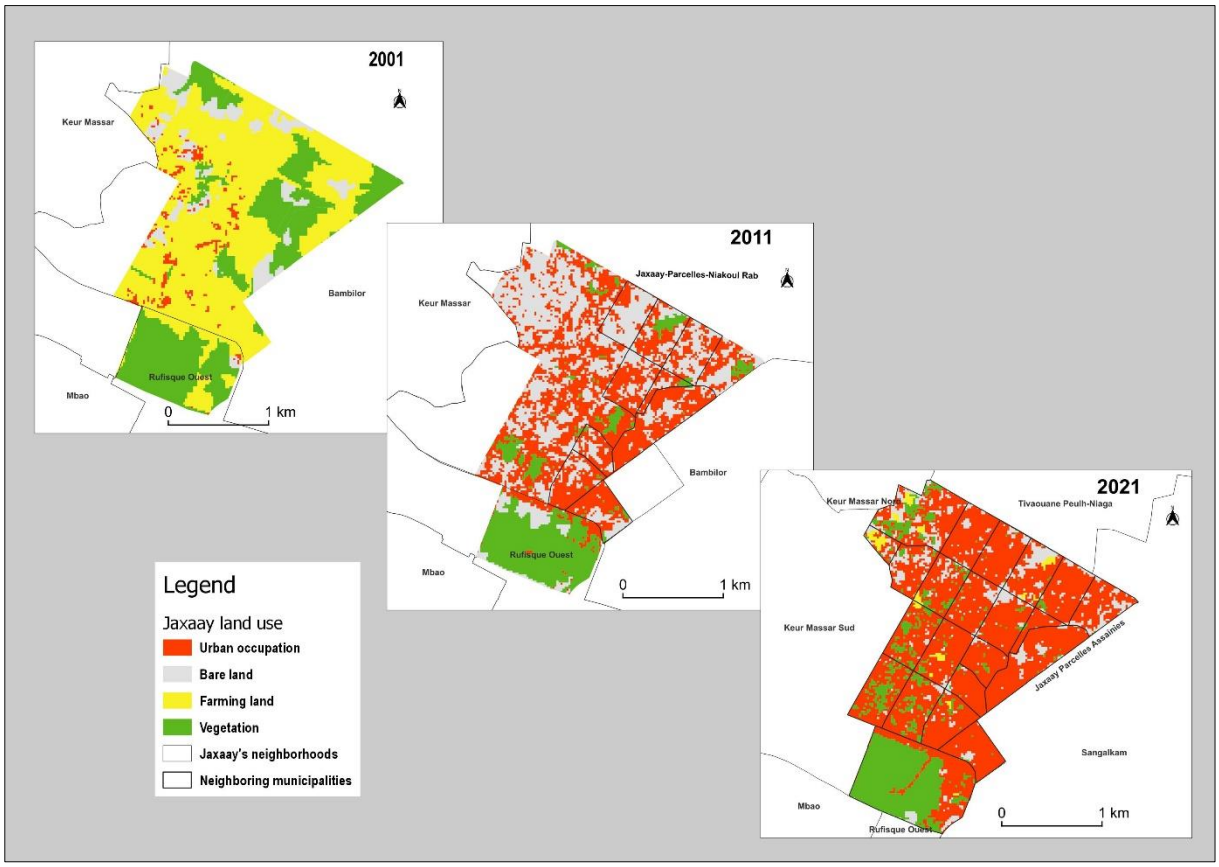
- **Patterns of change in the socio-spatial dynamics of Jaxaay**

In this section, we shall analyze the changes in the socio-spatial dynamics of Jaxaay, based on the construction of the Plan Jaxaay neighborhoods. Let us recall that these neighborhoods were built in the peri-urban zone of Dakar. In 2006, the date of the launch of the Plan Jaxaay project, the zone was mainly constituted of outlying farmland used for market gardening, and natural spaces of vegetation and savannah. Nevertheless, there was already human occupation with a few dwellings scattered around the space, notably the Cité Gendarmerie, a neighborhood dating from around 2002.

"You know, at Jaxaay, we know the area very well because it's us who built the Cité Gendarmerie which was next to the military base. When we worked there at the time, it was in around 1997 or 1996, I don't remember exactly, but it was just before the beginning of the 2000s, the neighborhood wasn't even accessible by car, there were fields everywhere". Extract from a life story by Mouhamed S., 76 years old, head of a household resettled at Jaxaay.

The construction of the Plan Jaxaay neighborhoods and the resettlement of the households which were the beneficiaries of it thus contributed to boosting demographic growth and sustained urban development in the municipality of Jaxaay-Parcelles and the neighboring municipalities which became the outer suburbs of Dakar.

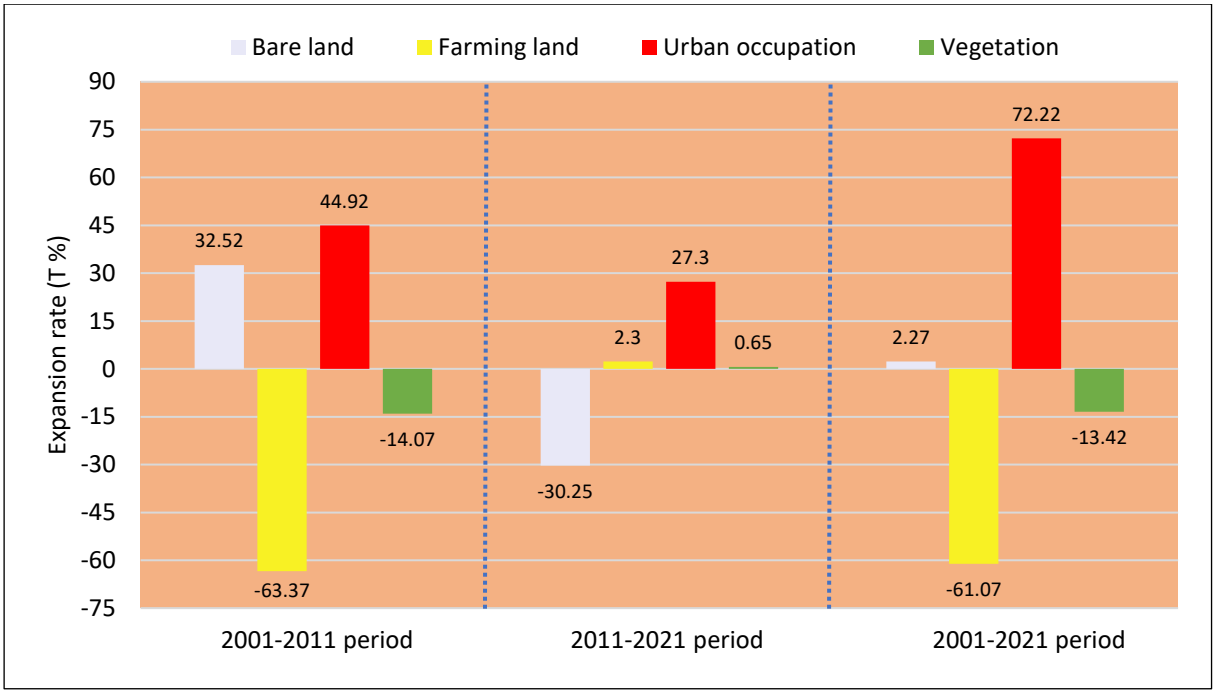
Map 4: Changes in the land use dynamics of the municipality of Jaxaay-Parcelles



Between 2001 and 2021, the Jaxaay area saw rapid urban growth. In Map 3[3], we may observe that the urban occupation class shown in red spread rapidly during this period. In 2001, urban occupation was in fact virtually non-existent in this area which mainly consisted of farmland and areas of natural vegetation.

[3] Note that in this map, we have retained the administrative borders of Jaxaay-Parcelles, recently established as a municipality with the administrative subdivisions resulting from the creation of the *département* of Keur Massar in 2021. Prior to 2021, Jaxaay was an area attached to the municipality of Jaxaay-Parcelles-Niakoul Rab, whereas in 2001, Jaxaay did not yet exist and the area was part of the municipality of Bambilor. These changes in the administrative subdivisions explain the changes observed in the maps for 2001, 2011 and 2021.

Schema 1: Changes in the expansion rate of the land use classes



During the period 2001-2011, urban occupation saw an increase of 44.92 % at the expense of the farm land which saw a regression of -63.37 % and the areas of vegetation with -14.07 %. This trend of rapid urban growth may be explained by the construction from 2006 of the eight neighborhoods of the Plan Jaxaay (shown on the 2011 map) for the resettlement of the households impacted by the floods of 2005 at Pikine and Guédiawaye. During the period 2011-2021, urban occupation also saw an increase at the expense of the bare areas which saw a regression of -30.25 %. However, the increase of urban occupation during the period 2011-2021 was at a slower rate (27.30 %) compared to the previous period 2001-2011 (44.92 %). This slowing down of urban growth may be explained by the fact that between 2011 and 2021, the urban occupation rate was boosted by the one-off construction of privately-owned houses in the new neighborhoods of the municipality of Jaxaay-Parcelle; whereas between 2001 and 2011, the urban occupation was boosted by the construction of hundreds of social housing units between 2006 and 2011 under the Plan Jaxaay.

Over the general period of 2001-2021, we first observed a high rate of growth in the urban occupation with a progression of 72.22 % and a strong regression of farm land with a decline of -61.07 %. The policy of the prevention and mitigation of flooding risks of the Plan Jaxaay thus contributed to the spatial transformation of Jaxaay-Parcelles. Before the construction of the Plan Jaxaay neighborhoods, this area was a space constituted mainly of farmland and

areas of natural vegetation, whereas after the construction of the Plan Jaxaay neighborhoods, the area rapidly became urbanized.

The influence of the Plan Jaxaay policy was also materialized in the difference in the demographic weight observed between the neighborhoods of Jaxaay-Parcelles municipality.

Table 4: Part of demographic weight of the neighborhoods of Jaxaay-Parcelles in 2013 - 2023

Jaxaay-Parcelles neighborhoods	**Jaxaay-Parcelles population (inhabitant)**		**Frequency (%)**	
Plan Jaxaay neighborhoods	**2013**	**2023**	**2013**	**2023**
Unit 11A	1 830	2 121	6.55	3.36
Unit 11B	2 221	3 326	7.95	5.27
Unit 12B	2 771	3 326	9.92	5.27
Unit 17A	4 734	6 241	16.96	9.88
Unit 17B	253	1 602	0.91	2.54
Unit 19	3 107	5 645	11.13	8.94
Unit 20	2 055	3 361	7.36	5.32
Unit 21	2 546	6 042	9.12	9.57
Other neighborhoods	**2013**	**2023**	**2013**	**2023**
Cité Gendarmerie	4 963	7 318	17.78	11.59
Unit 09	560	2 500	2.01	3.96
Unit 10	465	2 732	1.67	4.33
Unit 12A	160	943	0.57	1.49
Unit 13	169	2 596	0.61	4.11
Unit 14	466	2 658	1.67	4.21
Unit 15	248	2 199	0.89	3.48
Unit 16	305	2 168	1.09	3.43
Unit 18	235	1 383	0.84	2.19
Unit 22	220	1 980	0.79	3.14
Unit 23	360	2 443	1.29	3.87
Unit 24	206	1 886	0.74	2.99
Unit 25	46	675	0.16	1.07
Total	27 920	63 145	100	100

Source: Data from ANSD (2013 and 2023), reworked by Papa Gueye Sow, 2025

Table 4 shows the population of the different neighborhoods of the municipality of Jaxaay-Parcelles, and the frequency (in %) for the years 2013 and 2023. The frequency is understood here to mean the part of the population of each neighborhood in relation to the whole population of the municipality of Jaxaay-Parcelles for each year. The statistics show that the municipality of Jaxaay-Parcelles saw a strong increase in its population which rose from 27 920 inhabitants in 2013 to 63 145 inhabitants in 2023, or a demographic growth of 125%. Certain neighborhoods saw an increase in absolute numbers, but in parallel with a decline in frequency. This means that their demographic growth rate was lower than the mean for the municipality. In other words, these neighborhoods had a slower demographic growth rate than that of other neighborhoods in the municipality over the period from 2013 to 2023. We may cite as an example Unit 17A whose population rose from 4 734 inhabitants in 2013 to 6 241 inhabitants in 2023, whereas its demographic weight in relation to the total population saw a strong decline, from 16.96 % in 2013 to 9.88 % in 2023. This was also the case for the Cité Gendarmerie whose population rose from 4 963 inhabitants in 2013 to 7 318 inhabitants in 2023, and recorded a decline in the growth rate in relation to the whole population, with a frequency of 17.78 % in 2013 and 11.59 % in 2023. This slowing of the demographic growth rate may be explained by the fact that the two neighborhoods were created in particular contexts. Unit 17A was one of the Plan Jaxaay neighborhoods and the Cité Gendarmerie constitutes a Cooperative Habitat of the Gendarmerie (COHAG) where most of the inhabitants settled before 2013.

Other neighborhoods have, in contrast, seen both an increase in absolute numbers of their population and an increase in their frequency. This means that the demographic growth in these neighborhoods was higher than the mean for the municipality. This is the case for the neighborhood of Unit 13 whose population rose from 169 inhabitants in 2013 to 2 596 inhabitants in 2023, or a proportion that increased from 0.61 % in 2013 to 4.11 % in 2023 relative to the total population. The population of Unit 13 was thus multiplied by more than 15 over the period 2013-2023. Unit 10 was also among those neighborhoods that recorded a higher demographic growth rate than the average demographic growth rate in the municipality of Jaxaay-Parcelles. Its population which was estimated at 465 inhabitants in 2013 increased to 2 732 inhabitants in 2023, or a frequency that rose by 1.67 % in 2013 to 4.33 % in 2023. The increase in the demographic weight of these neighborhoods relative to

the total population shows that, in the municipality of Jaxaay-Parcelles, new neighborhoods had developed and densified during the decade 2013-2023, at the expense of the old neighborhoods of the Plan Jaxaay and the Cité Gendarmerie. Nevertheless, some neighborhoods recorded a stable demographic growth rate, such as Unit 21 which constitutes one of the Plan Jaxaay neighborhoods whose demographic weight was stabilized at between 9.12 % in 2013 and 9.57 % in 2023 relative to the total population. These different patterns of change show to what degree the demographic structure of the municipality of Jaxaay-Parcelles was transformed, with a consequent impact on the urban dynamics.

The urbanization of Jaxaay-Parcelles was also boosted in the past few years by the implantation of development infrastructures such as the toll freeway, the regional express train (TER), and factories such as SEDIMA. This form of rapid urbanization gives rise furthermore to other urban issues such as the management of climate-related risks.

- **Jaxaay in the face of flooding risks**

Here, we have tackled the flooding that is increasingly frequent in the municipality of Jaxaay-Parcelles. We have placed particular emphasis on the case of the vulnerable neighborhoods of the Plan Jaxaay where the households, more than a decade after their resettlement following the floods of 2005, are again experiencing flooding that they consider as a phenomenon that is "long-lasting" and "stressful".

"We are unfortunately still exposed to the risks of flooding and we can't sleep well because we think that at any moment there may be floods. And we haven't the means to cope with it". Extract from the life story of Déguène M., age 54, head of household resettled at Jaxaay.

In neighborhoods u11A and u11B, flooding events have been recurrent over the past few years, and the risks are increasingly cause for concern. According to the households surveyed, the water may stagnate during all the seasons of the year (rainy season and dry season). During the rainy season, they point out, the water stagnates under the combined effect of the rainfall and the saturation of the soil, and during the dry season, the stagnation of the water is aggravated by the rising level of the groundwater.

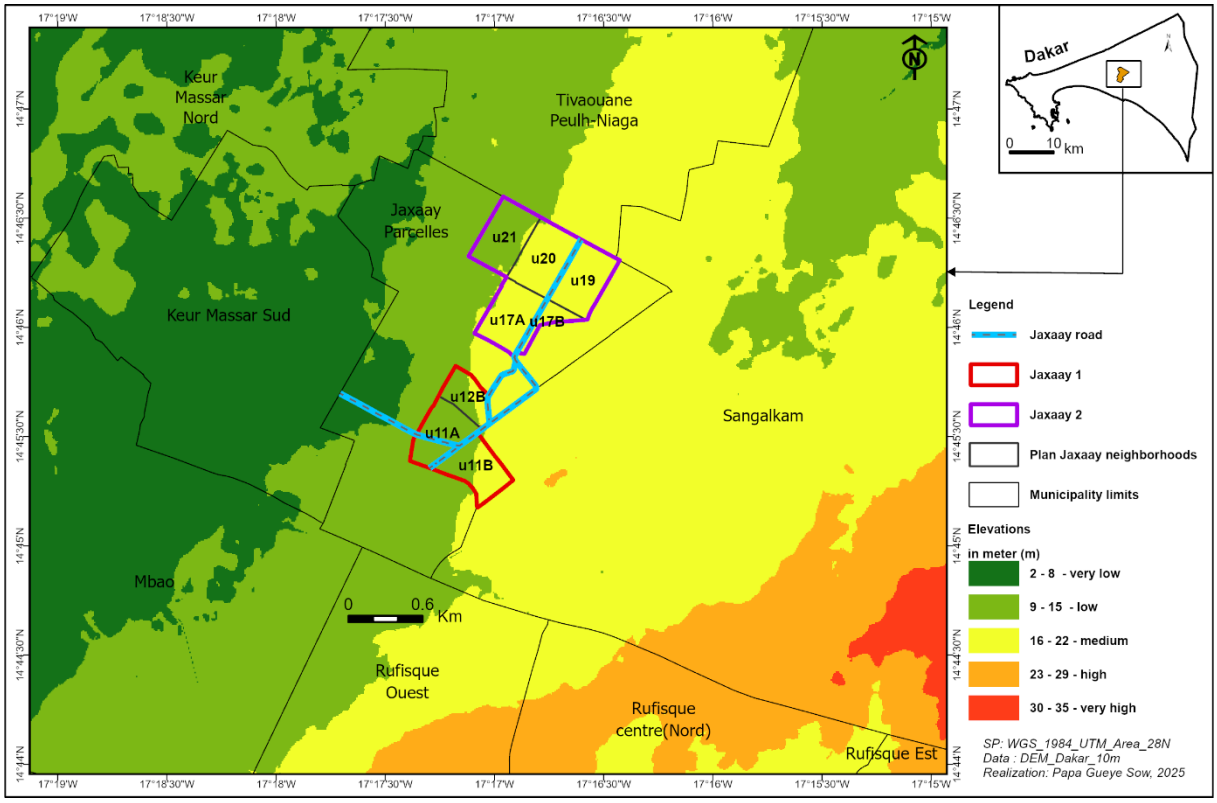
"In the house, it just needs a corner of the yard to dry dries for another to be filled with water, over there in the corner [she points to a space in the front yard] the water comes up all the time underneath the barrel, you know that it should be dry normally, but it's always full

of water […] here every day the water comes up to the surface, the house is weeping every day, it's like eyes that are weeping [she laughs], every day there's weeping, and if we live in a house that's weeping, we're likely to go on a long time without being able to sweep up, unless it dries out". Extract from the life story of Fatima D., age 60, head of a household resettled at Jaxaay.

The personification of the house which "weeps" as a stylistic device used by the narrator shows how the groundwater rises to the surface, causing dampness and long-lasting stagnation of the water in the houses at Jaxaay.

The flood risks are aggravated by several overlapping factors. There are the morpho-pedological characteristics of the area. The municipality of Jaxaay-Parcelles is in an area where the nature of the soil is essentially hydromorphic. Hydromorphic soils are characterized by a more or less impermeable layer which limits the infiltration of the water and favors its stagnation at the surface, thus increasing the risk of flooding. There is also the construction of certain infrastructures which may play a role in increasing the risk of flooding. We may take the example of the construction of a road without any drainage system for the rainwater (road in Jaxaay shown in blue in Map 5).

Map 5: Topographical characteristics of Jaxaay-Parcelles and the Jaxaay road



Map 5 shows that among the Plan Jaxaay neighborhoods, u20, u19, u17A, u17B (Jaxaay 2), with elevations ranging between 15 and 21 meters, are situated on higher ground relative to neighborhoods u11A, u12B and one part of neighborhood u11B (Jaxaay 1), with elevations ranging between 9 and 15 m. This relief does not in itself cause the overflow of the waters. It is combined with the poorly designed construction of certain transport infrastructures such as the Jaxaay road and with the lack of drainage systems such as drainage pipes.

It is along this road that the runoff waters flow from neighborhoods u17B, u19, u20 (Jaxaay 2 shown in mauve in Map 5) situated higher up towards neighborhoods u11A and u11B (Jaxaay 1 shown in red in Map 5) where they overflow and cause flooding in the surrounding houses (see photo 1).

33 of the 55 households surveyed indeed referred to the impact of the construction of this tarmacked road among the factors that aggravate the risk of flooding for two main reasons. Firstly, owing to the fact that it was after the construction of this transport infrastructure that they began to observe flooding in neighborhoods 11A and u11B. Secondly, it is along this road that the waters from the areas situated higher up (Jaxaay 2) transit towards the lower areas (Jaxaay 1), causing the water to overflow into the surrounding houses.

Photo 1: Illustration of the road at Jaxaay 1, flooded by runoff water

Source: Field surveys, Papa Gueye Sow, 2023 (photo taken on 24/07/2023 at Jaxaay 1)

Discussion

The public policies implemented to prevent and to mitigate climate-related risks in the cities have transformed the urban space. This spatial transformation may be achieved by the resettlement of the most vulnerable populations, the construction of infrastructure and engineering works to mitigate the risks, which also results in the reconfiguration of urban trajectories. In the city of Ha Tinh in Vietnam, as part of the Ha Tinh project, the public authorities undertook the resettlement of 250 households among around 1 650 affected by flooding and the construction of new more resilient infrastructure in the affected areas. The implementation of the project, which is governed by a safeguarding[4] policy, thus required major alterations of the urban space (Quérard, 2024).

Climate-related events thus determine the urban dynamics, as noted by Henderson et al. (2014) in their report intitled *'Is climate change driving urbanization in Africa ?'*, where they show how climate change has influenced the urban trajectories of most of the towns in Africa, especially West Africa (Henderson et al., 2014). Having worked at the scale of 359 districts in 29 African countries, these authors showed for example that drought increases the human concentration in the towns, which influences the urban trajectories. By shaping the urban trajectories in the Dakar conurbation, the policy of resettling flood-impacted households and the restructuring of the flooded neighborhoods falls within the same context, even if it should be made clear that it is on a more restricted temporal and spatial scale.

Furthermore, the resettlement policies for the populations impacted by extreme climate-related events in urban environment may contribute to the deterioration of their living conditions with the emergence of other social, economic and environmental issues. With the Plan Jaxaay at Dakar, the households impacted by the floods of 2005 were resettled in a flood-risk area. This resettlement again exposed them flooding in the Plan Jaxaay resettlement neighborhoods. This was also the case in Mozambique where the resettlement policies for the inhabitants impacted by the floods of 2000, 2001 and 2007 in the Zambezi basin exposed the resettled populations to another climate-related risk, that of drought. The dry conditions in

[4] This is a safeguarding policy that concerns all the actions undertaken to protect the populations, the infrastructure and the spaces against the effects of extreme climate-related events. To learn more about safeguarding policies and the norms in force, see (Wallbott & Rosendal, 2018).

the resettlement neighborhoods thus worsened the difficulties facing these populations, for whom agriculture was the main means of subsistence (Stal, 2010).

These various examples show that the resettlement policies of populations impacted by climate-related risks are often deployed in emergency situations without sufficiently taking into account the needs of those who are displaced. The exposure of the Plan Jaxaay neighborhoods raises the issue of the inadequacy of the urban planning with in particular poorly planned urbanization and a lack of drainage infrastructure at Jaxaay-Parcelles, although drainage infrastructure, which was a high priority for the resettled households which in some cases had paid to have it at Jaxaay, was indeed planned in the Plan Jaxaay project and the replacement of the drainage systems for sewage and rainwater could be seen on the presentation model. Meanwhile, these households are still waiting for the implementation of the model for the Plan Jaxaay with regard to the drainage system. All the more so, as, they stress, their former neighborhoods had the benefit of drainage infrastructure in the framework of the same plan bolstered by other projects such as the PROGEP[5]. It is thus difficult for these populations to understand how it is that they have been resettled because of the flooding without the prior installation of drainage infrastructure in the resettlement neighborhoods. It should be noted that to date the Plan Jaxaay neighborhoods are still without water drainage systems. This situation calls into question the effectiveness of the Plan Jaxaay policy, the aim of which was to mitigate and prevent flood risks.

Conclusion

The Dakar conurbation is regularly impacted by flooding. Since the end of the 1980s, floods have occurred almost every year. In response, the public authorities have implemented a certain number of policies to tackle the problem of flooding. These policies in reaction to flooding have proved ineffective. It is in this context that the Plan Jaxaay was launched following the severe flooding of 2005. With the Plan Jaxaay, the challenge for the public authorities was not to try to prevent the flooding, but to prevent and mitigate the impact of flooding by adapting the urban space to this phenomenon. Thus, the households impacted by flooding were resettled at the Jaxaay district of Keur Massar and the flooded and flood-prone

[5] The *Projet de Gestion des Eaux Pluviales et d'Adaptation au Changement Climatique* (PROGEP), launched in 2012.

neighborhoods of Pikine and Guédiawaye were restructured. The restructuration operations reconfigured the urban landscapes of the neighborhoods that were often flooded with notably the construction of dams, the installation of drainage systems for rainwater and resettlement operations for the flood-impacted households which favored the rapid urbanization of the municipality of Jaxaay-Parcelles, a peri-urban zone with the creation of the Plan Jaxaay neighborhoods. This rapid urbanization process was carried out in a flood-prone zone without being accompanied by adequate urban planning with in particular the installation of drainage infrastructure, thus favoring the emergence of the risk of flooding. The policy of the Plan Jaxaay thus contributed to the reconfiguration of the urban trajectories in Dakar and the increasing vulnerability to flood risks of the resettled households. This raises the question of the effectiveness of the resettlement policies for the populations impacted by climate-related risks which often fail to integrate the dimension of monitoring and assessment which is nonetheless essential for the improvement of the living conditions of the displaced populations in the resettlement zones.

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