

Dakar, Touba and the Senegalese cities network produced by climate change

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In this paper we analyse the manner in which the degradation of climatic conditions has stimulated mobility in Senegal and contributed to rapid urbanization of Dakar, Touba and other Senegalese cities. The determining factors of migration are always multifaceted and complex. Overwhelmed by drought, conflict and territorial pressure, rural residents are attracted to the cities. The urban primacy of Dakar and the stagnation of secondary cities were two dominant characteristics of the Senegalese urban network until the 1970s. With the volunteer-based politics of urbanization initiated by the State, the process of decentralization of 1996, and the changes in the economic structure of the country, many small and secondary cities have subsequently been consolidated. The birth of numerous religious cities outside of the administrative or communal systems contributes to a disturbance of previously established schemas of urban creation. Touba, Mbour, Richard Toll, and Ourosogui are key examples of this new urbanization. However, all the components of the urban network are experiencing new dynamics, thus continuously renewing the urban network in both its typology and configuration.

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Introduction

In this paper, we analyse the manner in which the degradation of climatic conditions has stimulated the mobility of many Senegalese and contributed to a rapid process of urbanization for Dakar, Touba and other Senegalese cities. The interest is that most studies about cities and climate change have tended to focus more on

urban adaptation and internal impacts [1,2]. Senegal's urbanization level is 45.2% from the 2013 census, with 49.6% of the urban population concentrated in Greater Dakar. After integrating Touba's inhabitants into the national urban population, over 50% of Senegal's population is urban.¹

Like the majority of West African nations, particularly in the Sahelian region, Senegal has experienced a complete upheaval of its climatic norms since the mid-1960s, when a long period (1950–1967) of surplus rainfall caused the rapid growth of the overall population and an augmentation of rural population density. The climatic variable is certainly a significant catalyst for migration towards urban centers. However, other possible responses exist that might reduce the influence of this factor in the mind of the potential migrant. The same is true with respect to the significance of the return of the heavy rains vis-à-vis the safety of recent constructions. Factors linked to urban ecology and to construction techniques are also important but their impact on the environment has been increased by the climatic variable. In both cases, the climatic variable is the trigger, but there is no mechanical link between periods of drought and the rhythm of departures, nor of the rhythm of depreciation of the urban environment. In general, the link between climate variability and migration to cities is a complex one and it is important to integrate other vulnerability factors [3] (e.g. liberalization of agricultural and trade policies, lack of bank credits, post crop losses, and limited resources diversity).

Drought disrupts rural communities

Le Borgne [4] identifies three distinct periods of pluviometric deficit (1970–1973, 1976–1977, 1983–1984) that punctuate the long period of drought in the Sahelian region between 1970 and 1990. Senegal's climate is regulated by a rainy season (3–4 months) and a dry season (8–9 months), and the natural environment is extremely vulnerable to climatic variations. Because the Senegalese economy was largely based on agriculture (e.g. peanuts, millet, rice, cotton, niébe, manioc, sugar cane, etc.), the chronic drought that began in the 1970s had an extremely traumatic effect on popular spirit, influenced landscape

¹ Touba has been always considered as a village meaning that its population is rural meanwhile it has become the second largest human settlement in Senegal. This paradox is explained by the fact that it is a religious city and a private property with an extraterritorial status. Since the last decentralization reform, Touba is considered as a 'commune', which is the administrative status of the cities.

and overall activity; it also caused a lasting perturbation of rural societies in Senegal, pushing them into exodus. The crisis of the agricultural economic motor thus inspired a massive migration towards the cities and, more and more, to foreign countries.

The period of drought in the Sahel began in the 1970s (Figure 1). 1973 is embedded in the mentality of the Senegalese peasant as the year of the great drought and of the subsequent loss of crops, the extensive drying up of water sources, the difficulty in procuring water, the death of livestock, the food shortages in most households and, consequently, of migration. Since the 1970s, a cycle of drought has broken the economic and social equilibrium of the Senegalese rural regions and migration towards cities has become the most common adaptive solution [3].

Figure 1 illustrates that the irregularity of rainfall has a long history but became more pronounced from the 1970s. In the mid 1980s, a new extreme drought hit rural regions so dependent on rainfall and already impacted by new state liberalization policies.

The long and intense periods of pluviometric deficit that marked the Sahelian region between 1970 and 1980 also affected Senegal, particularly in its northern regions. During that period, certain years were particularly catastrophic with respect to the limited rainfall: 1970 (653.6 mm) and 1972 (504.9 mm) because they were preceded by relatively rainy seasons (962.8 mm in 1969, 825 mm in 1971, 460 mm in 1977) (Figure 1).

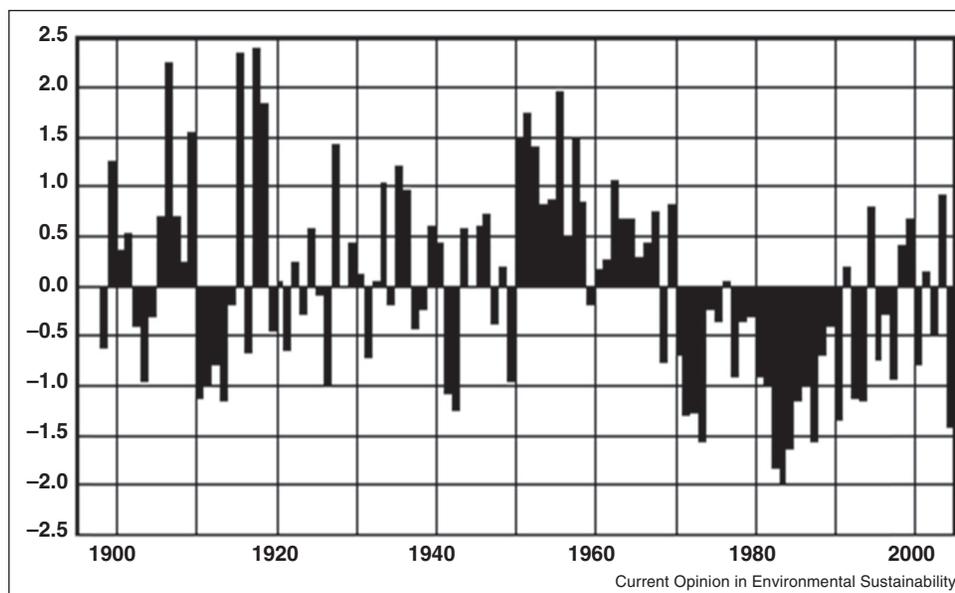
The year 1983 (411 mm) showed even more of a deficit. Dagana in the delta of the Senegal River (in the North) only saw 68 mm of rainfall during the entirety of 1983.

We noticed the shifting of the 400 mm isohyet from the latitude of Ferlo, a consistently dry area, to that of Kaolack in the center of the country, a region that constituted the capital of peanut production throughout the twentieth century. This 150–200 km shift to the south in less than two decades is dramatic. It obliged hundreds of thousands of rural citizens to adapt their calendar of activities and their cultural practices to the rigor of climatic conditions. The shifting of the 1000 mm isohyet from the latitude of Gambia to that of Ziguinchor, Sédhiou (in the South) or Kédougou (in the east) is also an important factor. It reveals a lesser-known type of ‘drought’ that is almost as destabilizing for populations known for their technical nature and their dependence on the cultivation of rice.

Reduction of cultivated land and stagnation of tonnages of agricultural production

One of the direct consequences of the drought is the reduction of cultivated land due to an insufficient replenishment of seed funds as is the case with peanut crops, or due to the loss of fields that have become uncultivable because of wind erosion. According to the PANAUDIT cabinet, ‘the total surface of cultivated land annually is 2.29 million hectares in Senegal, that is, about 60% of arable land.’ Furthermore, according to the same study, ‘the

Figure 1



Rainfall irregularity 1900–2005. Source: Ahmadou Thierno Gaye, UCAD.

Table 1

Average annual growth rate

Residency	1976	1988	2002	2013	1976–1988	1988–2002	2002–2013
Urban	1 713 295	2 653 943	4 008 965	6 102 800	3.7%	3.0%	3.5%
Rural	3 284 590	4 242 865	5 849 517	7 405 915	2.2%	2.3%	1.7%
Senegal	4 997 885	6 896 808	9 858 482	13 508 715	2.7%	2.5%	2.5%

Rate of increase in the population of Senegal between 1976 and 2013 Census year.

quantity of cultivated surfaces diminished by 4% between 1970/80 and 1980–94.'

With the crisis in the all-important peanut crop, agriculture has all but broken down. The breakdown is linked not only to diminished precipitation but also to the reduced fertility of the land and a corresponding reduction in harvests that neither the weak agricultural mechanism nor the colonization of new spaces towards the eastern region of the country has been able to counter. The only perceived solution to this decrease in harvests was an increase in the total area of cultivated land. The greater amount of land cultivated for niébé and manioc crops due to the resistance of these crops to drought conditions or to their short vegetative cycles has not changed the overall situation significantly.

Rural exodus and urban mutation: Dakar as hub of internal and international mobility

The majority of Senegalese migrants are rural. The links between outmigration, agriculture and standard of living are significant. The immediate effects of the drought are the migration of rural populations to the cities. Consequently, the growth of urban populations has been relatively rapid. The rural share of the national population fell from 77.1% in 1960 to 70% in 1970 and 60% in 1988 according to the national census. The territorial Plan of Action estimated that in 2006, *'only 55% of the total population will still be rural'* but that figure was reached only by the 2013 census, suggesting a modest slowdown in urbanization rates. Nevertheless, if Touba's population had been listed as urban by the 2013 census there would probably be more Senegalese in urban areas than in the countryside. The migration is the result of a dialectic relationship between the pressure on sites of outmigration, the attraction of zones of immigration, and a certain dose of subjectivism regarding the timing, the means and the form of emigration.

When the countryside 'empties' itself for the cities

In reality, the rural communities are not as sparsely populated as the above figures suggest. The high rural fertility rates have contributed to maintaining an elevated level of demographic increase despite the increase in departures towards the cities. The same inquiry reveals that close to 46.3% of the population of Dakar was not native in 1988. This proportion was brought down to

39.3% in 1993. This decrease reveals a high rate of settlement by migrants in the city.

Table 1 reveals that between 1976 and 2013, there was a catch-up phenomenon of rural population rates by urban populations and figures give a continuous process of inversion in the coming years. The urban population increased from 1 713 295 to 6 102 800 inhabitants and could be considered as the majority if Touba's population is included.

The 2013 census report that 'In Senegal, the internal migrants are estimated at 1 881 603 people, or 14.6% of the population. The regions of Dakar, Diourbel and Thies hosted the major part of this migration, with respectively 41.8%, 15.5% and 12.9%. The regions of highest outmigration are Ziguinchor, Kaolack, Louga and Fatick with respective output indices of 25.7%, 20.2%, 19.7% and 19.4%.'

The Senegalese migration balance shows that Dakar region recorded the largest net migration (685 292), while Saint-Louis displays the largest negative balance (−74 486), followed by Louga (−45 449) and Ziguinchor (−31 591).²

The determining factors of migration are always multifaceted, complex and difficult to identify. The migration of Senegalese rural populations towards the capital is likely to have been driven as a direct result of the drought. However, the process of urbanization of the countryside is more general. Thus, it is the entirety of the Senegalese population that is dramatically being urbanized. The augmentation rate of the urban population was 3.9% p.a. between 1976 and 1988. In this dialectic of emptiness, the rural population, overwhelmed by drought, conflict, and territorial pressure, is attracted to the city and leaves the countryside for urban centers near and far.

Dakar: a vacuum of resources and labor from the interior of Senegal

The initial settlement by the French on the Cape Verde peninsula that, at the time, was no more than an uninterrupted string of Lébou villages, took place in 1857. A veritable colonial enterprise, the development of Dakar

² http://www.ansd.sn/ressources/RGPHAE-2013/ressources/doc/pdf/ANSD_resume_RGPHAE_final.pdf, p. 7.

was stimulated by a reinforcement of its administrative power and development of its commercial activities to the detriment of the nearby city of Rufisque, and the progressive decongestion of the interior of Senegal, a consequence of the two above-mentioned factors. The strategic position of Dakar gave it a fundamental role in many types of exchanges. As an ocean port and sub-regional metropolis, the city greatly benefited from the establishment of structuring investments and migratory supplements that went beyond the frontiers of Senegal.

The process of decongestion of the demographic weight of other areas began a long time ago. This was the consequence of the process of centralization of the infrastructures and activities in Dakar. The rate of demographic augmentation in the city of Dakar fell from 9% between 1955 and 1961 to 4% during 1976–1988 (period of both drought impacts and liberalization of economy) 2.7% during 1988–2002 and 2.1% from 2002 to 2013.³ However, Dakar has always constituted the center of reception for internal migrants in the country and more than 20.8% of national inhabitants settled there. The minimal growth of the population at the beginning of the century has accelerated since the proclamation of independence: The part of Dakar in the total population has consistently increased over time: from 14.3% in 1961 it increased to 17.7% in 1971, to 18.8% in 1976, to 21.6% in 1988, 22% in 2002 and 23.7% in 2013 [5–7]. The city of Dakar is the principal center of urbanity, as much because of its size as because of the number of people it houses and the technical resources concentrated there. According to M'bow, 'one of every two city-dwellers lives in Dakar. From 1000 ha in 1945, its territory has expanded to 17 500 ha in 1980 ([6], p. 15).' The last wave of communalization in 1990 created 12 new communes, considered from that point on as cities, with populations thereafter considered city-dwellers.

Since very early in the colonial period, the populations of the interior have migrated to Dakar, attracted by employment possibilities in non-agricultural sectors. The informal sector early on absorbed the influx of rural populations to the city [8–11]. Pikine and Guédiawaye are the symbols of the informalization, metropolization and multipolarization of Dakar as an urban region [7].

The rural exodus to Dakar is, first of all, a question of individual and family circumstances. The migrants to the Dakar region are generally born in the regions most affected by the drought, particularly Saint-Louis (14.4%), Diourbel (12.1%), Louga (10.4%), Fatick (9.7%) and Thiès (9.5%). All the regions have experienced relatively intense emigration to Dakar. Along with definitive and long-term moves, temporary displacements were also quite significant during the 1960s and 1970s. In these cases, the

peasants retained an attachment to their original homelands and would return to farm there. Nevertheless, the majority of migrant visits to the center of the country are part of familial ceremonies (Fall, 1998) [10].

The intensity of the migratory phenomenon towards Dakar (around 30% of migrants come to Dakar) was maintained through the 1980s but its characteristics are different from in the 1960s and 1970s. The forms, the determinants and the directions of migration went through important evolutions.⁴ The internal and international influx was diversified into other rural areas (the Kolda region to the south) that were less affected by the pluviometric deficit and by property pressure, or into other countries like Italy and the USA [7].

For all that, the many changes that take place in Dakar make it a privileged space for the observation and identification of the process of urbanization. Despite the competition of neighboring cities whose attractive power is increasingly favored, the capital remains the place where the majority of migrants fleeing drought conditions are attracted to due to the so-called ease of professional insertion.

The pluviometric decrease brings with it a failure of traditional systems of agricultural production. The precariousness of the urban situation does not automatically imply a return to the village unless the opportunity to earn more money becomes possible. The ties to the village can wear thin but rarely break completely as migrants return from seasonal returns, return travels during religious events, for marriage and baptisms. In the city, insertion is possible with access to professional networks.

The return of the rains and their flooding impacts in Dakar since 2000

Floods account for the unpredictability of climate and urbanization without enforceable planning, particularly in the suburbs of Dakar where 49% of the damage related to housing. In 2009, 33 000 families in the suburbs of Dakar were flood victims, 11% of the population of the region and 25% of that of the suburbs (Pikine and Guédiawaye) (Figure 2).

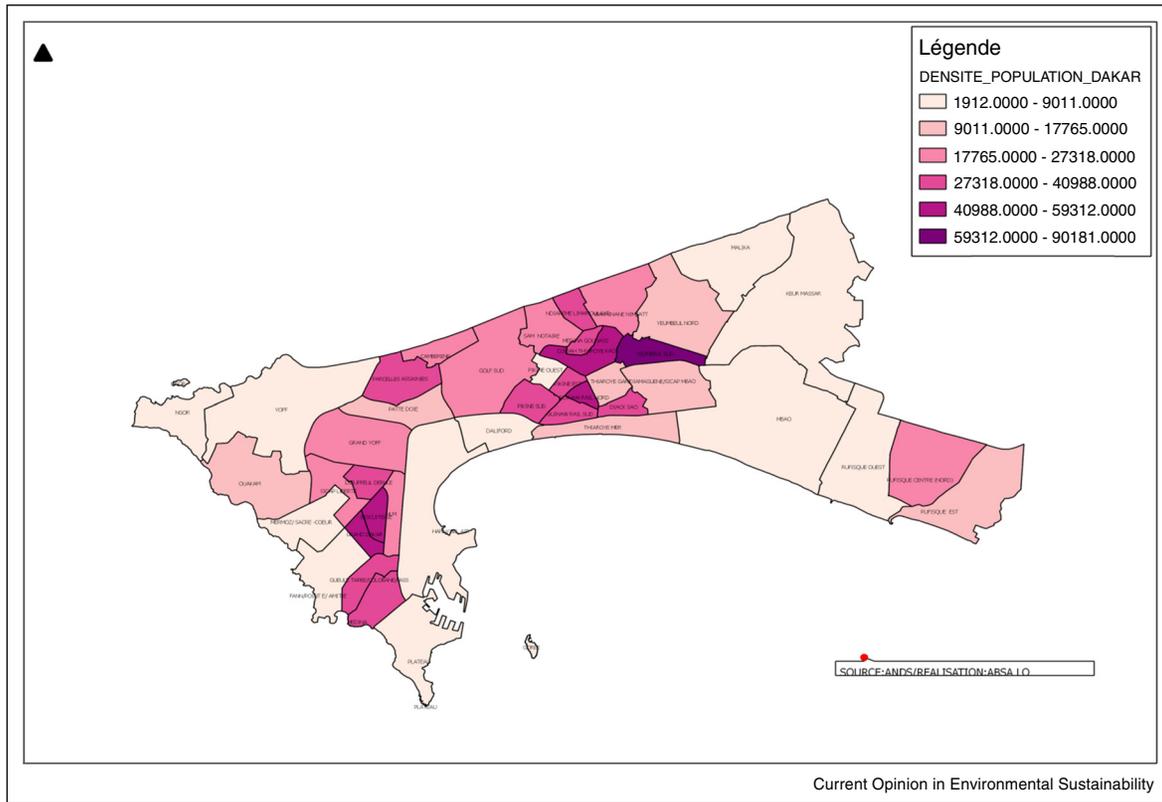
This map shows Dakar and suburbs with districts and decentralized communes and density of populations in the city. The density and lack of planning are the main cause of Dakar vulnerability to climate change.

The main challenge currently facing Dakar and other Senegalese cities remains the increasing severity of floods and their consequences. This phenomenon is partly due to the predominance of informal settlements and thus

³ Data from ADM/ANSD.

⁴ Source: DPS du Ministère de l'Économie, des Finances et du Plan: Enquête sénégalaise sur Migrations et Urbanisation (ESMU), 1993; Rapport National descriptif, 1995.

Figure 2



Map of Dakar with the 'Communes'.

illegal occupation unfit for habitation and deficiencies in the design and implementation of urban planning documents flood sites. Floods are one of the most serious hazards in Senegal and a major concern of the government for the past three decades. They affect both urban and rural areas. In 30 years (1980–2009 inclusive), they have affected more than 900 000 people, killed 45 people and caused damage estimated at more than US\$ 142 million. In peri-urban areas of Dakar, floods have become a regular reality which directly affects the poor. Populations settled in floodplains during periods of drought and lower rainfall than we see recently in a wetter cycle. The total cost of the 2009 floods is estimated at US\$ 104 million, of which almost \$56 million comprised direct damage and \$48 million indirect financial losses.

The new urbanization: revenge of ‘little cities’

The considerable weight of Dakar in the urban framework and the stagnation of secondary cities were the two dominant characteristics of the Senegalese urban network up until the 1970s. With the volunteer-based politics of urbanization initiated by the State, the process of decentralization of 1996, and the changes in the economic structure of the country, many small and secondary cities have been consolidated. The birth of numerous religious

cities outside of the administrative or communal systems contributes to a disturbance of urban mechanisms that upset previously established schemas of urban creation. Touba, Mbour, Richard Toll, and Ourossogui are pertinent examples of this new urbanization. However, all the components of the urban network are experiencing new dynamics, thus renewing the urban network in both its typology and its configuration (Figure 3).

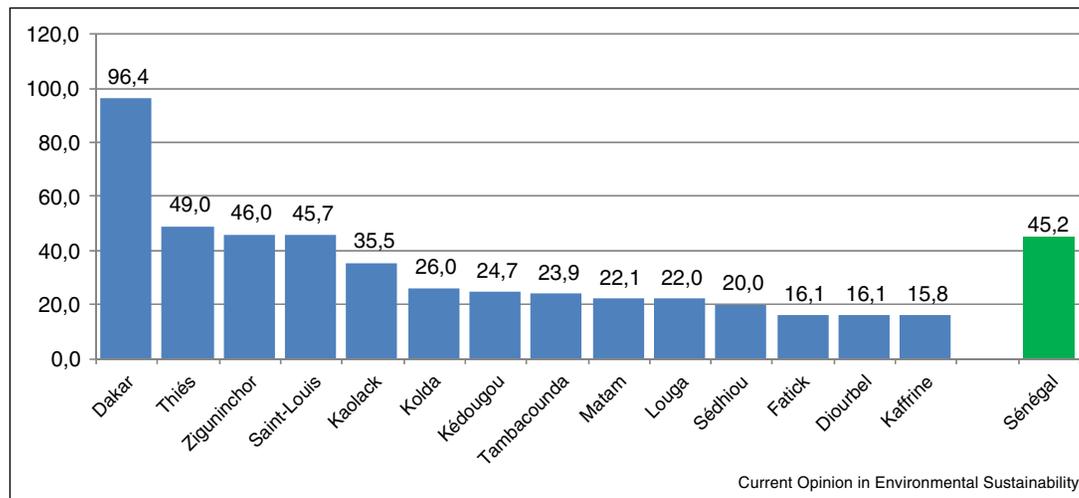
This figure shows how Dakar is an urban region. Diourbel that is far in the list is now with Touba the second urbanized region.

Touba, a religious capital becomes the second most important city

Touba is the capital of the *mouride* brotherhood. With an average growth rate of 15% per year for the last 40 years, Touba has constituted a viable residential, social and economic alternative to Dakar, and attracts as many if not more migrants than the latter city.

The exceptional and spectacular demographic growth of the *mourides* capital, which is now the second most important city in Senegal after the Dakar-Pikine-Guédiawaye conglomerate, is actually still considered a village,

Figure 3



Urbanization level by region from 2013 census.

but is the center of the rural community. The elevated rate of growth over a long period tends to blur the annual variations that, however, make evident the particular dynamics of the urban environment. The period of drought of the 1970s and 1980s was the determining factor in the populating of the city. Between 1970 and 1976, the population grew from 6427 to 29 738 inhabitants, a growth rate of 29% per year. The exceptional growth already expresses the new need for shelter of the thousands of rural *mourides*. As such, the establishment of infrastructure has also played an important role. Their construction has rendered the city 'inhabitable', and attracted *mourides* populations on both a permanent and a seasonal basis.

Between the two general censuses done in 1976 and 1988, the population of Touba grew by an average 12.7% per year, from 29 738 to 125 127 inhabitants. This period was also very much influenced by climatic changes corresponding to one of the major phases of urban population explosion despite the relative decrease in the rate of growth with respect to the period overall (1958–1988). This period witnessed the acquisition of the principal infrastructures of the city, the expansion of the city through massive housing initiatives in integrating several satellite villages the fields of which were transformed into housing [12]. But drought played a crucial role in this process in the 1980s and 1990s. In 1993, 90% of Touba's inhabitants came directly from rural areas.

The natural growth, the in-migration of rural populations, and the inclusion of integrated villages are also factors in Touba's urban growth. Richard-Toll grew even faster, which with 16.1% per annum holds the national record between 1976 and 1988 due to the cane-cutter jobs offered by the sugar industry.

Touba's estimated population of 45 229 in 1982 yields an average annual growth rate of 18.3%. The rate has not diminished since 1988, going up to 19.1% in terms of the most recent estimate that gave Touba a population of 300 000 inhabitants in 1993. Touba takes the lead thanks to many added values, of which the most important are its position as religious capital for an ever-growing brotherhood, migrant disciples who commercialize a new social and economic engineering system by innovating and controlling more and more new urban and rural services. This dynamic still continues. In 2013, Touba achieved more than 700 000 inhabitants officially and this census result is hardly contested by brotherhood's authority.

M'Bour, the urbanizing effect of fishing and tourism, two new motors of the national economy

M'Bour constitutes another example of urban development through drought cycle and the exploitation of new possibilities. With 6.28% for the 1976/1988 period, it recorded the 3rd greatest rate of growth in the country. Situated only 80 km from Dakar, Mbour is the tourism capital of Senegal and the most important artisanal fishing port. The growth of employment opportunities in fishing-related industries and tourism encourage significant migration. M'Bour, center of the department, thus third tier in the administrative hierarchy, is above all the largest non-capital city of the region.

The city counted 77 168 inhabitants in 1988; its estimated population in 1998 was 135 691 inhabitants. According to Ba, '*in ten years (1982–1992), the population of M'Bour has multiplied by two, going from 44 389 to 97 961 inhabitants* ([13], p. 21).' By 2013 Mbour's inhabitants doubled again. Between 2000 and 2014, the Dakar-Diamniadio-Mbour urban corridor has expanded

substantially with an upgraded road, the new international airport (Blaise Diagne), an international conference center, the Dakar Diamniadio highway and the 'Diamniadio new city' project.

The new cities of monetary flux by international migrants: Ourosogui, Louga, Kébémér, Guéoul, etc.

International migration accelerated after 1974, and corresponded ironically with the end of labor migration and the beginning of the drought. Instead of a reduced flow, departures became more frequent. Even the establishment of visa regulations in foreign western countries did not curb this emigration. According to the Ministry for the Senegalese overseas, over 1 million Senegalese live in foreign countries. The survey on migration and urbanization (EMUS in French) (1993) estimated that a third of recorded migrations in Senegal between 1988 and 1992 was oriented towards foreign countries, with emigration most significant from the regions of Diourbel, Tambacounda and Louga, all cities vulnerable to climatic changes.

The sites of departure to foreign countries have diversified over time. The Senegal River Valley, long the principal region of origin of Senegalese migrants, has been rivalled since the beginning of the 1980s by the old peanut basin. The migrants of the new generation leave the Diourbel, Louga and Dakar regions towards new destinations such as Italy, the United States and Spain.

Conclusion

The period between 1970 and 2010 is marked by the emergence of new migratory tendencies linked to climatic and ecological changes that have upset social aggregates and systems of production. The recurring droughts between 1970 and 1984 in Senegal and the entire Sahelian region caused progressive environmental disturbance, a crisis of systems of rural production, an impoverishment of the peasant masses and a massive exodus to urban zones.

The capital, Dakar, has been the principal destination for the rural exodus and the principal site for observing the most pertinent problems caused by this migration and accelerated urbanization. Dakar has also become a veritable hub of internal and international mobility, both of which have diversified their sources and their destinations. Furthermore, the city is at once a zone of departure to foreign countries and a site of return for international migrants. It is a privileged site of investment for emigrants attracted by its profitability.

The considerable weight of Dakar in the urban framework and the stagnation of secondary cities were the two dominant characteristics of the Senegalese urban network up until the 1970s. With the volunteer-based politics of urbanization initiated by the State, the process of decentralization of 1996, and the changes in the national

economic structure, we have noticed the growth of a multitude of small cities and secondary cities [14]. The birth of numerous religious cities outside of the administrative or communal systems contributes to a disturbance of urban mechanisms that redesign previously established schemas of urban creation. Touba, Mbour, and Ourosogui are patent examples of this new urbanization. However, all the components of the urban network are experiencing new dynamics, thus renewing the urban network in both its typology and its configuration ([15], p. 10).⁵

Migration linked to climate change is a major trend in Senegal and in other West African countries, especially those in the Sahel experiencing high inter-annual rainfall variability, creating unpredictability in agricultural investment. Rural-urban migration is so predominant in this context that it is arguably a major adaptation strategy. Having said this, it is difficult to separate out climatic drivers from other drivers of migration such as employment and other opportunities. In Burkina Faso, Mali, Niger and Senegal, cities are largely the product of the rural exodus and the development of a new urbanity. This trend is likely to continue in the coming decades with the accentuation of vulnerability to climate change. This said, a saturation of poorly planned cities affected by the floods and unemployment can reverse the flow of people to medium and small cities or rural areas. Movement between cities and villages will densify and accelerate hybridization between the urban and the rural areas.

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References

1. Hallegatte S, Henriet F, Corfee-Morlot J: *The Economics of Climate Change Impacts and Policy Benefits at City Scale: A Conceptual Framework*, OECD Environment Working Paper 4. Paris: OECD; 2008.
2. Kamal-Chaoui L, Robert A (Eds): *Working Paper 2009/2: Regional development Working Papers: Competitive Cities and Climate Change*, OECD Regional Development Working Paper. Paris: OECD; 2009.

⁵ IPCC Fifth Assessment Report, Chapter 12 says "While urbanization has been occurring in all major regions of the world (Table 12.1) since 1950, there is great variability in urban transitions across regions and settlement types. This variability is shaped by multiple factors, including history (Melosi, 2000), migration patterns (Harris and Todaro, 1970; Keyfitz, 1980; Chen *et al.*, 1998), technological development (Tarr, 1984), culture (Wirth, 1938); Inglehart, 1997), governance institutions (National Research Council, 2003), as well as environmental factors such as the availability of energy (Jones, 2004; Dredge, 2008). Together, these factors partially account for the large variations in urbanization levels across regions". p. 10.

3. Thiam MT, Crowley J. Impact des changements environnementaux sur les migrations humaines. Etude de cas: Sénégal et Côte d'Ivoire. UNESCO, secteur des sciences humaines et sociales. UNESCO/UCAD/UNA, 301 p.
4. Leborgne J, 1990, La dégradation actuelle du climat en Afrique, entre Sahara et Equateur, La Dégradation des paysages en Afrique de l'Ouest, ed. RICHARD J-F, 1990, pp. 17–30.
5. Seck A: *Dakar, métropole ouest-africaine*. IFAN; 1970.
6. M'bow LS: *Dakar. Croissance et mobilité urbaines*, p.15, *Thèse de doctorat d'État en géographie*. Université Paris X Nanterre; 1993: 670.
7. Tall SM: *Investir dans la ville africaine. Les émigrés et l'habitat à Dakar*. Karthala/Crepos, Paris et Dakar; 2009:: 289.
8. Diop AB: *Société Toucouleur et migration*. Dakar: IFAN; 1965.
9. Fall AS: *La migration rurale urbaine des sereer du Sine vers Dakar et sa banlieue. Le cas des ressortissants de Niaxaar, Ngayoxem et Sob*. Dakar, UCAD; 1987.
10. Fall AS: **Migrants' long-distance relationship and social network in Dakar**. *Environ Urban* 1998, **10(April (1))**:135-145.
11. Lericollais A: *La mort des arbres à Sob, en pays Serrer (Sénégal), in Tropiques, lieux et liens*, LERICOLLAIS A., et M. VERNIERE *L'émigration toucouleur du fleuve Sénégal à Dakar*. ORSTOM; 1974:: 21:. multigraphié.
12. Guéye C: *Touba la capitale des mourides*. Paris: IRD/ENDA/KARTHALA; 2002, 550.
13. El Hady BA: *Mobilité et circulation urbaine à M'Bour. Observations à partir des extensions orientales de ONCAD et Diamaguene 2, Mémoire de maîtrise de géographie*. Université Cheikh Anta DIOP de Dakar; 1999:: 98.
14. Thiam O: «L'axe Dakar-Touba (Sénégal): Analyse spatiale d'un corridor urbain émergent». Thèse de doctorat de Géographie de l'Université d'Avignon; 2008:: 308.
15. IPCC Fifth Assessment Report Chapter 12.

Further reading

16. Gueye C, Fall AS, Tall SM: *Climatic Deterioration and Urbanization in Senegal*. 2006 <https://ugec.org/docs/ugec/viewpoints/iudp-newsletter-2.pdf>.
17. Guéye C, Fall AS, Tall SM: **Climatic perturbation and urbanization in Senegal**. *Geogr J* 2007, **173**:88-92 http://dx.doi.org/10.1111/j.1475-4959.2007.232_4.x.
18. OCDE, Cities and climate change, 9789264063662 Publication Date: 29/11/2010, p. 276. <http://www.oecd.org/gov/regional-policy/citiesandclimatechange>.