Chapter 14

Seasonal migration and climate change in rural Senegal

A form of adaptation or failure to adapt?

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Introduction

Human migration resulting from climatic and environmental change is not a new phenomenon. Populations have migrated for centuries, often seasonally, following changes in their environment. It is even a principle of life for nomadic and pastoral peoples who continuously seek new resources. However, the question of relations between migration and the environment has only become a subject for scientific debate very recently, for the first time in the 1980s with the major ecological crisis triggered by the great droughts in the Sahel and for the second time with the emergence of the paradigm of climate change in the 1990s.

All authors agree that the droughts of 1968-1974 and 1982-1985 caused increased migration in Niger, Mali, Senegal and Burkina Faso both immediately and in the long-term (COULIBALY and VAUGELADE, 1981; FAULKINGHAM and THORBAHN, 1975; FINDLEY, 1994; GERVAIS, 1987; HENRY *et al.*, 2004). Use of this adaptation strategy is all the more systematic when drought is combined with rapid population growth and increased poverty (Henry *et al.*, 2004; KNERR, 2004; PEDERSEN, 1995; TAMONDONG-HELIN and HELIN, 1991). Generally, these authors note that intercontinental migration (to France) does not have the features of a spontaneous response to the ecological crisis, in contrast with internal or cross-border and circular or short-term migrations that more than doubled during the droughts (FINDLEY, 1994). Finally, they observe that migration caused by the droughts affected mostly the poorest families and young women and children, many of whom are put in foster care.

The question gained global status in the early 1990s when the international community started to recognise the global challenge of climate change, together with its links and impacts on human mobility. The debate then focused on theoretical views of environmental migration. The first approach that tended to dominate the debate was based on conventional push-pull theories. Environmental changes in poor countries classically result from demographic pressure on natural resources that exceeds the carrying capacity of an area's resources, thus causing a population exodus. This approach inspired by Neo-Malthusianism thus provides a mechanical and encompassing 'naturalising' explanation in which migration results from population growth that exceeds the limits of natural resources. Environmental migration is therefore the *escape* from a close threat, the *abandoning* of the home environment that has become inhospitable and the *failure* of persons and systems to self-adapt. This current of thought therefore sees it as forced displacement driven essentially by the environmental factor. Reflecting this trend, some studies on the poorest countries describe rural-urban migration as the final response to the difficulties facing rural households that cannot adapt to landholding pressure, state's withdrawal from agricultural sectors (Mortimore and Tiffen, 2004) and environmental degradation.

In contrast, the other migration theories that include the 'new economics of labour migration', the structuralist approach, the social network theory and the transnationalism theory all suggest in their own way that environmental migration is not only a response to a strong stimulus from the natural environment but is also migration per se with complex causality and a decision process, and that it should not therefore be analysed as totally different to other migration. People rarely move under the constraint of a single factor, except perhaps in the case of major natural catastrophes.

Even though migration by rural populations occurs more often when annual rainfall is insufficient and households no longer have food security, it is also related to a collective strategy defined at farm level (Stark, 1980). These analyses consider that the relationship between environmental change and migration is dynamic and complex, and does not just concern contextual (macro) but also individual- (micro) and farm-level (meso) factors. Like any other kind of migration, environmental migration is thus a socially constructed phenomenon and a choice in competition with many other adaptation options (Henry *et al.*, 2003).

Whether it is a survival strategy or an opportunity to improve living conditions, migration does not necessarily mean breaking with or abandoning the source territory, even if the causes are environmental. Rural-urban migration is usually analysed in relation with the sending area. Studies on West Africa show that population movements are generally temporary and/or circular labour migration (Beauchemin and Bocquier, 2004; Hampshire, 2002; Konseiga, 2007). Migrants maintain links with their home village and participate actively in food security and sometimes in the development of their community's agricultural or non-farming activities.

Migration may then be a short-term survival strategy aimed at meeting livelihood needs of households left behind through remittances used for consumption or by relieving the strain on food because consumers have left (De Haas, 2008).

Migration may also be an opportunity in which collective and individual strategies are mingled and enhance individual and community lives (HARBISON, 1981; KATZ and STARK, 1986; ROOT and DE JONG, 1991; STARK and LEVHARI, 1982). The household's migration history and family ties with urban residents reduce the economic and emotional cost of migration and therefore strengthen individual motivation and facilitate migration (ROOT and DE JONG, 1991). Thus the households with the most human capital and urban social networks are those that involve in migration most easily and strongly.

Assessing migration in terms of success or failure is a complex process that calls for taking into account the migration project, the migrant's previous migration experience and the contexts of departure and return (CASSARINO, 2004; CERASE, 1974). It is also dynamic insofar as a migrant's project is ceaselessly reformulated according to the failures and successes experienced. Nevertheless, in the same way that neoclassic economic theories affirm that any return from migration shows the inability of the migrant to maximise the income expected at his destination (TODARO, 1969), the supporters of a 'maximalist approach' (SUHRKE, 1994) to the theory of repulsion/attraction factors consider that out-migration for environmental reasons often express the failure of individuals and groups to adapt to the environmental change facing areas from which these migrants originate (MYERS, 1993, 2002; MYERS and KENT, 1995). The term 'refugee' is indeed used readily and this does not indicate an adaptation strategy.

Although it results partially from environmental causes, seasonal migration is difficult to analyse in terms of failure alone. Many studies carried out on this issue in Africa have shown that this form of mobility often follows a collective rationale whose aim is to maintain farms in spite of the constraints that they face and give them the technical and financial resources to enable them to develop further.

The Niakhar Health and Demographic Surveillance System (HDSS) site in Senegal provides an interesting opportunity for examining the relationship between internal migration and slow environmental and climatic changes (excluding sudden natural disasters) over a long period. Observations have been recorded there for more than 50 years and provide information about migration trends and its intensity, forms and causes. The Niakhar HDSS has also recorded daily precipitation totals since 1982 and, by means of several surveys, has documented the agricultural performance and food security of farms for about a decade.

From the economic point of view, agriculture in the Niakhar HDSS site, consisting of 30 villages, is focused mainly on rainfed millet and groundnut. After a dry period lasting for nearly three decades (1970-1999), rainfall totals have increased since the 2000s and there has been an uptrend in particular between August and mid-September (SALACK *et al.*, 2011). We observe at the same time a growing diversity of farm strategies and varying performance. First, we examine whether circular labour migration is sensitive to recent changes in rainfall and its strong variability given this new context. We then assess the impact of this migration on the cereal self-sufficiency of households, especially for poor harvest years. Finally, if seasonal migration proves to be a response to climatic events, we show that not all farms use this

adjustment lever to the same degree. Overall, the extensive resort to seasonal labour migration might depend on the occurrence of dry years and the acute vulnerability of some farms unable to cope with the resulting food crisis.

Context of the study

The study area covers the northern part of the former Sine Serer kingdom in the Fatick administrative region (Becker, 2014; Becker and Mbodj, 1999). It is located in a semi-arid dry zone (annual average rainfall between 500 and 650 mm per year since the mid-2000s), in the south-west of the groundnut area. The economy of the study zone is centred on agriculture and dominated by millet for on-farm consumption and groundnut as a cash crop, together with livestock (cattle, sheep and goats). This ancient farming system is set in wooded grassland in which man has chosen every species for its usefulness. Acacia (*Faidherbia albida*) is the dominant species, providing forage, food and ligneous resources and, together with livestock farming, ensures the maintenance of soil fertility.

The study zone covers all 30 villages of the Niakhar Health and Demographic Surveillance System (Niakhar HDSS)—a study population of about 45,000 in 2013 and an area of 200 sq. km. Average population density is 215 persons per sq. km, with villages reaching or exceeding a density of close to or greater than 400 persons per sq. km (Delaunay *et al.*, 2013 a). Despite signs of fertility transition onset, the fertility rate in the Niakhar study area is still very high (Delaunay and Becker, 2000; Delaunay *et al.*, 2003) and remains the driving force of population growth. Fertility still exceeds six children per woman (Buiatti *et al.*, forthcoming). Mass schooling is recent and still has a weak effect on fertility behaviour. In contrast, mortality has sharply decreased since the 1960s. Life expectancy has increased from 30 years in 1962-1968 to 69 in 2009-2011. Natural growth is therefore very strong at 3.5%.

Over the past century, the public authorities and population have tried to reduce the anthropic burden on the area and its resources by means of permanent and temporary internal migration. In the 1930s, the colonial authorities considered that population density was very high in the Sine region (Dubois, 1975). Furthermore, the authorities regarded the Serer from Sine and Saloum as excellent farmers capable of growing groundnut in the pioneer land in eastern Senegal. The first controlled emigration movement was thus set up, in particular to the Kaffrine region where the colonial administration awarded uncultivated land to farmers (Garenne and Lombard, 1991). This population settlement policy was used and implemented on a larger scale after independence in the Third 4-Year Plan (1969-1973). The Senegalese authorities encouraged the shifting of several thousand Serer families from 1972 to 1980. First directed and then spontaneous, these population flows were nonetheless not as intense as expected (in 1976, 5.3% of the families in the Niakhar district left to colonise pioneer fronts in the '*Terres neuves*' (New Lands) of eastern Senegal

from 1972 to 1987). Furthermore, even though they contributed to freeing some land, there was only a small decrease in the overcrowding of the area and a pause in demographic growth that lasted for only 5 years (Garenne and Lombard, 1991). These migration movements were accompanied after the Second World War by the first voluntary departures to large towns, often by way of stages such as Fatick, Kaolack or Thiès (Becker *et al.*, 1987; Becker and Mbodj, 1999).

Seasonal labour migration to the cities by young men and women started in the 1960s. They concerned the villages close to road links and mainly households belonging to castes (griots, blacksmiths, etc.) (Guigou, 1999). Young people left for several months of the year outside the farming period in order to find paid jobs (Roch, 1975). Seasonal migration spread to all the villages in the surveillance site in the 1970s and 1980s, and started at the onset of the dry season. This was also the period when migrant networks settled in the main destination cities (Fall, 1991). The Senegalese state withdrew from the groundnut sector in the 1990s and 2000s under pressure from the structural adjustment programmes imposed by the Bretton Woods institutions (Adjamagbo and Delaunay, 1998; Mortimore and Tiffen, 2004). The halting of subsidies for seed, inputs and groundnut purchase prices from farmers considerably weakened the role played by this crop in the local economy. The groundnut belt thus had to face a serious agricultural crisis that forced farmers to make agricultural innovations and diversify their incomes. This was when seasonal migration became widespread and reached a considerable scale, affecting very young people, especially girls (Becker and Mbodj, 1999; Delaunay, 1994; Delaunay and Enel, 2009; Delaunay and Waïtzenegger Lalou, 1998). In spite of a diversification of profiles and reasons for migration, the role of food vulnerability is still important today (Chung and Guénard, 2013).

With worsening climatic conditions, the liberalisation of the groundnut sector and the resulting agricultural crisis, the migration phenomenon gradually spread to all villages, all social groups and all age groups. It intensified in parallel with the improvement of transport (Lombard and Seck, 2008) and evolved in both form (destinations, characteristics of migrants) and duration. Depending on the strategies of households, migrants thus became an adjustment factor (a subsistence strategy) or an actor in social and economic change (enrichment strategy).

Dry season migrations referred to as *norane* seasonal migrations form the largest category and involve mainly young people going to cities. The men are very often unmarried and seek a job in town to help the family, prepare their marriage or cover their personal needs. Girls generally profit from migration to cities to earn money for a trousseau for their weddings (Delaunay, 1994; Delaunay and Enel, 2009). Both girls and boys return for the farming season. In the rainy season, young men may leave to work (*navetane*) as farm labourers or shepherds in rural areas. This *navetane* seasonal migration is less frequent than the *norane* one and generally occurs when a farm has surplus agricultural labour. Finally, in addition to these seasonal movements governed by the farming calendar, a mainly female form of migration has developed since the early 2000s with the generalised increase in schooling and is governed by school holidays. This migration enables them to cover school expenses and new needs (clothes, cosmetics, telephones, etc.) (Moullet and Engeli, 2013).

Material and methods

The Niakhar HDSS is the oldest population observatory in Africa. The first demographic observations were performed in Niakhar district in 1962 by Pierre Cantrelle, physician and demographer, and were aimed at measuring child mortality and collecting civil status data (Cantrelle, 1965 a, 1965 c). Repeated surveys were implemented and the study area rapidly became a multidisciplinary research platform hosting many research projects in different fields such as demography, medicine, geography, agronomy and sociology.

The Niakhar HDSS follow-up was set up in its present form in 1983. It provides longitudinal data, gathered continuously, on all the residents of the 30 villages. An update round is run several times a year to record all the events that have taken place (pregnancies, births, marriages, deaths, weaning, migration, etc.) since the previous survey. Arrivals and departures of individual persons are recorded in detail, with special attention paid to seasonal migration from 1998 onwards. Thus in each round, absent persons are identified and household members are questioned about absence motives, and migrant destination areas and activities.

Specific surveys are also carried out periodically between two update rounds. They are focused mainly on schooling, household equipment, housing quality and agricultural production. The '*Biens et équipements'* survey (Goods and equipment) was thus run in all households in 1998, 2003 and 2014. It makes it possible in particular to measure the patrimonial and multidimensional poverty of households and to make an inventory of the farming equipment owned by holdings. A '*Cultures et élevage'* survey (Crops and livestock) was conducted from 1998 to 2003 to evaluate yields, the degree of food self-sufficiency and the role of migration in household strategies. Finally, the Niakhar HDSS facilitates the conducting of one-off operations such as the '*ESCAPE-Senegal*' survey ("Environmental and Social Changes in Africa: Past, present and future") in 2013-14. This survey was based on a random sample of 1,061 family farms (32% of the households monitored). A 'Household' questionnaire submitted to farm-household heads was used to describe the cropping system used during the 2013 rainy season. It also documented the economic status of the household, non-farming activities and the sociocultural characteristics of the head of household. An 'Individual questionnaire' was then given to a household farmer who had cultivated at least one field during the three years preceding the survey. This questionnaire was focused on certain cash crops such as groundnut and watermelon and on cattle fattening.

Definitions and measurements of migration

The measurement of population mobility is complex even when reliable, accurate data are available. At the individual level, there are different kinds of movements according to destination, duration and reason. To quantitatively measure migration, there is a need to establish precise criteria on whether the movement should be considered as migration or a simple journey.

The residency status within the HDSS site depends on duration of stay and motivations. Residents stayed away from the HDSS site for more than six months are considered as out-migrants and exit the study population. However, here are several exceptions, such as young people who leave to gain an education (but who return for at least a month during the holidays), seasonal workers (who return for at least one month a year) and labour migrants who remain family heads (DELAUNAY *et al.*, 2013 b). Likewise, people that move in the study site become immigrants after the threshold period of six months or when they have declared their intent to stay. In other cases, they are considered to be visiting or passing through.

Although absences were recorded in writing in field logs, they did not start to be entered in the database until 1998 onwards. Data on temporary migration is therefore included in the HDSS platform from that year onwards, with dates of absences and returns from migration, destinations and reasons.

Permanent migration consists of departures or arrivals that do not match the definitions of temporary migration and visits above. Emigration and immigration rates are defined by calculating the ratio of the number of migration events in a group (defined by age or sex) to the resident population in this group (person-year). These indicators show the proportion of migrants (emigrants and immigrants) in the resident population in a given year.

Seasonal labour migration can be measured in two ways. Like for permanent migration, we can calculate a migration rate by dividing the number of temporary labour migration departures by the number of residents. In addition to measuring the proportion of seasonal migrants, we calculated the intensity of seasonal migration. Instead of considering the persons who had been migrants and those subjected to this risk, we can take into account for a given year the durations of seasonal migrations as the numerator and the total time of exposure to the risk (person-years) experienced during this period by those who escaped seasonal migration as the denominator. This more accurate measurement gives an indicator that shows the true weight of migration in the population, allowing for the durations of presence and absence.

Farm classification method

Farms sometimes opt for seasonal migration, either to face certain constraints such as rainfall deficit or food insecurity, or to improve the standard of living of migrants and their home household. Seasonal migration was analysed for different types of farms in order to highlight these relationships.

A typology was drawn up using information available in the population database (the Niakhar HDSS) and in the '*Biens et équipements 2013*' and '*ESCAPE-Senegal 2013-14*' surveys. Distinction is usually made in the literature between two farm typology categories: a structural typology that consists of defining groups of farms according to their means of production and a functional typology in which farms are differentiated according to the strategies used to meet constraints. Given our aim to categorize farms according to their adaptation capacity and vulnerability, we combined both approaches within a single typology. This category system was developed in two stages.

First we defined a structural typology considering the farmer's agricultural resources (land, labour, equipment, draught animals). A first factorisation operation was performed using multiple correspondence analysis to reduce the volume of this information. This factorial plan was then used as the basis for the categorisation of farms by ascending hierarchical classification.

We then drew up a functional typology taking into account the farming strategies identified, the structural typology, the farming systems used on family farms, food consumption, and economic status and demographic features of the household. Overall, 40 variables were selected to define farm structures and their economic strategies.

Functional typology is more complex to construct than structural typology because of the non-linear relationships between the variables considered. Indeed, farmers' strategies vary according to the constraints to which the household is exposed and sometimes compete with each other. To take into account the complexity of the relationships between variables, we used a non-hierarchical, unsupervised classification method whose learning algorithm is better suited to structures of non-linear data. These are self-organising maps or Kohonen maps (1995) (after the name of their designer), a perfected version of the K-means (or dynamic clustering) method that can separate non-linear groups.

We obtained a total of four farm categories, defined as follows:

1– Very small farms with very little agricultural equipment, labour and land but strongly supported by non-farming activities. They form 27% of all farms in the HDSS site.

2– Farms displaying under-production. They have substantial land but weak investment capacity and a low level of equipment. Their labour is under-used. The category forms 19% of farms.

3– Large farms that provide household food security and focus to a great extent on marketing their agricultural production. They have substantial capacity for farmland development, investment and innovation. These form 25% of farms.

4– Medium-sized farms with fairly ample land and equipment resources but that do not ensure food security of their very large households and that have small investment capacity. They are overall in a situation of decapitalisation and their labour resources are used mainly in farming. This group forms 29% of farms in the HDSS site.

Population movements dominated by seasonal migration

Long-term migration

In combination with a residential change, population movements can either be long-term (more than a year) and sometimes permanent, or seasonal and therefore

temporary. Movements in the first category are comparatively few and far between and fairly balanced as regards entries and exits in the study area. Emigration and immigration rates are around 50‰. These movements have tended to decrease during the period as a whole (Fig. 1). However, this pattern is doubtless partly an artefact resulting from the setting up in 1998 of procedures for monitoring temporary migration. From 1984 to 1998, the data collection system did not make it possible to distinguish clearly between seasonal and long-term migration. Some departures for more than six months and considered before 1998 as emigration, are now clearly recorded as temporary migration.

Although this indicator is sensitive to the change in the data collection rules, some conclusions can be drawn from it, especially after 1998. Immigration and emigration rates display a downward trend from 1998 to 2013—more marked for women (Fig. 1). During this period, net migration—the difference between arrivals and departures—was almost always negative (Fig. 2), very low and balanced between the sexes. *Since*

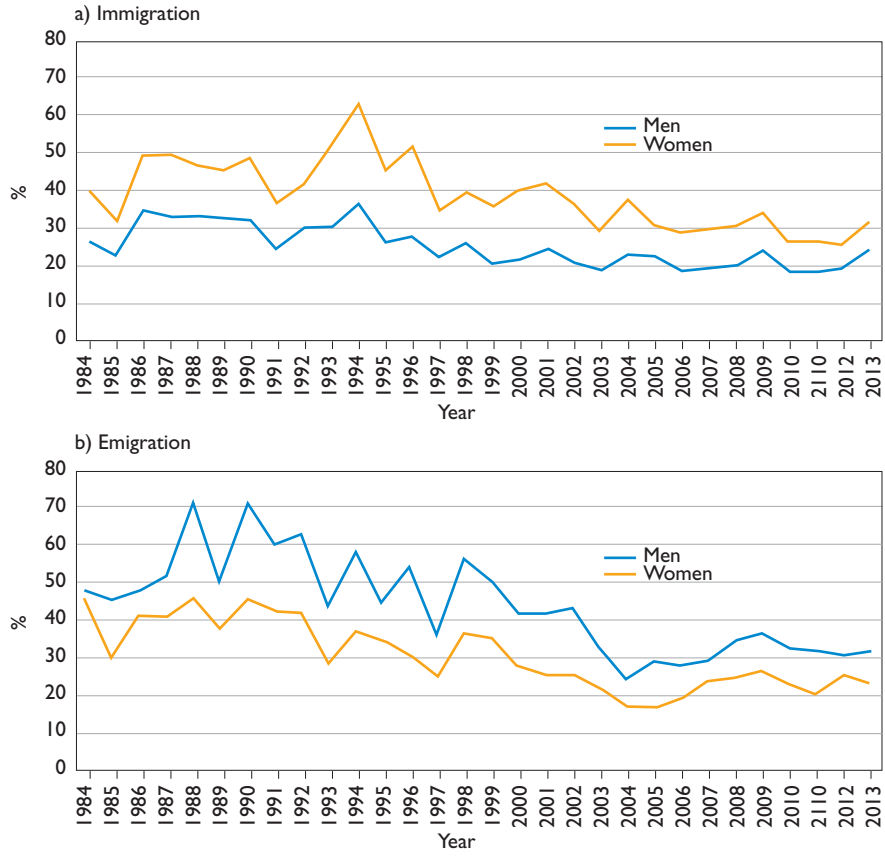

Figure 1.
Immigration rate (a) and emigration rate (b) (Niakhar HDSS site, 1984-2013).

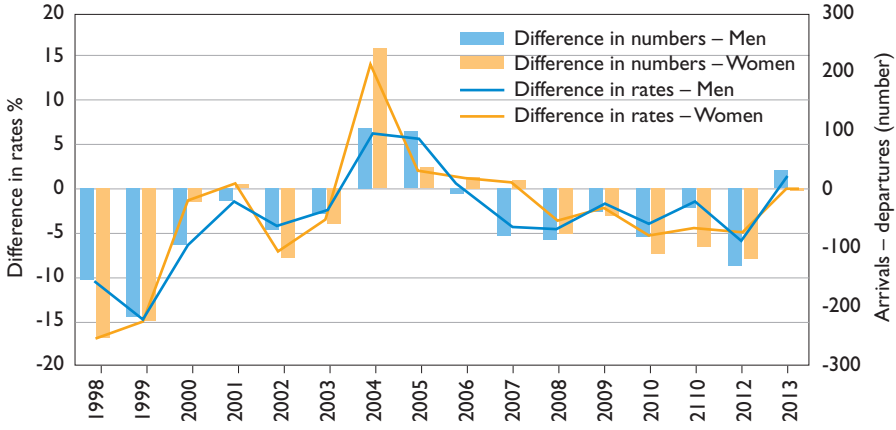

Figure 2.
Net migration in differences in rates (immigration rate – emigration rate) and numbers (arrivals – departures).
Niakhar HDSS site, 1998-2013.

1998, the Niakhar study zone has lost an average of 50 men and 50 women each year as a result of long-term migration. With such small numbers, permanent migration does not therefore seem to be an adjustment factor either as regards demographic pressure (with, nonetheless, a natural increase rate of more than 2.5% per year from 1994 to 2013) or as regards variations in rainfall (rainfall depth from 2002 to 2006 was distinctly less than after 2007).

Whether arriving in or leaving the Niakhar study area, women are more prone to permanent migration than men throughout the period (Fig. 1). Reasons for arrivals and departures by women are mainly related to marriage and divorce (Fig. 3) as

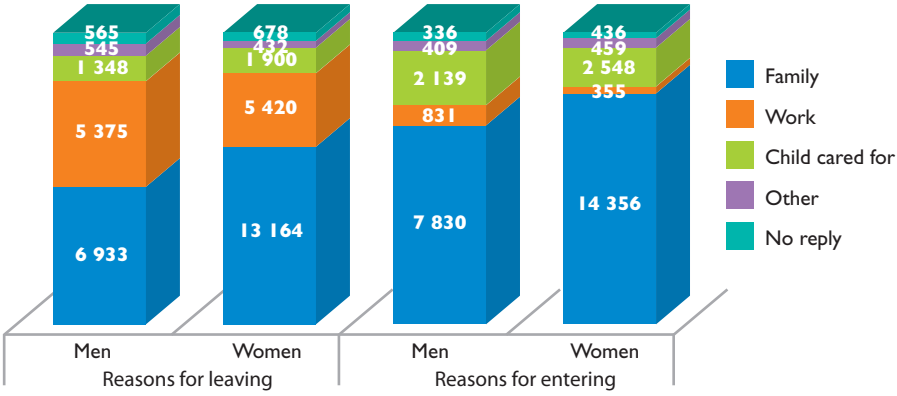

Figure 3.
Distribution (in numbers and %) of emigration and immigration according to sex and reason for migration.
Niakhar HDSS site, 1984-2013.

marriage determines the place in which a woman lives (virilocal marriage). On completion of the matrimonial process, the wife moves to her husband's home and returns to her parents' home after a divorce and even sometimes after the death of her husband. But work is nevertheless the second reason for emigration (accounting for 36% and 25% of male and female departures respectively) and, in numbers, involves women as much as men (- 5 420 compared to - 5 375 during the period). In contrast, work is rarely a reason for long-term immigration (7% for men and 2% for women).

Seasonal labour migration

As mentioned above, the intensity of seasonal migration can be measured by dividing the number of departures in temporary labour migration with the number of residents to obtain a migration rate (Fig. 4). On average since 1988, 30% of men and 20% of women are engaged in seasonal labour migration. In other words, one man in three and one women in five leave the HDSS site at least once a year to seek work. Seasonal mobility is therefore much greater than long-term migration that concerns an average of only one person in 20 (5%). It also affects more men than women (Fig. 4) but nonetheless displays an average migration duration of 4.7 months for both sexes. Expressed in terms of numbers, *seasonal movements since 1998 total 58,000 male migrations and 40,000 female migrations, that is to say respective averages of 3,600 and 2,500 circular migrations per year.*

Temporary labour migration in the Niakhar HDSS site probably started with the ecological shock of the 1970s, but then became widespread to the extent that today it is more or less an obligatory stage for young people in the Sine region. Among residents on 1 January 2014, 90% of men aged 30-34 and 70% of women aged 20-24 had already completed one temporary labour migration. As explained in detail

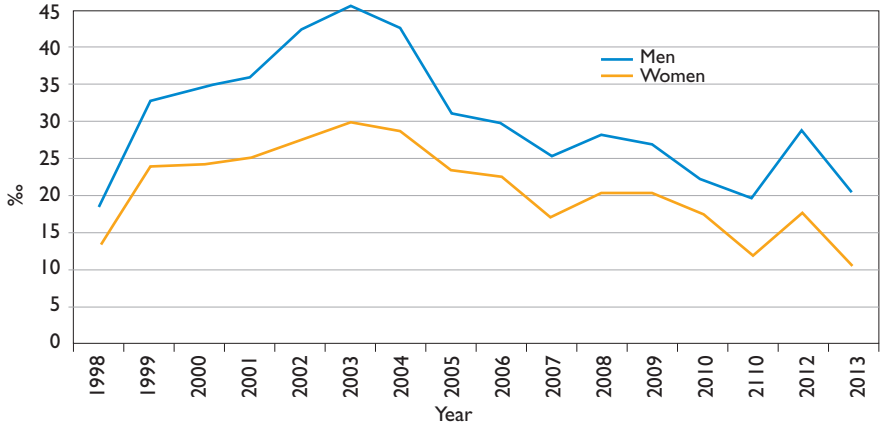

Figure 4.
Trends in seasonal labour migration.
Niakhar HDSS site, 1998-2013.

in the next section, the proportion of seasonal migrants is still sensitive to climatic events and the agricultural performances of the year; this is evidenced by the peak in male migration in 2003. The millet and groundnut harvests had been particularly disastrous in 2002 because of very serious rain shortage (less than 200 mm over the year). However, the migration system now responds to social and economic rationales—both individual- and household-related—that go beyond simple determinism driven by the climate and the environment. Ample rainfall and good harvests never cause the ceasing of migrant flows.

The migration rate calculated in this way awards equal weighting to each migration, whether it lasts for a week or for 11 months completed. We therefore chose to refine our calculation by taking the duration of migration stays into account. A person-year count was performed, that is to say the precise time spent in migration by each person during a period of a year. One person-year in migration corresponds to a cumulated 12 months of absence by one or more persons. This figure related to the number of residents in the HDSS site (also measured in person-years of residence) gives an indicator that reflects the real weight of persons absent from the households while taking the duration of absence into account.

Temporary labour migration has considerable weight in the population: 11% of the men and 8% of the women were absent because of labour migration. *In other words, 1 person in 10 is absent from the Niakhar study zone at any given moment for reasons of temporary labour migration.* The proportion varies during the period, showing the same major peak in 2003 with an average (in person-years) of nearly 15% absence for men and 11% for women (Fig. 5). Although seasonal labour migration intensified after the 2002 agricultural crisis, a decrease in intensity (in terms of duration of absence) is nonetheless observed since 2010 (Fig. 5). The dwindling of time

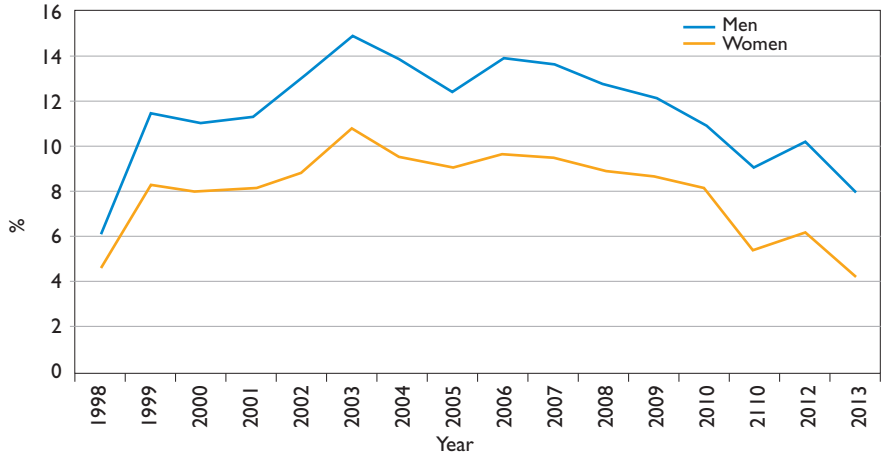

Figure 5.
Proportion of temporary labour migrants in person-years.
Niakhar HDSS site, 1998-2013.

of absence occurs a little later than the decrease in the number of migrations (Fig. 4), showing that the decrease in the number of persons migrating was compensated from 2005 to 2010 by a lengthening of durations of migration.

The spread of seasonal migration can be addressed using households with at least one temporary labour migrant during a given year. The proportions of such households were very high overall from 1998 to 2013, fluctuating around 70%, with an upward trend during the period. The figure even reached 80% from 2008. Increased use by families of labour migration led to a lengthening of periods of absence and the dissociation of migration from the farming calendar.

The average duration of absence from 1998 to 2005 was 3.9 months for men and 4.1 months for women. After 2005, the duration of absence by men increased by an average of 1.5 months and by 1.2 months by women. The forms and calendar of temporary labour migration are much the same today as those described in the past. From 1999 to 2012, whatever the month of the year, at least 400 persons left for seasonal migration (Fig. 6a). However, these population movements increased during the dry season (peak in January-February) and the rainy season (peak in June), showing the two usual migratory flows in Senegal: dry season migration (*norane migration*) and rainy season migration (*navétanat*) (Pontié and Lericollais, 1999; Roquet, 2008). Dry season migrations, the largest until recently, start after harvest. Migrants then generally go to cities to seek paid manual work (masons, carters, fishermen, etc.). Women work mainly in domestic service in Dakar and Mbour. The *navétanat* occurs at the beginning of field work when not all the abundant workforce can be used on family holdings. Men then leave home to work in places where there is insufficient agricultural labour (in the Saloum and eastern Senegal).

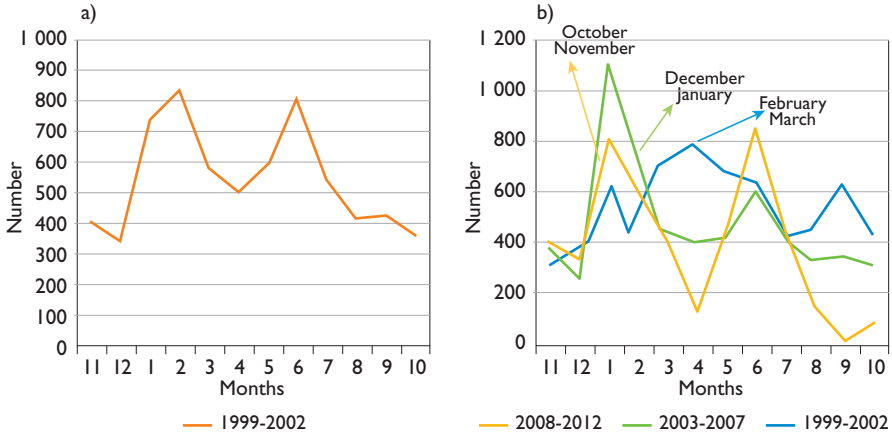

Figure 6.
The number of departures for temporary labour migration by month and period of departure. Niakhar HDSS site.
a: 1999-2012; b: three different periods: 1999-2002, 2003-2007 and 2008-2012. Inset: the months of the celebration of Tabaski (Eid al-Adha) during each period.

This general model of seasonal migration has changed somewhat in recent years. Although the intensity and calendar of dry season migration is still governed by harvests (field work calendar and yields), it can be seen in Figure 6b that departures also tend to be adjusted according to the date of the Tabaski festival (Eid al-Adha) when this occurs on the usual dates for migration departures (start of the calendar year). A shift in time of peak departures can thus be seen from one period to another (Fig. 6b). Maximum dry season departures were recorded in March-April during the period 1999-2002, in February during the period 2003-2007 and in January during the last period, that is to say one to two months after the month of the Tabaski festival.

The other point is that rainy season migration has considerably expanded in recent years. Departures in May, June and July increased by nearly 30% from 2005 to 2010 (middle of the last two periods), making the onset of the 'rainy season' as important a time for seasonal migration departures as that of the beginning of the year (Fig. 6b). This situation must be caused partly by population growth. Household size doubled from 1984 to 2012, increasing from an average of 6.7 persons to 13 persons today, doubtless causing an increase in the labour force during the period of field work, which could find employment through migration. However, widespread schooling for children—especially girls—at primary and secondary levels is probably the factor that has done most to change the seasonality of migration in recent years. Today, 76% of 10-14-year-olds and 72% of 15-19-year-olds attend or have attended schools. The time spent in school means that most cannot migrate and have to postpone this until the holidays at the end of the school year.

As shown in Figure 7, this recent phenomenon mainly concerns girls. Unlike men, who migrate extensively at the beginning of the year, women and girls migrate more during the rainy season (2.5 times as many departures in June than the annual average),

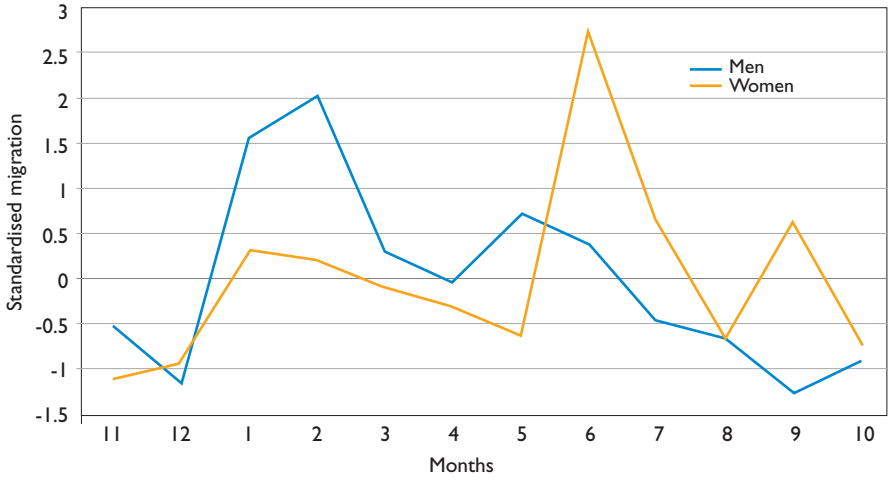

Figure 7.
Monthly variations (centred reduced variable) of temporary migration by sex. Niakhar HDSS site, 1999-2012.

but most likely for a somewhat shorter length of time. This shortening of absences is probably caused by the fact that the proportion of migrants reaches 30-40% (in person-years) at 25-29 years old for men and 15-19 years old for women; migration of young girls (in duration of absence) decreased from 2008.

Seasonal migrations, climatic factors and food security

Temporary labour migration is by far the most dominant form of human mobility in the Niakhar HDSS site. The causes of these movements are mainly rainfall uncertainty (severe droughts in the 1970s and 1980s), its impact on performances in agriculture and pressure on land, which was prompted by population growth (GARENNE and LOMBARD, 1991; ROQUET, 2008). But with time and dissemination of the migration behaviour, population movements do not fully result today from their root causes, and migration networks has certainly led to expand this form of migration (FALL, 1991).

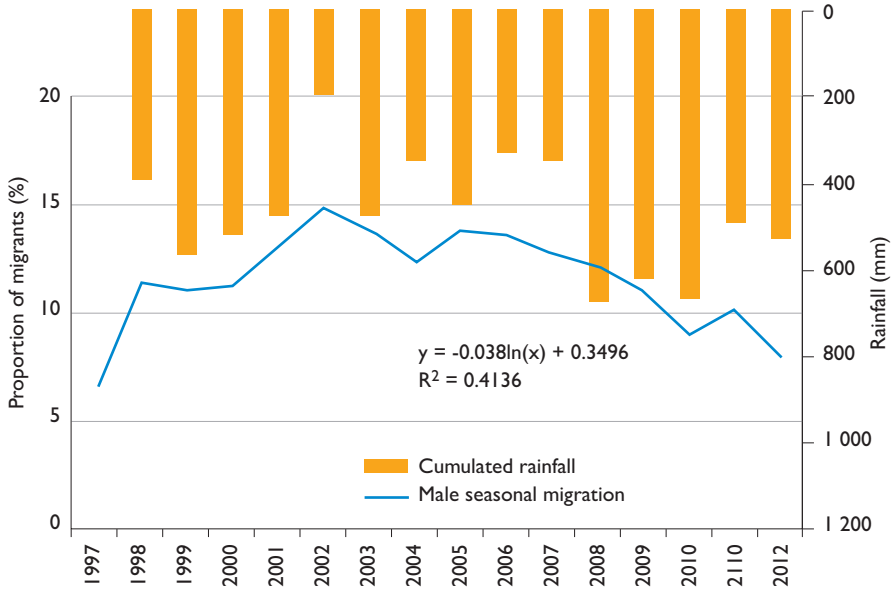

Figure 8.
Proportion of temporary labour migrants in person-years and annual cumulated rainfall.
Niakhar HDSS site, 1998-2012.
The percentages of migrants have been shifted one year to the left (n-1).
Thus the associated male migration in 2002 in the graph did in fact occur in 2003.

Even though it is more difficult today to show the link between seasonal migration and rainfall—if only because these movements are tending to become a homogeneous practice among the population—we observe that temporary migration has kept fairly strong sensitivity to climatic variations. For purpose of this analysis, we first chose male migration, found to be more sensitive to precipitation variability. We then set the proportion of migrants in year *n* against precipitation in year *n-1*. Taking the seasonal migration density again (calculated from durations of absence), we observe that male absences are at their maximum (average 13.0%) when cumulated annual rainfall is low (average 529 mm) during the period 1999-2007 (Fig. 8). In contrast, the proportion of migrants decreases when precipitation increases: from 2008 to 2013, cumulated average precipitation was 790 mm and the percentage of migrants fluctuated around 10% (average 10.4%). The link is even clearer for 2002, marked by severe drought (less than 200 mm rainfall during the year) and very poor yields. We note that male migration reached its maximum in 2003 with nearly 15% of the men absent. Finally, the statistical link between the two variables is comparatively strong since after a logarithmic adjustment (see the equation in Fig. 8) the intensity of the relation is $R^2 = 0.41$. An identical estimation for female migration shows a slightly weaker link between precipitation and the proportion of migrants, with a correlation coefficient of $R^2 = 0.36$. All these observations therefore suggest that seasonal migration is still fairly strongly driven by the climate (and its impacts on yields) and that the population is very reactive when faced with difficult situations.

Temporary labour migration responds to various motivations depending on whether it concerns young people or adults, men or women, poor households or richer ones. In the face of environmental and climatic changes, migrations are seen as strategies—often survival strategies—to relieve pressure on the resources of the environment and to enhance transfers of goods and capital that will enable families to remain in their home territory.

Whether considered in terms of number or duration of absence, temporary migrants do not generally account for more than 10% of the total population of the Niakhar HDSS site. In the worst drought year so far in the 21st century (2002-03), the proportion rose to a maximum of 15% of men and 11% of women. In other words, even in the most difficult moments, seasonal labour migration has never been massive and in no way caused the depopulation of the home territory. Calculation of population density from durations of presence (and not just the number of people) shows that from 1998 to 2013 temporary migration reduced population density by an average of 18 persons per sq. km, with population density falling from 184 to 166 after deduction of the durations of absence of seasonal migrants. As previously indicated, the Niakhar HDSS site loses only 100 persons per year because of permanent migration. Consequently, the prime function of temporary migration is not really to reduce anthropic pressure on resources that have become scarcer.

The second explanation generally put forward is that a large proportion of temporary labour migrants provide flows of foodstuffs and cash—from urban to rural areas—to ensure the survival of the families stayed behind in the village (Adjamagbo *et al.*, 2006). We used the repeated '*Cultures et élevage*' survey run from 1999 to 2003 to evaluate the impact of temporary labour migration on the food security of non-migrant

populations. This data collection made it possible to assess millet yields harvested by surveyed households for four years (1999-2002), together with the quantities of cereals acquired by the households thanks to migration (Fig. 9). The amount of cereals harvested and consumed were then analysed with reference to the FAO standard (210 kg millet per person per year). Senegal recently set the millet consumption standard at 185 kg per person per year.

During the four years of the survey, millet production as reported by farmers in the Sine never reached the grain self-sufficiency threshold set at 210 kg of millet per person (Fig. 9, orange line). Nevertheless, the shortage is probably not always climate-related. The link between precipitation and grain production is not totally linear during the short period covered (1999-2002). In the first three years, a 15% decrease in rainfall that always cumulated at more than 400 mm did not affect the millet shortfall per person (Fig. 9, differences between the red and orange curves). It must be noted that the poor yields and low grain production with regard to the needs of farming families are also caused by other factors such as the shortage of fertile land and rapid population growth. However, when there is a serious rainfall shortage, as in 2002 when precipitation was 60% less than in the preceding year, millet yields fell significantly, with hardly more than 80 kg per person. Whether the food deficit is structural or caused by the situation, it is covered each year by remittances (purchases of rice, millet, etc.) and donations from migrants (the green line is always above the orange line). Finally, temporary labour migrants have used various support mechanisms to enable the people who stayed behind across the study area to buffer climatic and agricultural shocks and remain on their land.

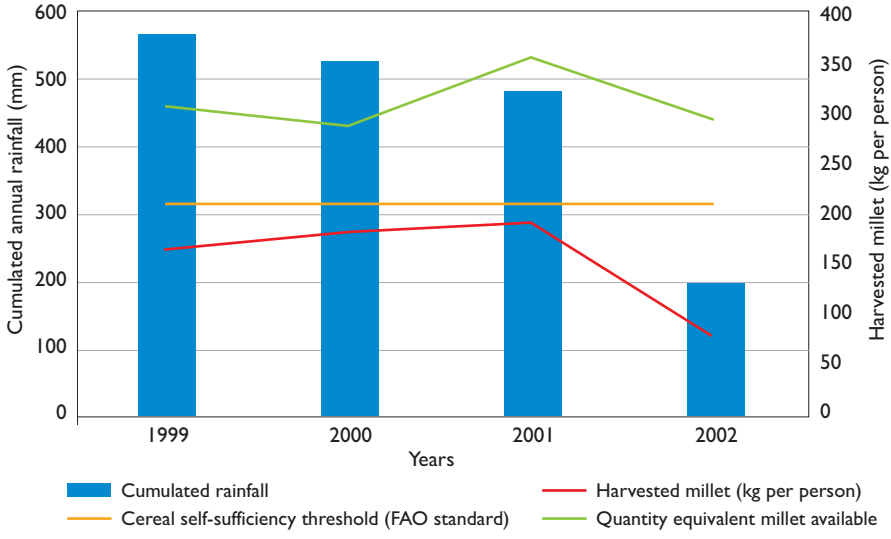

Figure 9.
Rainfall, harvested millet and total consumed cereals, after migrant transfers per person per year. Niakhar HDSS site, 1999-2002.

The two series of maps shown in Figure 10 confirm the results of the preceding graph. Millet yields are sensitive to very strong variations in precipitation and can hardly feed all farming families. Depending on the year, 21 to 28 villages of the 30 surveyed failed to meet the grain requirements of all their population during the four-year period (top maps, villages in red). Nevertheless, purchases and donations of grain thanks to temporary labour migration compensated grain yield shortfalls. In 2001, all the villages in the HDSS site succeeded in covering the needs of their population using migrant contributions in addition to local grain production. However, when the shortage of rainfall is catastrophic, as in 2002, the shortfall in grain production is too marked to be covered by migrant contributions. In 2002-03, a third of the villages could not cover the requirements of their population in spite of the positive efforts made by migrants. Given the weak agricultural and ecological capacities of family farming in the Sine, it would seem that the regulation function of seasonal migration reaches its limits when shortage of rainfall seriously affects grain yields.

The intensity of temporary labour migration is governed partly by rainfall—as shown above—but is also affected by the production capacity of farms. To show the latter link, we re-evaluated the migration rate for each of the four types of farm holding identified using Kohonen's self-organising maps (see above). As before, we examined only the male migration best correlated with the strategies and performances of farms. As this structural and functional typology was drawn up using data collected in 2013, we limited our analysis of temporary migration to the last five years (2009-2013) so that the farms that favoured male migration correspond as best as possible to the situation observed in 2013. The further analysis goes into the past (pre-2009), the more our typology diverges from the farm holding conditions that were at the origin of migration.

Generally, and in spite of these reserves as regards interpretation, we observed that temporary labour migration is a behaviour common to all types of farms. Whatever the reasons (survival or earning money), male seasonal migration is a phenomenon related to precipitation for all the farm categories (Fig. 11). Farms undergoing decapitalisation (i.e. when all of the production has been consumed) or with a shortage of production capacity, and farms with innovation and investment capacity call less on male temporary migration when annual rainfall increases, as happened during the period 2008-2013 (Fig. 11).

Although the same migration trend is observed in each of these farm categories, the degrees are markedly different. When extreme situations are observed, that is to say farms with a lack of production capacity and farms capable of investing, we observed that at all times the former have had an average of 25% more migrants than the latter during the last five years.

Farms with under-production are defined as those with substantial land capital (5 ha), but where only half is used. They have fairly small investment capacity and a very low level of equipment. Their labour force is under-used (3.1 workers per hectare farmed) and an average of 41% of household members have non-farming work. Nearly all the farms in this category purchase grain (94%) to feed the household.

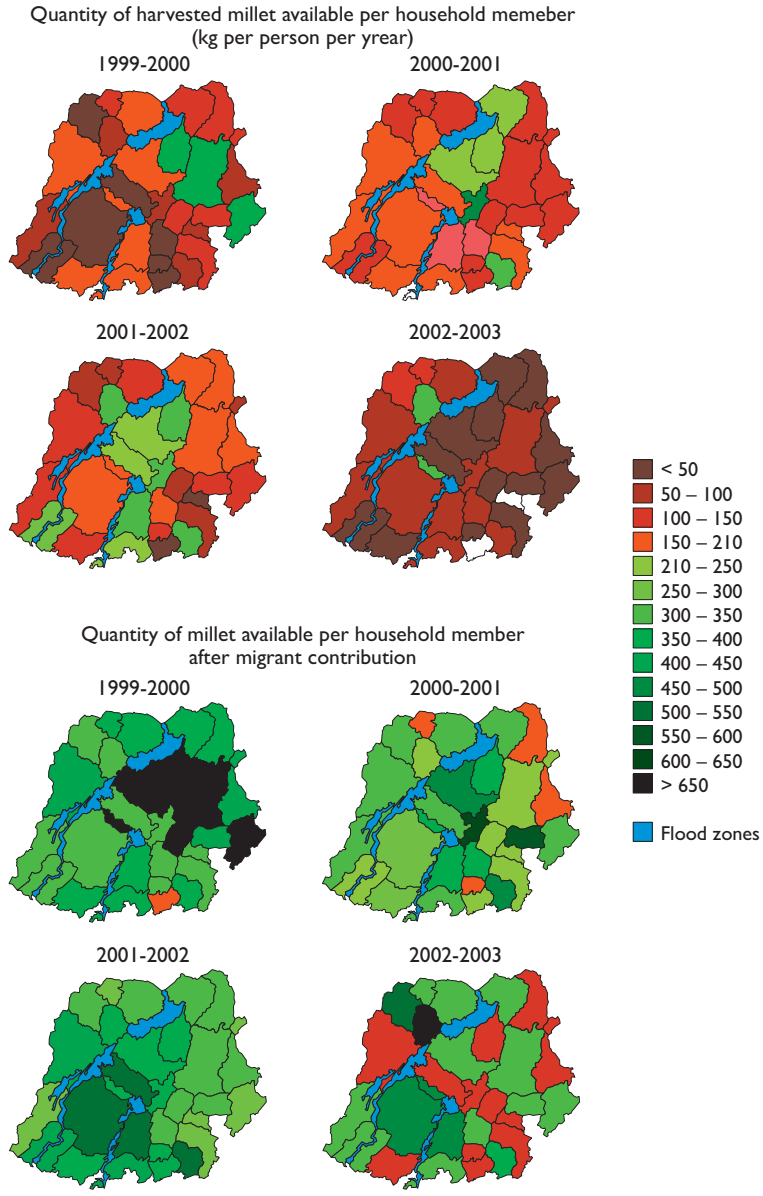

Figure 10.
Distribution by village of the quantities of harvested millet
and the total quantities of grain consumed per person per year after migrant contribution.
Niakhar HDSS site, 1999-2003.
The areas in shades of red are those where the quantity of millet
does not attain the 210 kg per person per year that is necessary.
In contrast, the areas in shades of green have quantities that exceed this standard.
The darker the shade, the further the distance (negative or positive)
from the threshold of 210 kg per person.

For these holdings, labour migration is thus a strategy for adaptation to agricultural production with a structural shortage and not sufficient to cover the household's food requirements.

In contrast, the farms that make the least use of labour migration are generally large (average owned land of 4.5 hectares, and one household in two also farms borrowed land), have a large labour force (10.2 workers) and much equipment. A large proportion of their farm production is intended for sale, with 40% of the usable agricultural area devoted to groundnut and watermelon, and one household in two fattening cattle. These farms also ensure food security for the members of the household. Only 20% of the farms purchase grain because the harvest has been too small. Finally, given their farming and trade performances, these farms make little use of male labour migration to cover the essential needs of the household. However, migration is not totally absent from the range of strategies used by these farms. From 2009 to 2013, an average of 9.5% of the men were absent from their farms, probably because they wished to increase the investment capacity and capitalisation of their farms.

After 50 years of intense circular mobility between the large cities in western Senegal and the villages in the Niakhar zone, temporary labour migration today concerns practically all persons of working age and responds to both constraints—those linked with increasing anthropic pressure on soil and water resources, food insecurity and the small capacity for change in family farming—and choices: meeting the cash requirements of young people, those attending schools or of marrying age and adults

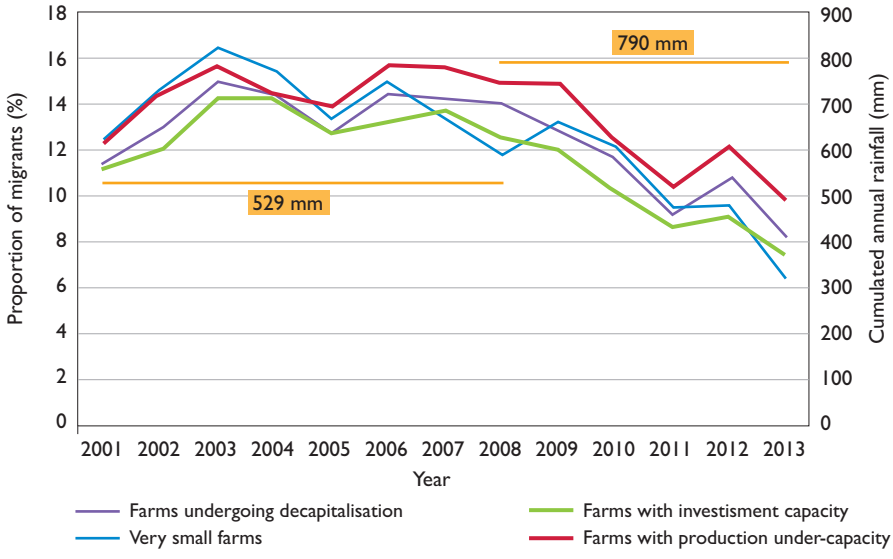

Figure 11.
The proportion of male temporary labour migration (in person-years) according to the type of farm.
Niakhar HDSS site, 1998-2013.

who wish to invest in an economic project. However, in spite of the increasing complexity of the causal factors, climatic uncertainty still marks seasonal migration strongly.

Conclusion

Even before climate change became a public debate issue, internal migratory movements from the south-west of the groundnut belt had long been linked with high population density in the home environment and the environmental shocks in the Sahel in the 20th century. Today, migration is becoming widespread and more intense while population is growing at a rate never seen before and climate is changing, with more uncertainty and extreme situations.

However, movements of population cannot be seen as an exodus or abandonment—either today or in the past. Permanent migration is still very rare in the Niakhar zone, and labour migration, extensive throughout the area, always entails long-distance relationships with home villages and the return of migrants after a more or less short-term absence.

These circular movements are not an escape either. In certain very dry years, a fraction of the population may run from the resulting food crises. This was the case in particular in 2003 after the catastrophic harvest of the 2002 rainy season. However, farmers have never run away from their fields at any moment, either temporarily or permanently, even during the ecological crisis of the 1970s. The climatic and environmental changes of the past 50 years have indeed hit agricultural yields and food security—sometimes dramatically—but the land has not become unsuitable for farming or even lastingly inadequate for feeding a large number of people. So the farmers in the Niakhar zone can make a strategic decision to leave their home base but never brutally or permanently, or simply choose to miss an agricultural season.

Finally, temporary labour migration is not a mark of failed adaptation. Of course, these trends could be less intense if family farming in the Sine had capacity for change and could improve its performance. But we have also seen that even the most innovative holdings that best ensure the food security of the family do not rule out migration. This strategy has become part of habits and is useful for young people who must fund their education and also for adults who wish to invest in their farms. Furthermore, migration would truly indicate failure if it were accompanied by agricultural abandonment and responded to a total inability to feed the population. The strategy is quite the opposite; thanks to remittances and food donations from a few, the majority of people can stay in the village, continue to farm the land and cover part of the essential needs. Migration is clearly adaptation rather than failure to adapt.

References

Adjamagbo A., Delaunay V., 1998
« La crise en milieu rural ouest-africain : implications sociales et conséquences sur la fécondité. Niakhar (Sénégal), Sassandra (Côte d'Ivoire); deux exemples contrastés ».
In Gendreau F., éd. : *Crises, pauvreté et changements démographiques dans les pays du Sud*, Paris, Estem : 339-356.

Adjamagbo A., Delaunay V., Lévi P., Ndiaye O., 2006
Production et sécurité alimentaire : comment les ménages d'une zone rurale du Sénégal gèrent-ils leurs ressources ?
Études rurales, 177 : 71-90.

Beauchemin C., Bocquier P., 2004
Migration and urbanisation in Francophone West Africa: An overview of the recent empirical evidence.
Urban Studies, 41 (11) : 2245-2272.

Becker C., 2014
Traditions villageoises du Siin. Recueillies par C. Becker, V. Martin et A. Ndène.
Dakar, IRD, révision 2014, 319 p.

Becker C., Mbodj M,. 1999
« La dynamique du peuplement sereer. Les Sereer du Sine ».
In Lericollais A., éd. : *Paysans sereer. Dynamiques agraires et mobilités au Sénégal*, Paris, IRD Éditions, coll. À travers champs : 39-73.

Becker C., Diouf M., Mbodj M., 1987
« L'évolution démographique régionale du Sénégal et du bassin arachidier (Sine-Saloum) au xx^{e} siècle, 1904-1976 ».
In Cordell D. D., Gregory J. W., eds : *African Population and Capitalism, Historical Perspectives*, Westview Press, Boulder and London : 76-94.

Buiatti A., Delaunay V., Douillot L., Dione D., à paraître
« L'évolution de la fécondité dans la zone de Niakhar ».
In : *Niakhar : 50 ans de recherche en Population et santé*.

Cantrelle P., 1965 a
« Aperçu sur les méthodes d'observation de la mortalité de l'enfance en milieu rural, en Afrique et au Sénégal ».
In Cantrelle P., Debroise A., Lacombe B., Raybaud N., Dan V., Satgé P. : *Mortalité de l'enfant en zone rurale au Sénégal*, Orstom : 28-130.

Cantrelle P., 1965 b
Étude démographique dans la région du Sine-Saloum (Sénégal). Déroulement de l'enquête.
Dakar, centre Orstom, 23 p.

Cassarino J.-P., 2004
Theorising return migration: The conceptual approach to return migrants revisited.
International Journal on Multicultural Societies (IJMS), 6 (2) : 253-279.

Cerase F. P., 1974
Expectations and reality: a case study of return migration from the United States to Southern Italy.
International migration review : 245-262.

Chung E. H.-C., Guénard C., 2013
« Mobilité en milieu rural sénégalais : une exploration de la relation avec la vulnérabilité alimentaire et le réseau social ».
In Duchêne-Lacroix C., Mäder P., éd. : *Ici et là : ressources et vulnérabilités dans la vie multilocale, Itinera, 34*, Basel, Société suisse d'histoire : 161-184.

Coulibaly S., Vaugelade J., 1981
« Impact de la sécheresse 1969-1974 sur les migrations en Haute Volta ».
In : Congrès général de Manille, Liège, UIESP, 12 p.

De Haas H., 2008
Migration and development: A theoretical perspective.
University of Oxford, 57 p.

Delaunay V., 1994
L'entrée en vie féconde. Expression démographique des mutations socio-économiques.
Paris, Ceped, Les études du Ceped n°7, 326 p.

Delaunay V., Becker C., 2000
« Vers une demande réelle de contrôle de la fécondité en milieu rural sénégalais ». *In* Pilon M., Guillaume A., éd. : *Maîtrise de la fécondité et planification familiale au Sud*, Paris, IRD Éditions, coll. Colloques et séminaires : 127-145.

Delaunay V., Enel C., 2009
« Les migrations saisonnières féminines : le cas des jeunes bonnes à Dakar ». *In* Vallin J., éd. : *Du genre et de l'Afrique. Ouvrage en hommage à Thérèse Locoh*, Paris, Ined : 389-401.

Delaunay V., Waïtzenegger Lalou F., 1998
« Migrations saisonnières ». *In : La situation démographique et épidémiologique dans la zone de Niakhar au Sénégal 1984-1996 (version mise à jour et augmentée du rapport Chahnazarian 1992)*, Dakar, Laboratoire population et santé : 33-38.

Delaunay V., Marra A., Lévi P., Etard J., 2003
« SSD de Niakhar, Sénégal 2003 ». *In* : *Population et santé dans les pays en développement*, Ottawa, CRDI, Indepth Networ : 313-321.

Delaunay V., Douillot L., Diallo A., Dione D., Trape J., Medianikov O., Raoult D., Sokhna C., 2013 a
Profile: The Niakhar Health and Demographic Surveillance System. *International Journal of Epidemiology*, 42 (4) : 1002-1011.

Delaunay V., Ndiaye E., Fall B. 2013 b
Manuel des enquêteurs. Dakar, IRD, 18 p.

Dubois J., 1975
Les Sereer et la question des Terres Neuves au Sénégal. *Cahiers Orstom, série Sciences humaines*, 12 (1) : 81-120.

Fall A. S., 1991
Une réponse à la crise de l'agriculture. La migration des Sereer du Siin (Sénégal). *Sociétés-Espace-Temps*, 1 (1) : 138-149.

Faulkingham R. H., Thorbahn P. F., 1975
Population dynamics and drought: a village in Niger. *Population Studies*, 29 (3) :463-477.

Findley S. E. 1994
Does drought increase migration? A study of migration from rural Mali during the 1983-1985 drought. *International migration review* : 539-553.

Garenne M., Lombard J. 1991
« La migration dirigée des Sereer vers les Terres neuves ». *In* Quesnel A., Vimard P., éd. : *Migration, changements sociaux et développement*, Paris, Orstom, coll. Colloques et séminaire : 317-332.

Gervais R. 1987
« Pour une problématique démographique des catastrophes dites naturelles. L'exemple du Niger 1969-1974 ». *In* D. Gauvreau, J. Gregory, M. Kempeneers, V. Piché, éd. : *Démographie et sous-développement dans le Tiers-monde*, Montréal, université de Montréal et Mc Gill University, 316 p.

Guigou B., 1999
« Les fondements de l'économie locale ». *In* Lericollais A., éd. : *Paysans sereer. Dynamiques agraires et mobilités au Sénégal*, Paris, IRD Éditions, coll. À travers champs : 485-520.

Hampshire K., 2002
Fulani on the Move: Seasonal Economic Migration in the Sahel as a Social Process. *The Journal of Development Studies*, 38 (5) : 15-36.

Harbison S., 1981
« Family Structures and Family Strategy in Migration Decision Making ». *In* De Jong G., Gardner R. W., eds : *Migration Decision Making*, Pergamon Press : 225-251.

Henry S., Boyle P., Lambin E. F., 2003
Modelling inter-provincial migration in Burkina Faso, West Africa: the role of socio-demographic and environmental factors. *Applied Geography*, 23 (2) : 115-136.

Henry S., Schoumaker B., Beauchemin C., 2004
The impact of rainfall on the first out-migration: A multi-level event-history analysis in Burkina Faso.
Population and Environment, 25 (5) : 423-460.

Katz E., Stark O., 1986
Labor migration and risk aversion in less developed countries.
Journal of Labor Economics, 4 : 131-149.

Knerr B., 2004
« Desertification and Human Migration ».
In Werner D., éd. : *Biological Resources and Migration*, Springer, Berlin Heidelberg : 317-337.

Konseiga A., 2007
Household migration decisions as survival strategy: The case of Burkina Faso.
Journal of African Economies, 16 (2) : 198-233.

Lombard J., Seck S. M, 2008
« Mouridoulahi ou les logiques d'investissement des Mourides dans le transport au Sénégal ».
In Bredeloup S., Bertoncello B., Lombard J., éd. : *Abidjan, Dakar : des villes à vendre ? La privatisation made in Africa des services urbains*,
Paris, L'Harmattan : 81-100.

Mortimore M., Tiffen M., 2004
Introducing Research into Policy: Lessons from District Studies of Dryland Development in Sub-Saharan Africa.
Development Policy Review, 22 (3) : 259-285.

Moullet A., Engeli E., 2013
Migrations saisonnières féminines du village de Toucar, Sénégal. Une analyse qualitative au travers de quatre profils migratoires.
Genève, université de Genève, IRD, 74 p.

Myers N., 1993
Environmental refugees in a globally warmed world.
Bioscience : 752-761.

Myers N., 2002
Environmental refugees: a growing phenomenon of the 21st century.
Philosophical Transactions of the Royal Society B:Biological Sciences, 357 (1420) : 609-613.

Myers N., Kent J., 1995
Environmental exodus: an emergent crisis in the global arena. Climate Institute, *multigraph*., 214 p.

Pedersen J., 1995
Drought, migration and population growth in the Sahel: The case of the Malian Gourma: 1900-1991.
Population Studies, 49 (1) :111-126.

Pontié G, Lericollais A., 1999
« Migrations et relations à distance ».
In Lericolais A., éd. : *Paysans sereer. Dynamiques agraires et mobilités au Sénégal*,
Paris, IRD Éditions, coll. À travers champs : 555-574.

Roch J., 1975
Les migrations économiques de saison sèche en bassin arachidier sénégalais.
Cahiers Orstom, série Sciences humaines, 12 (1) : 55-80.

Root B., De Jong G., 1991
Family Migration in a Developing Country.
Population Studies: A Journal of Demography, 45 (2) : 221-233.

Roquet, D., 2008
Partir pour mieux durer : la migration comme réponse à la sécheresse au Sénégal ?
Espace populations sociétés, 2008/1 : 37-53.

Salack S., Muller B., Gaye A., 2011
Rain-based factors of high agricultural impacts over Senegal.
Part I: Integration of local to sub-regional trends and variability.
Theoretical and applied climatology, 106 (1-2) : 1-22.

Stark O., 1980
On the Role of Urban-to-Rural Remittances in Rural Development.
Journal of Development Studies, 16 (1) : 369-374.

Stark O., Levhari D., 1982
On migration and risk in LDCs.
Economic development and cultural change : 191-196.

Suhrke A., 1994
Environmental degradation and population flows.
Journal of International Affairs, 47 (2) :473.

Tamondong-Helin S., Helin W. H., 1991
Migration and the Environment: Interrelationships in Sub-Saharan Africa.
Universities Field Staff International and the Natural Heritage Institute.

Todaro M. P., 1969
A model of labor migration and urban unemployment in less developed countries.
The American Economic Review : 138-148.

Lalou Richard, Delaunay Valérie.

Seasonal migration and climate change in rural Senegal : a form of adaptation or failure to adapt ?

In : Sultan Benjamin (ed.), Lalou Richard (ed.), Amadou Sanni M. (ed.), Oumarou A. (ed.), Soumaré M.A. (ed.).

Rural societies in the face of climatic and environmental changes in West Africa.

Marseille : IRD, 2017, p. 269-293. (Synthèses). ISBN 978-2-7099-2424-5