Geoforum 144 (2023) 103792

Contents lists available at ScienceDirect

Geoforum

journal homepage: www.elsevier.com/locate/geoforum

The causal nexus of Trans-Saharan migration: A political ecology approach from Niger

Matthew D. Turner [a,*], Soumaila Abdoulaye Sambo [b], Jesse Ribot [c], Papa Faye [d]

[a] Department of Geography, University of Wisconsin, 160 Science Hall, Madison, WI 53706, United States
[b] Groupe de Recherche, d'Etudes et d'Action pour le Développement, BP 10 380 Niamey, Niger
[c] School of International Service, American University, 4400 Massachusetts Avenue, NW, Washington, DC 20016, United States
[d] Centre d'Action pour le Développement et la Recherche (CADRE), Cité Poste, Immeuble Babacar Khouma, Rufisque Ouest N°. 155, Apart. 1G, Dakar, Senegal

ARTICLE INFO

Keywords:
Climate change
Experiences of poverty
Inequality
Labor migration
Vulnerability
Niger
Libya
Algeria

ABSTRACT

Increased Trans-Saharan migration over the past decade has spurred arguments that climate change or generic conditions of poverty drive West Africans to take this risky journey. These diagnoses are made with little empirical investigation of the conditions facing migrants and their families at home. This article reports on mixed-methods research conducted in southwestern Niger within ten communities where Trans-Saharan migration has recently begun, with interviews conducted at community, household and individual scales. Interviews were conducted within 331 households with or without members involved in Trans-Saharan migration. Individual interviews were also conducted with 67 returned Trans-Saharan migrants and 100 community youth who represent potential Trans-Saharan migrants. We find no evidence that new rainfall fluctuations influence the onset of Trans-Saharan migration. Study communities and migrant families within them are not poorer nor more food insecure than other communities or non-migrant families. The sole difference is that migrant families have more adult men. Interviews with returned Trans-Saharan migrants point to a mix of individual and family motivations for embarking on risky journeys north. A key factor is desperation – driven not by short-term scarcities but by a hopelessness due to life-long experiences of crushing poverty, past periods of recurrent drought, soil impoverishment, and political voicelessness. They go, despite knowing the grave abuses and risks they may face.

1. Introduction

> When you go out to work, they search you and take everything you have…. When you come back from work, they can stop you, hit you and they take everything you have. There are also people who kidnap you and put you in well-guarded places. If you don't give them 300,000 FCFA [US$600] they won't let you go. There are many people who build houses where they put up stakes where they can tie people up. These houses are like prisons…. If they take you hostage, they will ask you for the phone number of close relatives. And, they'll dial the number while hitting you really hard… so your relative knows that you are in their hands and that you are in pain. Also, sometimes they cut you with a long knife and you scream very loudly so your family will know that you are in pain. So, they ask your family to pay 300,000 FCFA to 400,000 FCFA [US$600-US$800]. If your parents [meaning friends and relatives] in town [in Libya] can afford it, they'll come and pay to release you. If not, your family in the village will be asked to manage to send the money to release you.
>
> Excerpt from a returned Nigerien migrant's account of his time in Sebha Libya 2015–16.

Many migrants from West Africa die in the Sahara. Media accounts highlight the drama close to European shores – drownings in the Mediterranean and European countries that not only refuse to accept migrants but assist in their rescues (McCormick et al., 2017). The Mediterranean crossing, however, is just one leg of a long and perilous journey. The more "hidden" suffering and loss of life in the Sahara is likely higher (Benattia et al., 2015; Danish Refugee Council, 2016; Miles and Nebehay, 2017). As the quote above illustrates, the risks to life, limb, and dignity are significant in Libya and Algeria. West African migrants are often victims of robbery; abandonment in the desert; racism; torture and random acts of physical and verbal abuse; and illegal

* Corresponding author.
E-mail address: mturner2@wisc.edu (M.D. Turner).

https://doi.org/10.1016/j.geoforum.2023.103792
Received 28 October 2021; Received in revised form 8 May 2023; Accepted 1 June 2023
Available online 2 July 2023

detention, trafficking, and extortion (Benattia et al., 2015; Brachet, 2018; Lucht, 2017; Malakooti and Benattia, 2013; McCormick et al., 2017; Reitano and Tinti, 2015). Despite what appear to be mounting risks, Trans-Saharan migration has been on the rise over the past 20 years (REACH Initiative, 2018; Ribot et al., 2020). Why do young West Africans embark on these journeys despite the high risks?

Observers have been quick to point to climate change as a driver of this expansion with Trans-Saharan migrants often described as climate or environmental refugees (Argos Collectif, 2010; Elliott, 2019; Friedman, 2016; Gonin and Lassailly-Jacob, 2002; Lustgarten, 2020; Miller, 2017). These diagnoses are often coupled with general references to widespread poverty in the Sahel as also contributing to these desperate decisions with *poverty* as an unexplained generalized condition or tied in some way to a mix of climate change, soil impoverishment, population-induced scarcity, government corruption, or political insecurity (Grolle, 2015; Grote and Warner, 2010; Laczko and Aghazarm, 2009; McCormick et al., 2017). Such shallow diagnostics, however, merely reproduce long-standing environment-development narratives about the Sahel (Reenberg, 2012; Ribot et al., 2020).

There are serious moral and political problems with leaving the causal analysis of migration so vague. The power of climate-induced migration discourses stems from Europeans fear of mass influx of migrants from the South. This fear is expressed broadly in the media and it is thus attractive to those who want to spur northerners to fight climate change (Brachet, 2018; Miller, 2017; Ribot et al., 2020). By not addressing how vulnerability in the face of climate change is produced, these discourses also treat the cause of migration as something that cannot be addressed without climate mitigation measures. The pressure on European and North African nations who receive "climate refugees" or "climate migrants" are used to point to a global crisis and our dystopian future (e.g. Kaplan, 1994) without actually engaging in the lived experiences of Sahelian people. The aspirations and struggles of Sahelian people, which lie at the heart of difficult decisions to cross the desert, are obscured and neglected – both product and cause of our continued ignorance of how vulnerabilities are generated.

Ironically, the rise of Trans-Saharan emigration coincides with a general improvement of average annual rainfall in the region since the late 1990s (Nicholson, 2005; Ozer et al., 2017; Biasutti, 2019), leading to some referring to a 'greening of the Sahel' (e.g. Dardel et al., 2014; Olsson et al., 2005; Rasmussen et al., 2016). There is a need to take more seriously the difficulties of making causal statements among long-lasting phenomena. In the Sahel, recurrent drought, economic precarity, and migration are *all* experienced by a significant fraction of the rural population over most years.[1] At the same time, the relationship among all three of these phenomena are strongly mediated by other conditions and processes – truly a nexus.[2]

Research on the climate-migration nexus in Sudano-Sahelian West Africa has, reflecting broader trends in the literature (Borderon et al., 2019; Brüning and Piguet, 2018; van der Land et al., 2018), been clustered around quantitative studies focused on correlations between the climate variables and human mobility (e.g. Alessandrini et al., 2021; Bertoli et al., 2020; Rigaud et al., 2021) and qualitative studies based on interviews with migrants as to their reasons for migrating (e.g. Afifi, 2011). Two features of migration decisions in this region pose particular analytical challenges. The first is that multiple factors, working at different sociospatial scales, likely shape migration decisions. There has been a tendency to focus on the environmental "push" factors in analyses without incorporating other factors that directly affect migration or mediate climate vulnerability. In any analysis, to ignore potential factors affecting migration decisions including those that produce climate-related vulnerability over time, is likely to lead to interpretation errors.

The second analytical challenge is that decisions are just as likely to occur in response to an accumulation of hardships over prolonged periods of struggle than from climate or economic events – e.g. a particularly severe drought or flooding event (Grolle, 2015). Despite the fact that climate change refers to decadal changes in temperature and rainfall, it has proven analytically useful in both qualitative and quantitative studies to conceptualize climate change as generating triggers that launch emigration via short-term extreme weather events (Alessandrini et al., 2021; Bertoli et al., 2020; Findley, 1994; Grace et al., 2018; Gray and Wise, 2016; Grolle, 2015; Henry et al., 2004; Nawrotzki and Bakhtsiyarava, 2017; Neumann et al., 2015; Rigaud et al., 2021). Still, to segment the long period of slow violence experienced by Sahelian communities into below and above average rainfall years does not do justice to the experience that elicits migration response, particularly for dangerous migrant destinations such as those in the Sahara. Long periods of the recurrent subsistence struggle may be more important in initiating Trans-Saharan migration than the interannual variability of climate parameters.

Quantitative work addresses some of the limitations of popular and policy discourse by exploring empirical relationships over longer time periods over broader geographical areas (Alessandrini et al., 2021; Bertoli et al., 2020; Grace et al., 2018; Gray and Wise, 2016; Henry et al., 2004; Nawrotzki and Bakhtsiyarava, 2017; Neumann et al., 2015; Rigaud et al., 2021). Still, they do not escape the causal inference problems associated with the analytical challenges raised above. As a result, these studies have shown negative, no, or positive effects of climate-induced resource deficits on migration (e.g. Brüning and Piguet, 2018; van der Land et al., 2018).

Inspired by Romankiewicz and Doevenspeck's (2015) call for place-based, multi-level mixed methods research to address the limitations of current approaches, we bring a political ecological lens to the study of the vulnerability of migrants and their families (e.g. Ribot, 2014; Turner, 2016, Ribot et al. 2020) to better understand decisions to embark on these dangerous journeys. A migrant's experience at home, in terms of food security and access to resources, is conceptualized here as very much shaped by his/her membership within a household, the social unit where resource access rights are generally held and food and income are shared. The decision is also influenced by community, which affects the level of land-based resources available to households as well as the social networks that surround young men and help shape their sense of self, status and future.

We focus on the recent increase of young men in southwestern Niger (Say and Kollo departments, Tillaberi Region) deciding to migrate to particularly dangerous destinations in North Africa. In this way we focus on a period of disjuncture with respect to international migration destination when the material factors (ecological, political-economic) at home contributing to the change are best revealed. We conceptualize these material conditions through a political-ecology lens that treats peoples' access to productive resources as shaped by environmental change necessarily experienced at the local level, as mediated by political economic structures (Ribot and Peluso, 2003). In this way, we bring to the existing literature closer attention to the material conditions, working at multiple levels of social organization at home that may contribute to the upswing of Trans-Saharan migration. As such, our research does not to directly engage with long-standing debates in the migration literature (push–pull theory, migration aspiration and ability,

[1] Dating back to the early colonial period, the region has a long history of seasonal and semi-permanent migration, largely oriented from rural to urban and from the Sudano-Sahelian zone to areas to the south (Ouedraogo, 2009) with seasonal migration seen as an important livelihood adaptation (Black et al. 2011). Moreover, rural poverty is widespread and rainfall has always been variable from year to year especially at the level of the cropped field with harvest shortfalls that could be seen to elicit migration, a routine event in peoples' lives (Zampaligré et al., 2014).

[2] Unless people emigrate from an area solely because they experienced an abnormally hot or dry month, the relationship between climate and migration is necessarily mediated by peoples' vulnerability to these climate parameters which is not due solely to their exposure but to a large number of cultural and political-economic conditions that shape their vulnerability (Ribot, 2014, Turner, 2016).

human capital and proclivity to migrate, migration hump, etc.) but its findings do have implications that may be useful to these bodies of work. More specifically, our research addresses three questions:

1. What is the trend of Trans-Saharan migration in southwestern Niger over the past twenty years?
2. How do communities and households within communities that participate in Trans-Saharan migration differ from other communities and from other households in terms of economic security and perceptions of climate and other constraints to their livelihoods?
3. How do migrant subjectivities with respect to their feelings of family, dignity, economic future, and work influence their decisions to depart despite uncertain returns and high risks?

After a brief introduction to the history of Saharan labor emigration from Niger, we describe our innovative methodological approach that addresses these questions at different sociospatial levels through mixed methods grounded in place. Research results are presented in four sections: 1. Trans-Saharan migration in relation to historic destinations in other Sub-Saharan African countries; 2. Longitudinal trends in Trans-Saharan migration in relationship to economic and rainfall trends in the study area; 3. Cross-sectional analysis among households that are or are not involved in Trans-Saharan migration with respect to economic security and perceptions in livelihood constraints; and 4. The conditions of their departures and perceptions among returned migrants as to their motivations for embarking on Trans-Saharan migration. The significance of results is discussed followed by a short conclusion.

2. History of Trans-Saharan labor emigration from Niger

Studies have long documented high rates of seasonal and longer-term migration from rural Niger (e.g. Mounkaila, 2002; Painter, 1986; Rain, 1999) with young men making up the vast majority of labor emigrants (Diarra, 1974; Sudarkasa, 1977).[3] Like most West Africans, the vast majority of Nigerien migrants stay within West Africa, migrating to countries to the south or to a lesser extent, other Sahelian countries, with destinations changing over time due to political and economic conditions.

In Northern Niger, Trans-Saharan emigration is not a new phenomenon from northern Niger particularly by the Tuaregs of the Agadez region (Brachet, 2012) but also by Toubou and Kanuri youth to the east. Until recently, Trans-Saharan migration has been very rare from southern Niger, limited to small pockets of people – particularly among the Hausa and Beri-Beri communities in the Zinder region (Benattia et al., 2015). Most all Nigeriens who embark on Trans-Saharan migration do so to find work in North Africa rather than seek to continue on to Europe (Brachet, 2018; Malakooti and Benattia, 2013; Molenaar and El-Kamouni-Janssen, 2017) with important destinations being Libya (Benattia et al., 2015) and Algeria (Molenaar and El-Kamouni-Janssen, 2017).

3. Methods

In this study, we focus on the southwestern portion of the country that does not have a history of Trans-Saharan migration but where we learned anecdotally about an accelerating increase in Trans-Saharan migration since Muammar Gaddafi's death in 2011. This suggests that within the study area, the development of Trans-Saharan migration is relatively recent, providing a unique opportunity to understand the shift before Saharan migration patterns fully establish themselves.

3.1. Fieldwork

During initial fieldwork (June–December 2017) in the Say and Kollo Departments of the Tillibery Region, Saharan migrant households were identified by first finding communities where Trans-Saharan migration had begun (Fig. 1). Seven of the ten communities so identified were villages and three were neighborhoods within larger towns. In each selected community, group interviews with community representatives were conducted to develop exhaustive household lists with each household categorized with respect to size (large, medium, small), overall wealth, and the presence or absence of any members who have traveled to North Africa for work.

These household lists were used to select households for more detailed interviews. We set out to interview all households identified as having current or former Saharan migrants, interviewing 70–100 % of these households in each village. Within each community, an approximately equal number of households were randomly selected from among those without Saharan migrants with the stipulation that at least 15 non-migrant households were interviewed.[4] Interviews were conducted with the male head of household (89 %) unless he was absent and in these rare cases, his wife (6 %), brother (2 %), or son (3 %) was interviewed.[5] Household interviews focused on household composition, labor emigration, livelihood practices, constraints to farming and livestock husbandry, land access, food security, economic vulnerability, and remittances from migrants.

Household informants were asked to list household livelihood activities, ranking the three activities that are most important for supporting the household. Crop agriculture and livestock husbandry dominate livelihood activities. For both of these activities, informants were asked to identify major production constraints from most to least important. This was an open-ended question with post-hoc categorization of reported constraints.

To provide an understanding of household access to farming land, informants were asked to list the fields that they had cultivated during the previous season and to provide an estimate of their size. The number of hectares cultivated per household adult was calculated as a measure of the household land access. Two types of information related to food security of the household were collected. First, informants were asked to provide an estimate of the number of months of household grain need supplied by their harvests in each of the previous two years (2015, 2016). The sum of these divided by 24 months provide a measure of the degree to which harvests were sufficient to support the household. Households were asked whether over each of the past two years, they found it necessary, due to food shortage, to reduce consumption in different ways or accept gifts or loans. The fraction of all such practices conducted by the household over the previous two years serves as an additional measure of food insecurity. Information about household indebtedness was used as a measure of economic insecurity. Informants were asked to describe the debts that they currently were holding. The level of debt held divided by the number of adults within the household is used as another measure of the economic insecurity of the household.

Sixty-six returned Saharan migrants were interviewed. Information about their education level, marital status and prior experience with labor emigration was collected. Foci of these interviews were the types of work performed, length of stay, periods of work, the level of remuneration, and the money saved at their destinations for all previous

[3] While there are regional differences, the dominance of young men is stronger for Saharan destinations. Among the Hausa in South Central Niger, there is greater involvement of women in labor migration (Roberts 1989) and growing female involvement in Trans-Saharan migration (Samuel Hall, 2016).

[4] This sampling resulted in the interviewing of 11 %–75 % of village households, totaling 331 household interviews (177 with no Saharan migrants, 154 with Saharan migrants). The fraction of all households interviewed within a village that had experience with Saharan migration ranged from 24 % to 58 %.

[5] It should be noted that livelihood decisions for the household are largely made by male heads of households (father or senior brothers in corporate households) who control access to land farmed by household members.

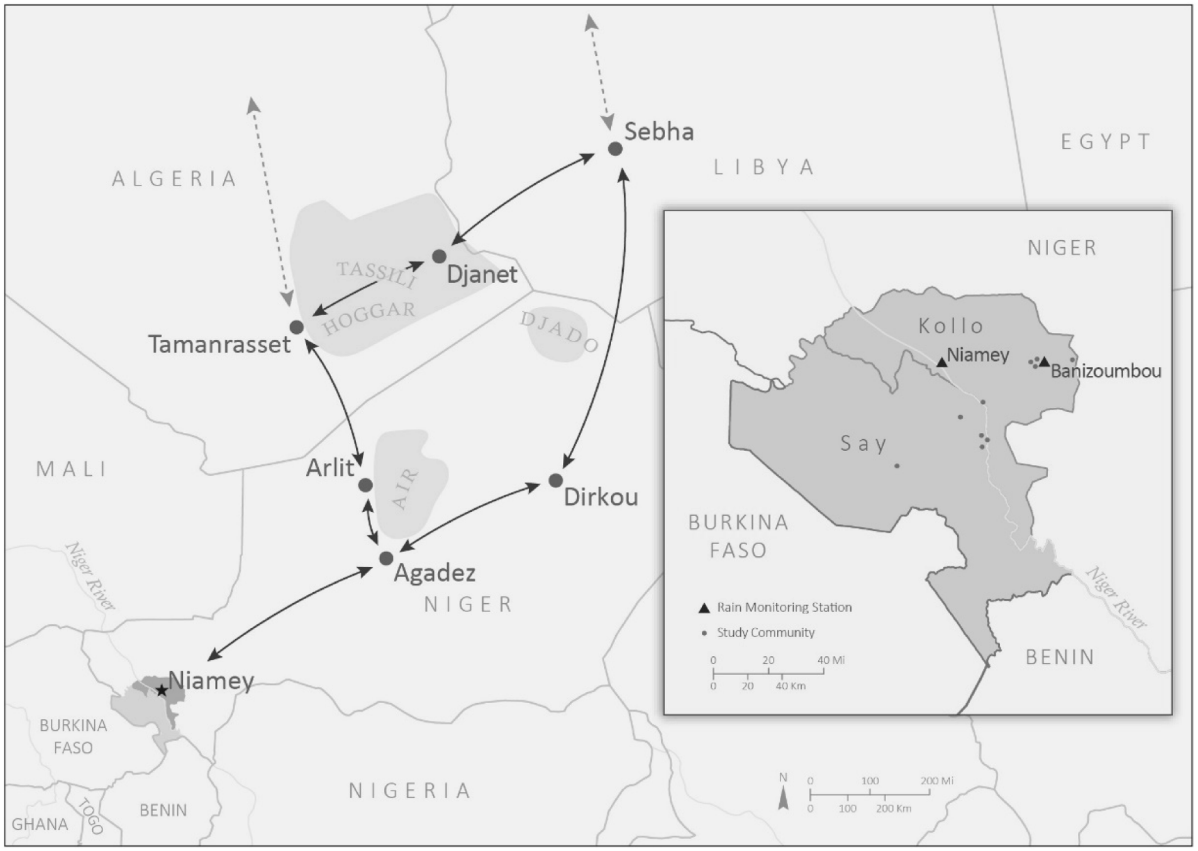

Fig. 1. Map of the study area and major Saharan transit routes.

Saharan migrations. In addition, information was gathered about what influenced their decision to embark on Saharan migration, their prior experience with other forms of labor emigration and the degree to which others were involved in these decisions. These later questions were asked in an open-ended fashion with post-hoc coding of responses.

In 2021 (May–June), follow-up interviews with key informants knowledgeable about nine of the ten study communities and neighboring communities (within 7 km) were conducted. The focus of these interviews were to gain at least a qualitative sense of whether levels of Saharan migration had changed in the study villages (and the communes where they are located) and whether residents in neighboring villages had begun embarking on Saharan labor emigration since 2017. To help to evaluate why Saharan migration first developed in these communities, characteristics of nine of the ten study communities were collected including ethnic/caste composition and land access control. Estimates of average cultivatable land available per household and descriptions of land quality for each of the study and neighboring communities were also collected.

3.2. Data Analysis

3.2.1. Trends and patterns of Trans-Saharan migration in southwestern Niger

Household interviews provide data on the prevalence within the 311 surveyed households of migration to different destinations. The prevalence of labor emigration was measured by dividing the number of returned and current migrants to the north or to other Sub-Saharan countries by the number of all adults within the household. Interviews of returned migrants will provide basic information about their demographic status and migration experience when departing on Saharan migration as well as the average length of stay and remuneration at migration destinations.

To provide a sense of how the prevalence of Trans-Saharan migration has changed over time, the absences due to Saharan migration were plotted over time using the descriptions of the periods away by returned Saharan migrants. In addition, these data were supplemented by qualitative data collected in 2021 about whether Trans-Saharan migration has increased in the study and surrounding communities since 2017.

3.2.2. Factors behind the prevalence of Trans-Saharan emigration within the study area

This question was addressed through four analyses at different social and geographical scales. First, thirty years of rainfall data at two sites within the study area were compared with the temporal trends of Saharan migration reconstructed from returned migrant interviews. In addition to annual rainfall, we also obtained the number of rainy days (>3mm of rainfall) as a measure of rainfall distribution (Ozer et al., 2017).

Second, information collected during follow-up interviews in 2021 focused on common characteristics of the study communities where Trans-Saharan migration was first prevalent with respect to land rights and ethnic/caste composition. In addition, the land endowment of each study community was compared with that of surrounding villages in terms of extent (estimates of the average hectares cultivated per community household) and land quality for agriculture (three scale coding with 1 = poor, 2 = medium, 3 = good). A two-level logistic regression analysis (with community as random effects variable) was performed to investigate the effect of the two measures of land endowment on the incidence of Saharan emigration among communities (both study and neighboring).

Third, information collected during group interviews of village representatives was used to categorize households with respect to their size (number of members), overall wealth (low, medium, high) and livelihood activities. Household experience with Trans-Saharan emigration

(0,1) was regressed on household wealth, livelihood activities and size using a two-level logistic regression with community as the random effects variable and robust standard error estimation clustered on community. While informants' assessments of household wealth are not entirely accurate, this analysis provides a broad sense of how Trans-Saharan migration is related to household wealth and livelihood over a large sample size (n = 1088) while controlling for community.

Fourth, household survey data were analyzed to evaluate the effects on Trans-Saharan migration (0, 1) of independent variables including the size of the pool of possible migrants (number of adult males in household), household economic variables, and measures of the importance of perceived constraints/risks to household livelihood. Household economic variables included land endowment (cultivatable HAs per household member aged 18 or older), economic insecurity (outstanding debts per household member aged 18 or older), and the two measures of food security described above. The relative importance of constraints affecting the household economy were also used as independent variables to understand whether households that experience or perceive greater constraints due to the post-hoc categories of rainfall, soil fertility, disease/pests, labor availability, land access, or capital access were more likely to participate in Trans-Saharan migration. These measures were calculated taking into account both informant's impressions of the importance of the constraint for crop agriculture and livestock husbandry and their estimate of the importance of each activity to household livelihood.[6] The focus on crop agriculture and livestock husbandry is warranted given their dominance within the livelihood strategies of study households. Still, this approach likely underestimates the importance of capital and labor access for the small number of households that agriculture and livestock husbandry activities are not important.

The covariance structure among these household economy and livelihood constraint variables was assessed. To avoid problems of multicolinearity, variables that were strongly correlated with others were excluded from regression analysis. The incidence of Trans-Saharan migration among the 331 surveyed households was regressed on all retained independent variables using a two-level logistic regression with community as the random-effects variable.

3.2.3. Individual motivations of migrants to pursue Trans-Saharan migration

To what extent are decisions to embark on dangerous Saharan journeys driven by household subsistence concerns or the related but more individual concerns of young people to find work and establish economic autonomy? This question was addressed through the analysis of the data generated from individual interviews of returned Saharan migrants to address: 1. the demographics of Saharan migrants to illustrate when such journeys are situated with respect to migrant age and marital status; 2. the involvement of household members in the migrant decisions to travel through the Sahara; and 3. the stated motivations by returned migrants for originally embarking on these dangerous journeys. Open-ended questions about migrants' motivations were coded into motivational categories (multiple binary codes per response) with frequency analysis performed to identify relationships among these motivational categories and with the marriage status of respondents.

4. Results

Labor emigration from Southwest Niger has a long history and therefore it is important to contextualize the newer phenomenon of Trans-Saharan in relation to more common migration experiences to other SSA countries. This will be done using data from our migrant and household surveys to focus on different effective levels of remuneration at these two destination types, as well whether Trans-Saharan migration can be seen as an alternative or part of an overall migration strategy. We then move into sections that address the causal nexus surrounding the emergence of Trans-Saharan migration from southwestern Niger in different ways. First, at the scale of the study area, we compare longitudinal trends in Trans-Saharan migration with currency exchange rates and rainfall. Second, we compare the economic security of, and perceptions of livelihood constraints held by households with and without Trans-Saharan migration experience. Finally, we report on the motivations and aspirations held by Trans-Saharan migrants themselves. These analyses together provide a fuller multi-level (community, household, and individual) assessment, using both longitudinal and cross-sectional data, to understand the multiple factors leading to the rise of Trans-Saharan migration within the study area.

4.1. Labor emigration to Saharan and SSA destinations

Table 1 presents data from household interviews showing the prevalence of different migration destinations among household members. These data reflect the current migration status of household members. Returned migrants were categorized based on their last destination (Saharan or SSA destination). In the study area, migration remains highly gendered with only twelve of 331 surveyed households with women who were absent or returned from migration (usually with husbands). All of these cases were to destinations in other Sub-Saharan countries. Of those households with at least one member either absent or returned from migration (n = 239), the average fraction of adult males in the household with international labor emigration experience is 66.5 %. As can be seen in Table 1, greater fractions of men within larger households have migration experience. Households having no migration experience average 1.8 adult male members compared to an average of 3.1 male members for all other households. This is consistent with our informants' portrayals of household heads as being less likely to migrate

Table 1
The composition of 331 surveyed households with respect to the migration status of its members at the time of household interviews (TS = Trans-Saharan, SSA = Sub-Saharan). Composition was characterized by members: 1. Currently absent due to Saharan (Cur Sah) or SSA (Cur SSA) migration; 2. Currently present and returned from Saharan (Ret Sah) or SSA (Ret SSA) migration. For each category, the number of households, average number of adult males, and the average percentage of the household's adult males with international migration experience are provided.

Migrant Composition of Households	# of Hshlds	Average Adult Males in Hshld	% with Migration Experience
No current or returned migrants	92	1.8	0
Absent TS migrants only	22	4.0	47
Absent SSA migrants only	45	2.8	54
Absent TS and SSA migrants only	27	4.6	60
Returned TS migrants only	54	2.2	68
Returned SSA migrants only	35	2.1	73
Returned SSA and TS migrants only	12	3.2	90
Absent SSA and returned TS migrants	23	3.1	89
Other mixes of returned and current migrants	21	4.4	68

[6] Given the number of ranked items for both economic activities and constraints vary among households, ranks were first normalized as outlined by Barrett et al. (2001). To illuminate the overall effect of constraints on household economies, a measure equal to the sum of the products of the normalized rank (0–1) of agriculture and livestock rearing with their activity-specific normalized ranks (0–1) for the major constraint categories were calculated.

and that departures create labor shortage for smaller households.[7]

It is important to understand Saharan migration in the context of longer-term patterns of migration in the study area to other Sub-Saharan countries. Even among families sampled because of their experience with Trans-Saharan emigration, 53 % of absent members were in other Sub-Saharan countries (47 % in North Africa). Frequency analysis of household data finds that households with absences due to North African and SSA emigration are positively related (Pearson chi$^2 = 13.8$, $p < 0.001$). Individual interviews of returned Saharan migrants show that 77 % had experience with SSA migration prior to embarking on their first Saharan voyage with an average of 1.5 prior international trips representing 2.1 years of absence from their home community (Table 2).

Table 2
Characteristics of returned Saharan migrants when they first departed for Saharan destinations and of their Saharan trips. At first departure, migrant characteristics include, age, marital status, education level and prior experience with labor migration within Niger or to other Sub-Saharan countries (SSA). The characteristics of Saharan trips include destinations, their length (in years), and length of time they were gainfully employed (years).

Characteristic	Mean (s.d.) or %
Migrants at first Saharan departure (n = 66)	
Age (years)	26.4 (7.1)
Married (%)	53
Education level (%)	illiterate (44), primary (41), middle (13.5), secondary (1.5)
Within-Niger migration experience (%)	46
Prior SSA migration experience (%)	77
Previous SSA destinations (%)	Ivory Coast (29), Benin (20), Ghana (18), Togo (11), Mali (8), Nigeria (8), Burkina Faso (5), other (2)
# of previous SSA trips	1.52 (1.32)
Cumulative SSA stays (years)	2.10 (2.40)
Types of work performed at destination (%)	petty commerce (82), unspecified laborer (3), work in trades (2), herder (4), other (9)
Saharan migration trips (n = 73)	
Cash at depart (1000 FCFA)	193.4 (72.6)
Source of cash at depart (%)	crop harvest sale (16), livestock sale (40), gifts (4), loans (32), commerce (4), other (4)
Source of gifts and loans at depart (%)	friends (4), specific nuclear family member (35), other family members (61)
Seek permission from:	no one 1 %, father 58 %, mother 31 %, siblings 4 %, wife 3 %, friends 2 %, other 0 %
Seek advice from:	no one 5 %, father 26 %, mother 11 %, siblings 1 %, wife 0 %, friends 50 %, other 7 %
Notify departure date:	no one 0 %, father 48 %, mother 25 %, siblings 1 %, wife 9 %, friends 14 %, other 2 %
Destinations (%)	Libya (89), Algeria (11)
Duration (years)	2.58 (2.43)
Number of work years	1.30 (0.88)
Types of work performed at destination (%)	Unspecified manual labor – often agricultural (32), mason assistant-construction (8), commerce (6.5), hauler/porter, handler (9), store assistant (12), unknown (25), other (8)

Thus, in general we find that Saharan migration at this early stage should not be seen as a distinct livelihood strategy from migration to other Sub-Saharan countries.

When asked to compare, people describe Saharan destinations as involving higher risks for higher rewards compared to conventional SSA destinations. The daily wages reported by returned migrants for work at Saharan destinations (averaging 7,500 FCFA/day [US$12.50]) are approximately five times the daily rate for similar work in Niger. As shown in Table 2, the types of work are also different at Saharan versus SSA destinations with the later dominated by itinerant petty commerce and the former dominated by unspecified manual labor, though often tied to agriculture or construction. There is ubiquitous agreement among returned migrants of the significant suffering endured during desert crossings and of difficult work conditions in Algeria or Libya. Saharan migrants report gaining employment during approximately half of their periods of absence (Table 2) with days without work associated with not only the inability to find work but also with long travel times and periods of imprisonment by different armed groups (particularly in Libya).[8] Even if one works, it does not mean that one will be remunerated. Returned migrants report that it is not uncommon for employers to refuse to pay migrants for the work that they have performed. Once paid, migrants are vulnerable to being robbed by bandits, border guards, or by other migrants. While it is possible to avoid these problems and return with significant sums of money, it is much more likely to experience at least one of these problems (e.g. inability to find work, no remuneration for work, or theft of earnings).

4.2. Longitudinal trend in Trans-Saharan migration

At the time of the initial fieldwork, the district-wide prevalence of Saharan migration was low, very much centered among a relatively small number of communities that we sampled. The detailed migration histories collected from returned Saharan migrants provide an opportunity to reconstruct the growth of Saharan migration within these communities. Fig. 2 presents the number of the 66 interviewed returned Saharan migrants who were in North Africa during each quarter year from 2007 through the second quarter of 2017. This sample shows a rapid increase in the migration starting in the fourth quarter of 2012 with absences plateauing to around 35–40 individuals starting in 2015. This sample provides a sense of the growth of Saharan migration within the sampled communities.[9] The decline seen among returned migrants starting in 2016 is most likely due to the sample – returned Saharan migrants – which does not take into account new Saharan departures (Fig. 2). These data support the conclusion that Trans-Saharan emigration most likely rose rapidly starting in late 2012 and then stabilized from 2015 to 2017. Finally, while most likely an undercount due to the sensitivity of the information, the number of deaths in the Sahara reported in household interviews was eleven with those for which approximate dates of loss are known, all falling within the 2013–2016 period.[10]

This curvilinear trajectory of the incidence of Trans-Saharan migration is consistent with mixed changes in the prevalence of Trans-

[7] Data on the migration status of household members are consistent with lower labor migration rates among adult men once they become heads of households. Household heads represent 37 % of adult males across the 331 households but only represent 7 % of currently absent migrants and 47 % of returned migrants. This is consistent with young men being more actively involved in labor emigration before becoming heads of households.

[8] From migrant interviews, remittance rates and savings rates (FCFA/day) were calculated from reported remittances during the journey (of specified number of days) and cash carried back upon return by migrants to Saharan and SSA destinations. Remittance rates are quite similar (498 and 514 FCFA/day respectively) while Saharan migrants report higher savings rates than SSA migrants (689 and 427 FCFA/day.

[9] This estimate does not account for: 1. Saharan migrants who still remain in the Sahara (n=108); 2. Saharan migrants who have returned but since departed to SSA countries (unknown); 3. Saharan migrants who died in the Sahara. We expect that these deficiencies are likely to lead to an under-estimate of the rise seen across all household members since 2013.

[10] Eleven deaths represent 6.25 % of all household members who have returned from or are currently residing at Saharan destinations.

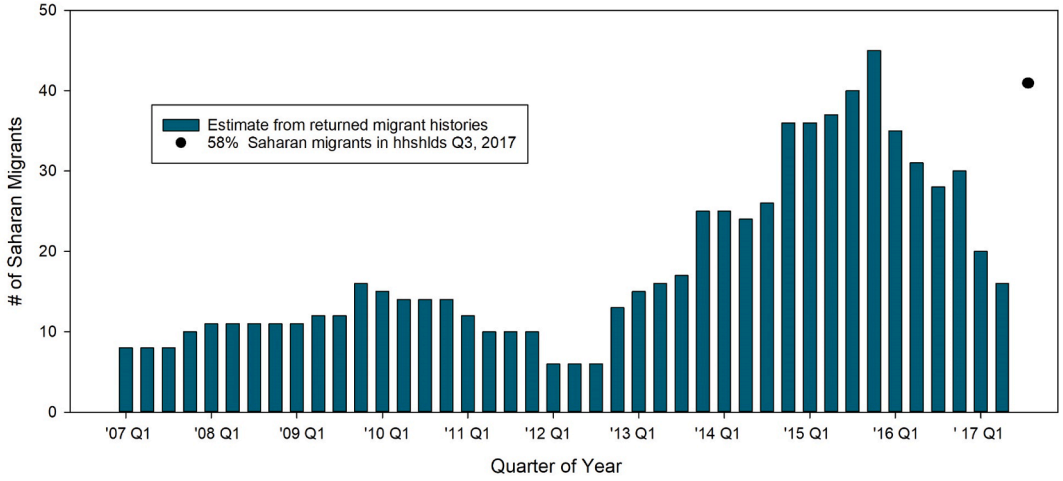

Fig. 2. Numbers of Saharan migrants absent from study households each quarter from the first quarter of 2007 through the third quarter of 2017 (bars). Absences among returned migrants were determined from detailed departure and return information provided by them for all of their Saharan trips. Since these data come from returned migrants and do not include migrants who have departed and not returned during the time period (average stays in North Africa average 2.6 years), absences are undercounted particularly later in the time series. Since interviewed returned migrants represent 58 % of all returned Saharan migrants within surveyed households, 58 % of absent migrants (indicated by black circle on graph) is an estimate of the Saharan absences at the time of fieldwork.

Saharan emigration since 2017 as reported by our informants in 2021. The averages of coded responses (−1 = decline, 0 = same, 1 = increase) were both 0 for the nine study communities and for the communes where they are located. Still, there does seem to be some geographical expansion of Saharan migration since 2017. Approximately a third (10) of the thirty-three unique neighboring villages, which had no Saharan migrants in 2017, now have young men who have travelled to the Sahara.

4.3. Trends in Trans-Saharan emigration in relation to changes in community-wide factors

To what extent does the emergence of Trans-Saharan migration within the study area match changes in broader factors experienced by most communities in the study area? Fig. 3 provides exchange rate and historical rainfall data at two sites within the study area (Fig. 1). A comparison of Figs. 2 and 3 shows that the increase of Trans-Saharan migration (2012–2016) does not reflect changes in exchange rates between Niger's currency (FCFA) and those of Algeria and Libya. Nor does the increase reflect changes in rainfall during the 2012–2016 period. In addition, agronomic and ecological work in the study area has found that productivity in the 2012–2016 period is not significantly lower than over the previous or subsequent five years (Hiernaux et al. 2021). Since 2017, while the incidence of Saharan migration has spread to surrounding villages, its overall prevalence has increased in some communities and declined in others with no net change in prevalence.[11] This is during a period of similar if not higher rainfall. We thus fail to uncover changes in rainfall or exchange rates concurrent with the rise of Saharan labor emigration in the study area.

To what extent are communities with Trans-Saharan households different from those without? Ethnic/caste compositions and arable land endowments of communities that showed early onset of Trans-Saharan emigration did not differ significantly from those of their neighbors nor with their commune as a whole. Two-level logistic regression analysis of Saharan migration incidence (in 2017 or 2021) on estimates of average land farmed by community households and levels of farming land quality found no significant relationships.

In sum, we find little evidence for recent rainfall variation in the study area being a straightforward explanation for the rise in Trans-Saharan emigration. Nor do the communities with early Trans-Saharan migrants differ significantly from surrounding communities in terms of their control of land (quantity or quality) or ethnic/caste composition. These findings suggest that social networks operating within and across villages as well as processes working at the household and sub-household levels as more likely explanations for Trans-Saharan migration participation.

4.4. Household economic insecurity and Trans-Saharan migration

Are poorer households within the study communities more likely to have members who choose Trans-Saharan emigration? Group interview data were used to assess the broad relationships of household wealth, livelihood and size in affecting the proclivity of household members to embark on Trans-Saharan emigration. As shown in Table 3, Trans-Saharan migration was statistically more prevalent among larger households and those categorized by informants as having medium levels of wealth. Involvement in livestock husbandry or commerce is not associated with the Saharan migration. These findings support the argument that members of households of higher wealth are less likely to embark on these dangerous journeys while those who are very poor do not have adequate funds needed at departure for travel to Saharan destinations (see Table 2).

Household-level surveys provide the basis for a more fine-grained analysis of how household economic security can affect decisions of its members to embark on Saharan journeys. Table 4 presents basic statistical parameters of four variables across Trans-Saharan migration status of households: 1. Those who have at least one member on Saharan migration; 2. Those without current Saharan absences but with returned Saharan migrants; and 3. All others. The four household economy variables provide measures of resource access (land endowment), economic vulnerability (debt), food self sufficiency (self provisioning) and measures taken by household indicative of food shortage (food insecurity). Self-provisioning rates span the whole range from 0 to 100 % of

[11] It should be noted that the 1990-to-present period has experienced higher rainfall, like the rest of the Sahelian region, compared to the previous two decades (1970–1989). It is true that the intra-seasonal distribution of rainfall is less ideal for crop agriculture with more of annual rainfall occurring in large rainfall events and rates of evapotranspiration being more elevated due to higher temperatures (Brandt et al., 2019). As measure of rainfall distribution, Fig. 3 shows the number of days with >3 mm of rainfall. A greater number of such days is consistent with a more even distribution of rainfall. As with total rainfall, we don't see any trends nor deviations when Trans-Saharan migration increased.

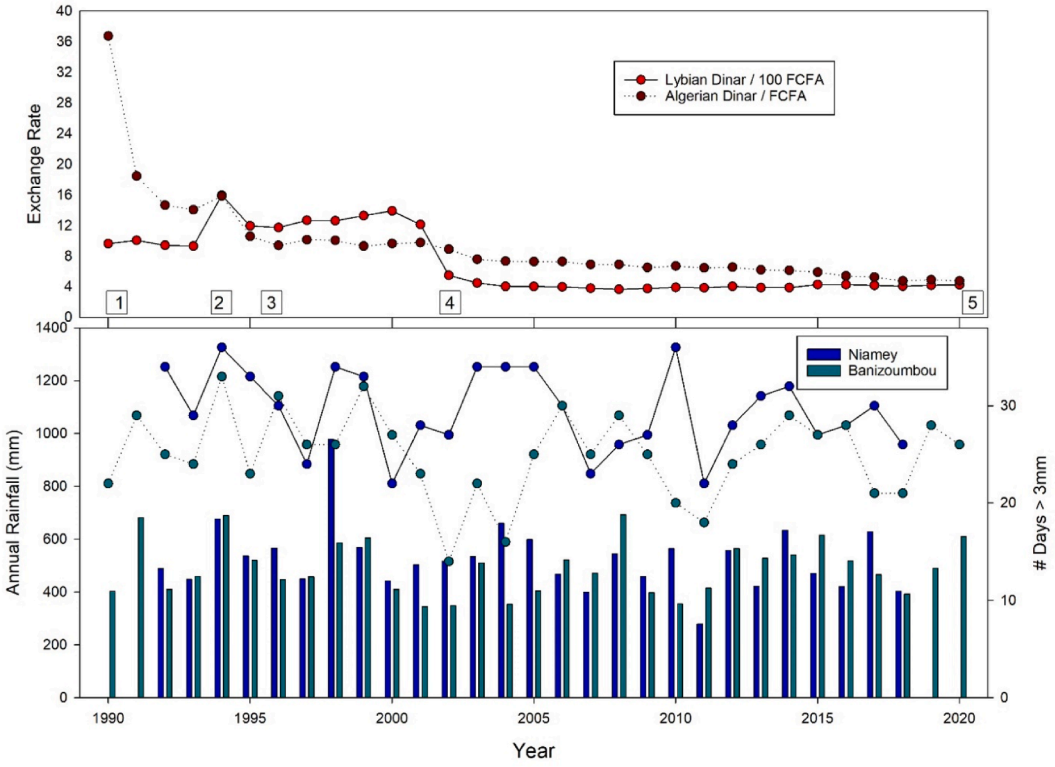

Fig. 3. Trends in exchange rates of Algerian and Libyan currencies (against the FCFA) and local annual rainfall (bars) and number of days with rain > 3 mm (symbols) at Niamey ORSTOM (1992–2018) and Banizoumbou (1990–2020) since 1990, a period with significantly higher rainfall than during the 1970s and 80s. Rainfall data was obtained from the Amma Catch database (https://bd.amma-catch.org/main.jsf). Codes (1–5) refer to key events in monetary policy that explain sudden changes in exchange rates.* Exchange rate data were obtained from the World Bak's Global Economic Monitor (https://databank.worldbank.org/source/global-economic-monitor-(gem)/). *1. 50 % devaluation of the Algerian Dinar in mid-1990; 2. 50 % devaluation of the FCFA against the French Franc on January 12, 1994; 3. Algerian Central bank adopted a managed floating exchange rate in 1996; 4. 50 % devaluation of the Libyan Dinar on January 1, 2002; and 5. devaluation of the Libyan Dinar on January 3, 2021.

household grain need with the average self-sufficiency rates across all Saharan migration categories being just under two thirds. This reflects the reality that despite the fact that households ubiquitously describe their major livelihood pursuit being crop agriculture, agriculture does not alone support households nutritionally. Off-farm income, such as migrant remittances, are generally insufficient to fully provide for harvest-deficient households with 50 to 75 % practicing some forms of consumption reduction to maintain grain stocks. Households with the Saharan migrants absent from the household show a higher prevalence of conducting at least some of these practices (approximately 75 % to 50 %) and a higher average reliance on these practices compared to other households (average of 35 % of five practices across two years compared to around 25 % for other households). This suggests that households are likely to suffer nutritionally during times when Saharan migrants are absent (especially before receiving remittances).

How variation in these measures of economic (in)security affect variation in current Saharan migration participation was evaluated through a two-level logistic regression of household participation in Saharan migration (0,1) on these household economy variables (Table 5). This analysis shows no significant effect of these variables on participation in Saharan migration (Household Economy Model) once controlling for the number of adult males in households. While not presented, the same lack of significant relationships was found with Trans-Saharan emigration experience (whether there are current or returned Saharan migrants in household) as the dependent variable.

4.5. Perceptions of livelihood constraints and Trans-Saharan emigration

Households may become involved in risky Saharan migration not solely due to their current economic situations but to a range of constraints on the longer-term persistence of their livelihoods. The degree to which these constraints are seen as difficult to surmount can lead to dangerous decisions. While not often made clear, those who call Trans-Saharan migrants 'climate refugees' are assuming that experiences of climate change have resulted in a sense of desperation and hopelessness driving West Africans northward. During household interviews, informants were asked to rank the importance of different livelihood activities in their support of household subsistence and for the two most important across all households, farming and livestock husbandry, the importance of different constraints to production. Table 6 presents the means of the normalized ranks for both activities and constraints. These data show that respondents view farming and to a lesser extent, livestock husbandry, as the two most important activities of the household economy. Other activities, including migration, rank low in supporting the household.

The relative importance of different biophysical and social constraints varies between farming and livestock husbandry with rainfall, soil fertility and access to capital being most important for farming while access to land and livestock disease being the most important constraints to livestock production. Weighted by the relative importance of these activities to household livelihoods, soil fertility and access to capital are viewed as the most important followed by rainfall (causing either drought or flooding). Given that these constraints are solely tied to farming and livestock husbandry, it is likely that if the constraints facing other household activities, such as commerce and migration, were included, the relative importance of access to capital and labor would increase. Despite understandings that changes in climate spur Trans-Saharan emigration, rainfall should best be seen as only one of several

Table 3
The relationship of the incidence of Trans-Saharan emigration within households with their size and wealth as reported by key informants in ten villages/neighborhoods. These relationships were assessed by a random intercept two-level logistic regression of village households' incidence of Saharan labor emigration on estimates of household size (number of members), wealth categories (poor, medium, rich), and livelihood pursuits (livestock rearing, commerce) with village as grouping variable (n = 10).[1] Robust standard error estimation was performed clustered by household. To aid interpretation, the null model (without fixed factors introduced) is presented. Coefficients and significance levels (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$) for fixed factors are listed in the first section while in the second section, the variance of random effect of community level, intraclass correlation, and log likelihood are presented.

	Null	Model
Intercept	−1.62***	−2.44***
Household Size (number of members)		0.08***
Household Wealth Category		
Middle		0.86***
Rich		0.01
Involved in livestock husbandry		0.09
Involved in commerce		−0.06
Community variance	0.34	0.43
Intraclass correlation (ICC)	0.09	0.08
Log likelihood	−445.1	−417.0
Wald chi^2		38.5***
N	1088	1069

[1] Except for livestock husbandry and commerce, other livelihood activities show little variation among households and therefore were not included in analysis. 96, 59, 6, and 2 % of households were described as being involved in crop agriculture, livestock husbandry, commerce, and artisanal pursuits in their home community.

constraints facing surveyed households.

Similar to the household economy variables, the effect of household perceptions of constraints to their livelihoods on their proclivity to embark on Saharan migration was assessed through two-level logistic regression. Table 5 presents the results of this analysis (Livelihood Constraint Model). Similar to the Household Economy Model, constraints to production were not found to significantly affect a household's current participation in Saharan migration once controlling for the number of adult males in the household. At least at the household level, variation in the perceptions of constraints, with quite different prospects for addressing them, are not found to explain variation in Saharan migration. This same regression was also performed with Trans-Saharan migration experience (current and returned Trans-Saharan migrants) as the dependent variable with very similar results.

These findings do not support arguments that current levels of economic insecurity or perceptions of production constraints explain the variation in Trans-Saharan emigration among households. At least at the level of the household, the number of the male adults within the household is found to be the only independent variable that is statistically related to Saharan migration with larger households more likely to be involved. Before discussing the implications of these results, we must consider the individual motivations of Saharan migrants.

4.6. Individual motivations for Saharan migration

Decisions to travel to the Sahara for work are motivated not only by the constraints to meeting household subsistence needs but also by migrants' concerns about their individual futures. First, we should note that the family and its immediate subsistence needs play an important role in supporting and motivating migrants to embark on Saharan migration. During our study, while we found expressions of concern by family members about the danger of such trips, we found little questioning of such decisions. Instead, migrants often gained financial support from extended family members for these trips with migrants seeking permission from and notifying family members of their decisions to depart (Table 2). Still, the relationship of poverty to Saharan migration decisions are complex with motivations, especially of young men, oscillating between the immediate subsistence needs of their families and income needed to marry and establish their own place in the world.

As shown in Table 2, most of the sixty-six returned Saharan migrants interviewed in this study were young men (average 26 years) of mixed marital status (53 % married) when they first left for the Sahara. When interviewed, 91 % were married and 59 % were heads of households.[12] Therefore, the experience of Saharan migration falls for many within the transition period culminating in marriage and for some, the establishment of a separate household. This is consistent with testimony from returned migrants of the economic possibilities that the higher daily rates of remuneration in North Africa could provide and how that income could be used to marry and gain greater autonomy from fathers or older brothers.

Table 4
Household land endowment, debt levels, self provisioning and food insecurity among households with Saharan migrants who are currently absent (CM), with only those who have returned (RM) and all others (No). Reported extent of land farmed and sum of current debts held by households are expressed on a per adult basis. Self provisioning is the fraction of household consumption needs provided by 2015 and 2016 grain harvests. Measure of food insecurity is the fraction of the total range of consumption reduction behaviors practiced by households in 2015 and 2016. Sample sizes (n), maximums (Max), minimums (Min), means, coefficients of variation (CV), medians (Med), % of values equal to 0 (%0), and for the fractional values % of values equal to 1 (%1) are provided.

	Land (HA/adult)			Debt (FCFA/adult)			Self Provisioning			Food Insecurity		
	CM	RM	No	CM	RM	No	CM	RM	No	CM	RM	No
Max	3.00	4.00	5.20	52,500	75,000	66,667	1.00	1.00	1.00	1.00	1.00	1.00
Min	0.22	0.00	0.00	0	0	0	0.04	0.04	0.00	0.00	0.00	0.00
Mean	0.98	1.31	1.34	4631	5410	6163	0.64	0.65	0.65	0.35	0.22	0.27
Med	0.83	1.12	1.00	0	0	0	0.63	0.67	0.67	0.20	0.15	0.10
CV	0.63	0.65	0.83	2.33	2.09	2.09	0.35	0.36	0.37	0.93	1.25	1.24
%0	0.00	2.22	1.70	68.25	61.54	66.09	0.00	0.00	0.56	25.81	43.33	46.59
%1							9.52	10.99	11.30	9.68	4.44	6.82
N	63	90	176	63	91	174	63	91	177	62	90	176

[12] Within the study area, households are defined as the social unit that controls cropped fields. These often include multiple nuclear families including those of fathers, sons, and brothers. Of the sixty-six returned migrants, the average age of those who are or are not household heads is 34 and 28 years respectively.

Table 5
The results of two-level logistic regression analyses of Saharan migration within household (0,1) on: 1. household economy parameters; and 2. normalized ranks of informants' assessments of the importance of agricultural and livestock husbandry constraints/barriers to their livelihoods with level-2 grouping variable equal to the household's community (village/neighborhood). Independent fixed factors in the household economy model include the fraction of two years of food need provided by household harvests (FracHHNeed), food insecurity index, household land per adult member, household debt per adult member, and number of adult males in the household. Normalized rank constraints to crop agriculture and livestock husbandry were independent factors along with the number of adult males in the household. Robust standard error estimation was used, clustered on community. In the first section of the table, the coefficients of fixed factors included in each model are presented with their significance levels. In the second section, variance and ICC for the community random effect are presented. In the third section, general model parameters are presented along with the overall significance level of the model (tied to Wald chi^2).

	Household Economy Model[1]		Livelihood Constraint Model[1]	
Fixed Factors				
NR Lvlhd Constraint: Rainfall			0.13	
NR Lvlhd Constraint: Soil Fertility			−0.16	
NR Lvlhd Constraint: Pests/Disease			−0.92	
NR Lvlhd Constraint: Capital			−0.36	
NR Lvlhd Constraint: Land			−1.79	
NR Lvlhd Constraint: Labor			0.34	
Self Sufficiency	0.25			
Food Insecurity Index	0.22			
Land per Adult (HAs)	−0.14			
Debt per Adult (10,000 FCFA)	−0.03			
Adult Males	0.46***		0.53***	
Constant	0.02		−3.37***	
Random Effect	**Variance**	**ICC**	**Variance**	**ICC**
Community (n = 10)	0.93	0.22	0.76	0.19
Model Parameters				
Log pseudolikelihood	−120.85		−121.9	
Wald chi2	100***		139***	
N	323		329	

[1] Significance levels: *< 0.05, **<0.01, ***<0.001.

The underlying motivations for embarking on Trans-Saharan emigration were discussed with each of the sixty-six returned Trans-Saharan migrant informants. Motivations expressed were often multiple and were coded into four general themes. The first is simply a reference to poverty and the need to make money ([poverty]). The second is the need to support the food needs of their family ([family]). The third refers to the need to make large amounts of money necessary for investments such as building a house, buying land, or starting a business ([investment]). The fourth are expressions of the lack of productive work, hopelessness and the inability to apply their efforts effectively in their home village ([lack work]). Testimony from a single informant could be coded with multiple theme codes. Table 7 reports the results of two-way frequency analyses among these four measures and with marriage status [Married]. There is a cluster of two motivations ([Poverty], [Family]) with married status [Married] that are all positively associated. Thus, married men are more likely to refer to general conditions of poverty and the need to support the food needs of family. [Lack of Work] and [Investment] motivations are not significantly related to marriage status but are negatively associated with the other two motivation categories. While all migrants undoubtedly are motivated by both food security for the family and interests directed at the individual's future, these findings suggest at least two groups of respondents weigh individual and family concerns differently.

5. Discussion

In this study, we have taken the prospect of climate- and/or poverty-induced Trans-Saharan emigration seriously. The study area has experienced a long period of recurrent drought (1970–1995) and a

Table 7
Results of two-way frequency analyses among stated motivations to embark on Trans-Saharan migration by interviewed returned migrants (n = 66). Pearson chi-square value is presented with significance value (*<=0.05, *<=0.01) along with the direction of the significant relationships determined by a comparison between observed and expected frequencies. Responses to an open-ended question about motivation were coded based four categories (multiple categories allowed per response) including: general condition of poverty and need of money (poverty, n = 59); to address food insecurity of family (Family, n = 31); the need to accumulate wealth for significant investments (Investment, n = 40); and the lack of work and hopelessness for the future at home (Lack of Work, n = 33). Two-way frequency analysis of each of these motivation categories and marriage status variable (Married) is also presented.

	Married	Poverty	Family	Investment
Poverty	6.0* (+)			
Family	4.7* (+)	6.9** (+)		
Investment	0.9	5.1*(−)	8.5**(−)	
Lack of Work	0.4	4.0*(−)	4.9* (−)	2.3

Table 6
The relative importance of different livelihood activities and of constraints to agriculture and livestock husbandry. Mean normalized ranks (NR) of livelihood activities in their importance in supporting 331 surveyed households are presented in the second column. For the two most important activities, crop agriculture and livestock husbandry, the mean normalized ranks of constraints to these activities are presented in the upper-right quadrant of the table. The normalized product (sum to 1) of these constraints multiplied by the relative importance of crop agriculture and livestock husbandry for the household are presented in the third row.

Livelihood activities importance in supporting household		NRs of Constraints to Agriculture and Livestock Husbandry						
Activity	NR	Rainfall	Soil Fertility	Pests/ Disease	Capital	Land	Labor	Poverty
Agriculture (rain-fed, gardens, irrigated rice)	0.93	0.35	0.40	0.09	0.36	0.11	0.17	0.07
Livestock rearing	0.37	0.07	0.10	0.30	0.09	0.63	0.07	0.09
Constraints weighted by NR of agriculture and livestock husbandry		0.19	0.26	0.05	0.26	0.07	0.11	0.04
		Description of Other Activities						
Internal Migration	0.06	Labor migration to destinations within Niger						
SSA Migration	0.15	Labor migration to other Sub-Saharan African countries						
Saharan Migration	0.06	Saharan labor migration						
Commerce	0.08	Includes petty commerce, livestock trading, store owner, non-manual wage occupations						
Manual Labor	0.14	Includes manual labor, transport, artisanal activities, mechanic, wood cutting, and other wage labor						
Other	0.01	Other activities including fishing						

subsequent period of increased, but poorly distributed annual rainfall. Rural poverty is also ubiquitous. Thus, climate and poverty play a role in all decisions made by rural smallholders. Still, we sought to go beyond simply identifying these broad conditions as causes and analyze the particular experiences of communities, households, and individuals that lead some to make the dangerous decisions to embark on Trans-Saharan migration. Our view is that to simply point to the general conditions that have existed in the Sahel for decades as "causes" does little to understand the difficult decisions people face. What is interesting and useful is what explains the temporal variations in migration flows and what explains why some choose to participate in Trans-Saharan migration and others do not. To answer these questions, one must seriously grapple with the causal nexus that surrounds migration decisions.

We addressed this analytical problem by taking a multi-level approach (individual, household, community) to better understand the recent onset of Trans-Saharan migration in southwestern Niger. We reconstructed the growth of Trans-Saharan migration and related it to rainfall trends. We asked migrant and non-migrant families about the importance of rainfall as a productive constraint relative to other factors. We find no evidence that timing of the northward shift in emigration from southwestern Niger is related to contemporary rainfall patterns. Nor is rainfall seen as a more important constraint for migrating households than for others. In short, contemporary weather does not explain Trans-Saharan migration consistent with the findings of other local studies (e.g. Grace et al., 2018).

We compared the communities and households within communities who have first embarked on Trans-Saharan migration with those that did not. Communities where Trans-Saharan emigration first developed are not significantly poorer in terms of land endowment nor are they composed of ethnic/caste groups different from those of surrounding villages. The current food security situation of households does not explain variation in the prevalence of Trans-Saharan emigration among surveyed households. Using a less detailed and accurate data set derived from group interviews, we find that those households categorized as having intermediate levels of wealth to more likely participate in Trans-Saharan migration. This is consistent with previous work that has found that the poorest households are less likely to be involved in labor emigration (Hampshire, 2002) and more broadly, with the aspiration and ability framework (Carling and Schewel, 2018).

Our most robust finding was that Trans-Saharan emigration was statistically more common among households with greater numbers of adult men. This finding supports arguments that household nutritional and labor needs play an important role in migration decisions. This conclusion is also supported by our findings that a major motivation to migrate is to support the subsistence needs of families as well as how common it is for migrants to not only notify but ask permission and advice from other family members to leave (Table 2). The strong role of the family in migration decisions is consistent with previous findings (Piquet, 2018; van Hear et al., 2018) and supports the arguments for multi-level causal analysis (Romankiewicz and Doevenspeck, 2015).

This study demonstrates the diversity of peoples' views of the constraints to their livelihoods and the complexity of their experiences of poverty (Vigil, 2017). A major topic raised by migrants in our discussions with them was their little hope for a future at home. They face not only biophysical (soil fertility and rainfall) but political economic constraints working at the household, community and regional levels. The erosion of their hope to find remunerative work is not shaped by assessments of recent economic or biophysical declines but from decades of struggle. Informant statements, particularly in the Say Department, point the limited prospect of gaining sufficient land to support their autonomy from fathers and older brothers once they are married. This is due not only to declining soil fertility levels but to the purchasing of land by Niamey-based elites (Turner et al., 2021). One interpretation of our robust finding that households with more adult male members are more likely to participate in Trans-Saharan emigration is that they have an excess labor supply in search of opportunity – thus emigrating north. Alternatively, it also suggests that the conditions within corporate households with multiple brothers may spur dangerous travel as a chance to gain the financial resources to break away from age-based hierarchies. Unfortunately, we did not collect sufficient data to characterize household structures and Trans-Saharan emigrants' positions within these structures, but statements by migrants suggest research to further evaluate this hypothesis is needed.

As described, most Trans-Saharan emigrants already have prior migration experience to other SSA countries before they first depart for North Africa (Table 2). Their work there is dominated by petty commerce which is remunerated through a commission on sales made and therefore is often not very remunerative (due to market saturation) and is precarious. The variation in the savings rate experienced in SSA countries is higher than in North Africa. Moreover, our informants point not solely to the differences in the remuneration for work at the two destinations, but also to the nature of the work performed. We do not find large differences in the net remuneration[7] but we do find large differences in the nature of work between Saharan and Sub-Saharan destinations. Selling items that thousands of other street vendors are selling is not seen as satisfying since your labor is not producing anything and you have limited opportunities to learn. Despite the trauma many experienced in North Africa, with most all saying that they would not return unless conditions changed, returned migrants ubiquitously mention that they value the fact that their work was productive and they had the opportunity to learn about agricultural and construction techniques as laborers. We were surprised when they and other community members raised the point that migrants return with new ideas about work. Despite living in near slavery conditions in North Africa, the fact that they could see their labor produce something tangible made a strong impression on our informants, giving them some hope. In short, the "driver" of Trans-Saharan emigration is more a search by young men for learning, dignity, meaning, autonomy and purpose in their lives than it is about drought, mean temperatures, and measures of poverty.

More broadly, this study points to the need for new methodological approaches appropriate for arid regions such as the Sahel where production-relevant climatic variability has always been common, subsistence crisis is often felt, and migration is long-standing. Event-driven climate triggers, methodological foci of both qualitative and quantitative studies, may help understand interannual patterns of rural-to-urban human mobility but are much less useful for understanding the far more consequential decisions to embark on dangerous voyages through the Sahara. We have found that these decisions are less driven by current weather conditions than by longer-term material conditions (biophysical and social) that have led to hopelessness among young people. More place-based, multi-level, mixed methods research is needed to better capture human material experience, as shaped by biophysical and social conditions over time, to better understand the consequential decisions made by rural residents seeking hopeful futures. While correlative studies dominate climate migration studies in the Sahel (Brüning and Piguet, 2018), it is important to investigate the complex question of climate-induced migration from multiple analytical/methodological frames (Cottier et al., 2022).

6. Conclusions

This research was designed to better understand the underlying reasons for the increase of the Trans-Saharan migration from southwestern Niger. The effects of climate change and general conditions of poverty are ubiquitous in the study area and region and are thus necessarily behind the decisions of largely young men to embark on these dangerous voyages. Still, our place-based multi-level research has shown that contemporary measures of rainfall, wealth or food security do not explain the consequential decisions to cross the desert in search of work. To suggest that Trans-Saharan migration is driven by contemporary triggers or the calculation of economic return denies migrants' everyday human experiences, aspirations and consequent life decisions.

The experiences that are pushing them transcend here-and-now measures of rainfall and poverty and instead relate to longer-term experiences of poverty and climate over their lifetimes and their hopes, despite their generally bleak situations, for a better future. As a result, their quest to break out of the grinding poverty they have experienced since their births, shaped not only by climate but political-economic history, is a calculated risk where staying home or being a street vendor is not seen as an option many of them can live with.

CRediT authorship contribution statement

Matthew D. Turner: Conceptualization, Investigation, Supervision, Formal analysis, Methodology, Writing - original draft, Writing - review & editing. **Soumaila Abdoulaye Sambo:** Investigation, Supervision, Project administration, Methodology. **Jesse Ribot:** Conceptualization, Funding acquisition, Methodology, Writing - review & editing. **Papa Faye:** Conceptualization, Project administration, Methodology.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Acknowledgements

This research was supported by a grant from Swedish International Centre for Local Democracy. Field research was coordinated by the Groupe de Recherche, d'Etudes et d'Action pour le Développement (Niamey, Niger) with research assistance provided by Oumarou Moumouni and Adamou Harouna Zamno. We very much thank migrants, their families and the members of their communities for the patience and openness they showed in responding to our questions.

References

Afifi, T., 2011. Economic or environmental migration? The push factors in Niger International Migration 49, 95–124.
Alessandrini, A., Ghio, D., Migali, S., 2021. Population Dynamics, Climate Change and Variability in Western Africa: The Case of Sahel Regions. Joint Research Center of the European Union, Ispra, Italy.
Argos Collectif, 2010. Climate Refugees. MIT Press, Cambridge.
Barrett, C., Smith, K., Box, P., 2001. Not necessarily in the same boat: heterogeneous risk assessment among East African pastoralists. J. Dev. Stud. 37 (5), 1–30.
Benattia, T., Armitano, F., Robinson, H., 2015. Irregular Migration between West Africa, North Africa and the Mediterranean. Altai Consulting for IOM Nigeria, Abuja.
Bertoli, S., Docquier, F., Rapoport, H., Ruyssen, I., 2020. Weather shocks and migration intentions in Western Africa: Insights from a multilevel analysis CESifo Working Paper Series 8064. CESifo 2020 Munich.
Biasutti, M., 2019. Rainfall trends in the African Sahel: Characteristics, processes, and causes. WIREs Clim. Change 10, e591.
Black, R., Bennett, S.R.G., Thomas, S.M., Beddington, J.R., 2011. Migration as adaptation. Nature 478 (7370), 447–449.
Borderon, M., Sakdapolrak, P., Muttarak, R., Kebede, E., Pagogna, R., Sporer, E., 2019. Migration influenced by environmental change in Africa: A systematic review of empirical evidence. Demogr. Res. 41, 491–544.
Brachet, J., 2012. Movements of People and Goods: Local Impacts and Dynamics of Migration to and through the Central Sahara. Indiana University Press, Bloomington, Indiana.
Brachet, J., 2018. Manufacturing smugglers: From irregular to clandestine mobility in the Sahara. Ann. Am. Acad. Polit. Soc. Sci. 676 (1), 16–35.
Brandt, M., Hiernaux, P., Rasmussen, K., Tucker, C.J., Wigneron, J.-P., Diouf, A.A., Herrmann, S.M., Zhang, W., Kergoat, L., Mbow, C., Abel, C., Auda, Y., Fensholt, R., 2019. Changes in rainfall distribution promote woody foliage production in the Sahel. Commun. Biol. 13, 1.
Brüning, L., Piguet, E., 2018. Changements environnementaux et migration en Afrique de l'Ouest. Une revue des études de cas. BELGEO 1/2018, 1-26. http://journals.openedition.org/belgeo/28836.
Carling, J., Schewel, K., 2018. Revisiting aspiration and ability in international migration. J. Ethn. Migr. Stud. 44 (6), 945–963.
Cottier, F., Flahaux, M.-L., Ribot, J., Seager, R., Ssekajja, G., 2022. Framing the frame: Cause and effect in climate-related migration. World Development 158, 106016.
Danish Refugee Council, 2016. Mixed Migration in the Horn of Africa and Yemen Region, Monthy Report. Mixed Migration Monitoring Mechanism Initiative June 2016 Nairobi Kenya https://reliefweb.int/sites/reliefweb.int/files/resources/4mi_Mixed_Migration_Monthly_Summary_June_2016.pdf.
Dardel, C., Kergoat, L., Hiernaux, P., Mougin, E., Grippa, M., Tucker, C.J., 2014. Re-greening Sahel: 30 years of remote sensing data and field observations (Mali, Niger). Remote Sens. Environ. 140, 350–364.
Diarra, F.-A., 1974. Les relations entre les hommes et les femmes et les migrations des Zarma. In: Amin, S. (Ed.), Modern Migrations in Western Africa. Oxford University Press, London, pp. 226–238.
Elliott, L., 2019. Global warming could create greater migratory pressure from Africa. The Guardian April, 11, 2019.
Findley, S.E., 1994. Does drought increase migration? A study of migration from rural Mali during the 1983–1985 drought. Int. Migr. Rev. 28 (3), 539.
Friedman, T.L., 2016. Out of Africa, The New York Times. April 13, 2016.
Gonin, P., Lassailly-Jacob, V., 2002. Les réfugiés de l'environnement: Une nouvelle catégorie de migrants forcés ? Rev. Eur. Migr. Int. 18, 139–160.
Grace, K., Hertrich, V., Singare, D., Husak, G., 2018. Examining rural Sahelian out-migration in the context of climate change: An analysis of the linkages between rainfall and out-migration in two Malian villages from 1981 to 2009. World Dev. 109, 187–196.
Gray, C., Wise, E., 2016. Country-specific effects of climate variability on human migration. Clim. Change 135 (3-4), 555–568.
Grolle, J., 2015. Historical case studies of famines and migrations in the West African Sahel and their possible relevance now and in the future. Popul. Environ. 37 (2), 181–206.
Grote, U., Warner, K., 2010. Environmental change and migration in Sub-Saharan Africa. Int. J. Glob. Warming 2, 17–47.
Hampshire, K., 2002. Fulani on the move: Seasonal economic migration in the Sahel as a social process. J. Dev. Stud. 38 (5), 15–36.
Henry, S., Schoumaker, B., Beauchemin, C., 2003. The impact of rainfall on the first out-migration: a multi-level event-history analysis in Burkina Faso. Popul. Environ. 25 (5), 423–460.
Hiernaux, P., Kalilou, A.A., Seybou, G., Alzouma, Y.Y., Issoufou, H.-B.-A., 2021. Compte rendu des observations et mesures de végétation dans la commune de Dantchandou au Niger du 7 au 31 Octobre 2021. Amma-Catch, Niamey, Niger.
Kaplan, R.D., 1994. The coming anarchy. The Atlantic Monthly February, pp. 44–76.
Laczko, F., Aghazarm, C., 2009. Migration, Environment and Climate Change: Assessing the Evidence. International Organization for Migration, Geneva.
Lucht, H., 2017. European anti-migration agenda could challenge stability in Niger. Danish Institute for International Studies (DIIS), København, Denmark. June 19, 2017.
Lustgarten, A., 2020. The great climate migration. New York Times Magazine. July 23, 2020.
Malakooti, A., Benattia, T., 2013. Mixed Migration: Libya at the Crossroads. Mapping of Migration Routes from Africa to Europe and Drivers of Migration in Post-revolution Libya, UNHCR, Tripoli.
McCormick, T., Sobecki, N., Tinti, P., Filipovic, J., Abadi, C., 2017. Europe slams its gates: Imperiling Africa - and its own soul, Foreign Policy. http://europeslamsitsgates. foreignpolicy.com/intro-0–intro.
Miles, T., Nebehay, S., 2017. Migrant deaths in the Sahara likely twice Mediterranean toll: U.N., Reuters, London. October 12, 2017.
Miller, T., 2017. Storming the Wall. Climate change, migration, and homeland security. City Lights Books, San Francisco, CA.
Molenaar, F., El-Kamouni-Janssen, F., 2017. Turning the Tide: The Politics of Irregular Migration in the Sahel and Libya. Institute of International Relations, Clingendael, Netherlands.
Mounkaila, H., 2002. De la migration circulaire à l'abandon du territoire local dans le Zarmaganda (Niger). Rev. Eur. Migr. Int. 18, 1–23.
Nawrotzki, R.J., Bakhtsiyarava, M., 2017. International climate migration: evidence for the climate inhibitor mechanism and the agricultural pathway. Popul. Space Place 23 (4), e2033.
Neumann, K., Sietz, D., Hilderink, H., Janssen, P., Kok, M., van Dijk, H., 2015. Environmental drivers of human migration in drylands – a spatial picture. Appl. Geogr. 56, 116–126.
Nicholson, S., 2005. On the question of the "recovery" of the rains in the West African Sahel. J. Arid Environ. 63 (3), 615–641.
Olsson, L., Eklundh, L., Ardö, J., 2005. A recent greening of the Sahel-trends, patterns and potential causes. J. Arid Environ. 63 (3), 556–566.
Ouedraogo, D., 2009. Chapter 5. Migration and population in West Africa: Political issues and perspectives. In: OECD/SWAC (Ed.), Regional Challenges of West African Migration: African and European Perspectives. OECD Publishing, Paris, pp. 128–142.
Ozer, P., Laminou Manzo, O., Tidjani, A.D., Djaby, B., De Longueville, F., 2017. Evolution récente des extrêmes pluviométriques au Niger (1950–2014). Geo-Eco-Trop 41, 375–384.
Painter, T.M., 1986. Peasant migrations and rural transformations in Niger: a study of incorporation within a West African capitalist regional economy c. 1875 to c. 1982. Doctoral Dissertation. University of New York at Binghamton.
Piquet, E., 2018. Theories of voluntary and forced migration. In: McLeman, R., Gemenne, F. (Eds.), Routledge Handbook of Environmental Displacement and Migration. Routledge Press, New York, pp. 17–28.
Rain, D., 1999. Eaters of the Dry Season. CIrcular Labor Migration in the West African Sahel. Westview Press, Boulder, Colorado.

Rasmussen, K., D'haen, S., Fensholt, R., Fog, B., Horion, S., Nielsen, J.O., Rasmussen, L. V., Reenberg, A., 2016. Environmental change in the Sahel: reconciling contrasting evidence and interpretations. Reg. Environ. Chang. 16 (3), 673–680.

REACH Initiative, 2018. Mixed Migration in Libya. The United Nations Refugee Agency Geneva, Switzerland.

Reenberg, A., 2012. Insistent dryland narratives: portraits of knowledge about human-environmental interactions in Sahelian environment policy documents. West Afr. J. Appl. Ecol. 20, 97–111.

Reitano, T., Tinti, P., 2015. Survive and advance-the economics of smuggling refugees and migrants into Europe. Institute for Security Studies Papers 2015, 32.

Ribot, J., 2014. Cause and response: vulnerability and climate in the anthropocene. J. Peasant Stud. 41 (5), 667–705.

Ribot, J.C., Peluso, N.L., 2003. A theory of access. Rural. Sociol. 68, 153–181.

Ribot, J.C., Faye, P., Turner, M.D., 2020. Climate of anxiety in the Sahel: emigration in xenophobic times. Publ. Cult. 32, 45–75.

Rigaud, K.K., de Sherbinin, A., Jones, B., Adamo, S., Maleki, D., Abu-Ata, N.E., Casals Fernandez, A.T., Arora, A., Chai-Onn, T., Mills, B., 2021. Groundswell Africa: Internal Climate Migration in West African Countries. World Bank Group, Washington, D.C.

Roberts, P., 1989. The sexual politics of labour in Western Nigeria and Hausa Niger. In: Young, K. (Ed.), Serving Two Masters: Third World Women in Development. Allied Publishers, New Delhi, pp. 27–47.

Romankiewicz, C., Doevenspeck, M., 2015. Climate and mobility in the West African Sahel: Conceptualising the local dimensions of the environment and migration nexus. In: Greschke, H., Tischler, J. (Eds.), Grounding Global Climate Change. Springer, Dordrecht, Netherlands, pp. 79–100.

Sudarkasa, N., 1977. Women and migration in contemporary West Africa. Signs 3 (1), 178–189.

Turner, M.D., 2016. Climate vulnerability as a relational concept. Geoforum 68, 29–38.

Turner, M.D., Carney, T., Lawler, L., Reynolds, J., Kelly, L., Teague, M.S., Brottem, L., 2021. Environmental rehabilitation and the vulnerability of the poor: The case of the Great Green Wall. Land Use Policy 111, 105750.

van der Land, V., Romankiewicz, C., van der Geest, K., 2018. Environmental change and migration: A review of West African case studies. In: McLeman, R., Gemenne, F. (Eds.), Routledge Handbook of Environmental Displacement and Migration. Routledge Press, New York, pp. 163–177.

Van Hear, N., Bakewell, O., Long, K., 2018. Push-pull plus: reconsidering the drivers of migration. J. Ethnic Migrat. Stud. 44 (6), 927–944.

Vigil, S., 2017. Climate change and migration: Insights from the Sahel. In: Carbone, G. (Ed.), Out of Africa: Why People Migrate. ISPI, Milan, pp. 51–71.

Zampaligré, N., Dossa, L.H., Schlecht, E., 2014. Climate change and variability: perception and adaptation strategies of pastoralists and agro-pastoralists across different zones of Burkina Faso. Reg. Environ. Chang. 14 (2), 769–783.