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ORIGINAL ARTICLE

Perceived changes in daily life complement perceived environmental change in shaping adaptation to environmental change: case study in Senegal

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Abstract

This research develops a new conceptual framework to improve the understanding of adaptation to environmental change, based on farmers' and pastoralists' perceptions of both environmental change and change in daily life. A case study in rural Senegal provides a first evaluation of the framework's relevance. The added value of including perceptions of change in daily life alongside perceptions of environmental change is assessed through logistic regression models exploring links with three types of adaptation strategies: migration, crop-related and livestock-related. Model performance is evaluated using McFadden's adjusted R^2 and the Akaike Information Criterion (AIC). Results show that models combining both types of perception consistently outperform environmental-only models, with McFadden's R^2 increasing from 0.07 to 0.11 to 0.16 for migration, from 0.27 to 0.31 for crop adaptation, and from 0.05 to 0.11 for livestock adaptation, alongside systematic AIC reductions exceeding the two-point threshold. Including perceptions of change in daily life therefore improves explanatory power and provides complementary insights into adaptation intentions. These findings suggest that it is beneficial to consider both types of perception when studying adaptation to environmental change.

Keywords Perceptions · Daily life · Environmental change · Adaptation intention · Migration

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Introduction

Many regions are affected by climate change and its consequences, including sea level rise, desertification, and coastal erosion. Populations respond to these changes in diverse ways, depending on their location, economic activities, available resources, and socio-cultural factors (Nielsen and Reenberg 2010). Among the most vulnerable are those who rely on rain-fed agriculture or pastoralism, as their livelihoods are highly dependent on weather conditions (Juana et al. 2013). In this context, Western Africa – particularly Senegal – deserves continued attention, as it is already experiencing significant climate impacts and is expected to face further challenges (De Longueville et al. 2016; Van der Land et al. 2018). In addition, agriculture remains a key sector in the region's economy, and most rural populations depend directly on the natural environment (Mertz et al. 2011).

Environmental changes in Western Africa and Senegal, both past and projected, require local populations to adapt. Akinnagbe and Irohibe (2014), in their review of African adaptation strategies, identify three main categories: crop adaptation, livestock adaptation, and other strategies such as migration and income diversification. However, for adaptation to occur, Abid et al. (2019) emphasize two preliminary steps: perceiving environmental change and forming an intention to adapt.

The study of environmental perceptions faces two key limitations. First, responses may be influenced by social desirability, as individuals tend to align their answers with socially accepted norms (Félonneau and Becker 2008). Second, research shows that when not explicitly asked about the environment, individuals rarely cite it as a driver of adaptation (e.g. Koubi et al. 2016; Morrissey 2012; Warner 2011). This suggests that environmental change often influences people indirectly—by altering other aspects of their lives that, in turn, guide the adaptation strategies they choose to pursue.

To address these limitations, the present study does not introduce a new concept per se but rather synthesizes and formalizes an emerging idea in the literature—the notion of perceived change in daily life—as a complement to perceived environmental change. This notion builds on studies of everyday adaptation (Castro and Sen 2022) and on research examining how households perceive climate-related impacts (e.g., Adger et al. 2013; Grothmann et al. 2013), yet has not been explicitly framed within adaptation research. This approach is consistent with studies documenting how households perceive climate-related impacts in terms of changes to their living conditions, livelihoods and wellbeing (e.g. Poudel et al. 2017; Kothari and Arnall 2019; Asante et al. 2021; Cuni-Sanchez et al. 2025). Perception of environmental change refers to how individuals interpret and assess changes in climatic conditions such as rainfall, temperature, and wind over time, while perceived change in daily life refers to how individuals subjectively experience and interpret changes in their everyday routines, livelihoods, and social relations that stem – directly or indirectly – from environmental transformations (Castro and Sen 2022). It encompasses dimensions such as economic stability, access to basic resources, social cohesion, and overall quality of life (Keles 2012; Prabhugaonkar 2025). For agricultural households, this includes factors like land accessibility, soil fertility, and household expenditures. By focusing on daily life rather than abstract environmental variables, this perspec-

tive captures the ways people perceive changes in their living conditions — such as shifts in food security, workload, mobility, or expenses. These perceptions are crucial, as adaptive responses are often triggered not by climate metrics, but by the felt impact of those changes on daily life (Adger et al. 2013; Grothmann et al. 2013). Thus, it is expected that perception of change in daily life is more tangible to the population, resulting in more reliable answers. A recent study by Castro and Sen (2022) theorizing climate change adaptation in daily life started to confirm the importance of considering the daily life and developed a classification in the logics of everyday adaptation highlighting the relevance of this studies approach.

The present study focuses on adaptation intentions — defined as the stated willingness or plan of individuals or households to implement measures in response to perceived environmental changes. While not all intentions lead to actual adaptation (Grothmann and Patt 2005), they are considered reliable indicators of future behavior (e.g.: Fielding et al. 2008). Studying intentions offers a key advantage: the population is still living in the affected area, allowing for more accurate and timely perceptions. For this reason, adaptation intentions are analyzed using data from the African Monsoon Multidisciplinary Analysis (AMMA) database, which enables exploration of the link between perceptions and intended adaptation strategies.

The aims of this study are threefold. First, it evaluates the added value of including perceptions of change in daily life when studying adaptation intentions. Second, it distinguishes between short-term and long-term adaptation measures – short-term responses to a single drought season, and long-term responses to projected permanent aridification. Third, it explores three categories of adaptation intentions: migration, crop adaptation, and livestock adaptation.

Conceptual framework

Adaptation to environmental change: an overview of current frameworks

There is a well-established body of literature exploring how communities adapt to environmental change (e.g. Adger et al. 2003; Nelson et al. 2007; Mertz et al. 2009a; O'Brien et al. 2012), with a particular emphasis on migration as a key adaptation strategy (e.g. Vinke et al. 2020; Gemenne and Blocher 2017; Yamamoto and Esteban 2017; Maharjan et al. 2020). Many scholars have been intrigued by the question of why some individuals choose to migrate while others stay when confronted with the same hazards (e.g. De Groot et al. 2011; Adams 2016), and this has motivated further research into the influence of various factors (e.g. Henry et al. 2003; Van der Land 2015; Borderon et al. 2019; Priovashini and Mallick 2022; Mallick et al. 2023; Wolde et al. 2023).

Perch-Nielsen et al. (2008) analyzed the impact of sea-level rise as well as river and coastal floods against the broader backdrop of household strategies. Drawing on evidence from multiple case studies, they developed a conceptual model on adaptation in the face of environmental hazards. It highlights that communities have a wide range of adaptation options, including migration. For instance, farmers experiencing declining rainfall can shift to more drought-resistant crops, invest in irrigation infra-

structure, or implement soil fertility enhancement measures. Although floods are usually temporary and therefore less likely to cause large-scale population migrations, sea-level rise poses more severe and long-lasting risks due to its potential for permanent land loss. Taking this perspective further, Hoffmann et al. (2022) conducted a systematic review and meta-analysis of 89 original case studies investigating the relationship between environmental change, adaptation and migration in rural sub-Saharan drylands. They found that households employ a diverse range of adaptive strategies, shaped by different livelihood systems and ecological conditions, as it was shown for instance by Mertz et al. (2009b); Beye and Diop (2023) in rural Senegal. While migration emerges as a common response in certain contexts, it plays a much smaller role in others and can take multiple forms depending on local circumstances. The study shows that migration is often used alongside in-situ adaptations as a complementary strategy, rather than as a stand-alone response.

To better understand how the population responds to environmental changes, it is essential to identify the factors that influence their choice of adaptation strategies, including migration. The growing scholarly interest led to the development of increasingly complex frameworks that integrate environmental drivers but also other types of drivers. Among these, the conceptual framework proposed by Black et al. (2011) examined the influence of environmental change on five key drivers of migration -environmental, economic, political, demographic, and social. In addition, it incorporates socio-demographic characteristics (as micro-level factors) and meso-level factors, such as obstacles and facilitators, making it one of the most comprehensive frameworks to date. This conceptual model is one of the most widely used in environmental migration research. For instance, it has been used to empirically test the direct and indirect effects of environmental factors on migration in Burkina Faso (De Longueville et al. 2019), and it has been adapted to identify the drivers of migration in the context of climate change, with an example application in Malawi demonstrating its applicability to local scenarios (Parrish et al. 2020). Conversely, it has also been used to deepen the understanding of environmental non-migration decisions in Africa (Balgah et al. 2022).

Conceptual models usually focus on measured environmental change, often overlooking individual perceptions, even though research has shown that people's perception of environmental change can differ from actual environmental change (see De Longueville et al. 2020). Yet, many authors indicated that perceiving change is necessary before any adaptation is considered (Grothmann and Patt 2005; Deressa et al. 2011; Simelton et al. 2013). In Africa specifically, the link between perception and adaptation has been empirically established in different countries such as Uganda (Okonya et al. 2013), Ghana (Yaro 2013), or Ethiopia (Deressa et al. 2011). In these studies, perceptions concern the change in environmental conditions, focusing on rainfall and/or temperature. Nevertheless, Yaro (2013) highlights that the latter is more accurate when related to farm productivity and other livelihoods. Abid et al. (2019) developed a conceptual framework including perception of environmental change and considered a three-step process. First, the perception of environmental change is either accurate, underestimated, or non-existent. Second, the intention to adapt or not. Finally, the adaptation which can occur or not. Although this framework seems simpler than the one developed by Black et al. (2011), it places greater empha-

sis on the decision-making process. More recently, Datta et al. (2022) proposed an integrated approach to understanding farmer's adaptation actions by differencing famers' responses based on conscious adaptation, unintentional adaptation, or unconscious adaptation.

The present research has developed a new conceptual framework based on the three frameworks presented above (Perch-Nielsen et al. 2008; Black et al. 2011; Abid et al. 2019). This was followed by a preliminary empirical study to evaluate its effectiveness. As the inclusion of perception in frameworks is a recent development, this aspect was central to the evaluation. The influence of the national context, networks and individual socio-economic characteristics on adaptation measures in the face of environmental change has already been proven.

A new conceptual framework including perception of daily life

At the core of the proposed conceptual framework (Fig. 1) is an explanation of how indivuals adapt in response to environmental change. It considers various forms of adaptation to improve our understanding of why and how some individuals do not migrate in the face of environmental changes. The juxtaposition of intentions and actual adaptation illustrates the different stages of the decision-making process.

In this framework, perceptions can vary depending on the level of analysis. An individual, a household, or a community may perceive the same environmental change differently. Therefore, understanding the level at which decisions are made is crucial. This study emphasizes the household level, as this is the most relevent in the

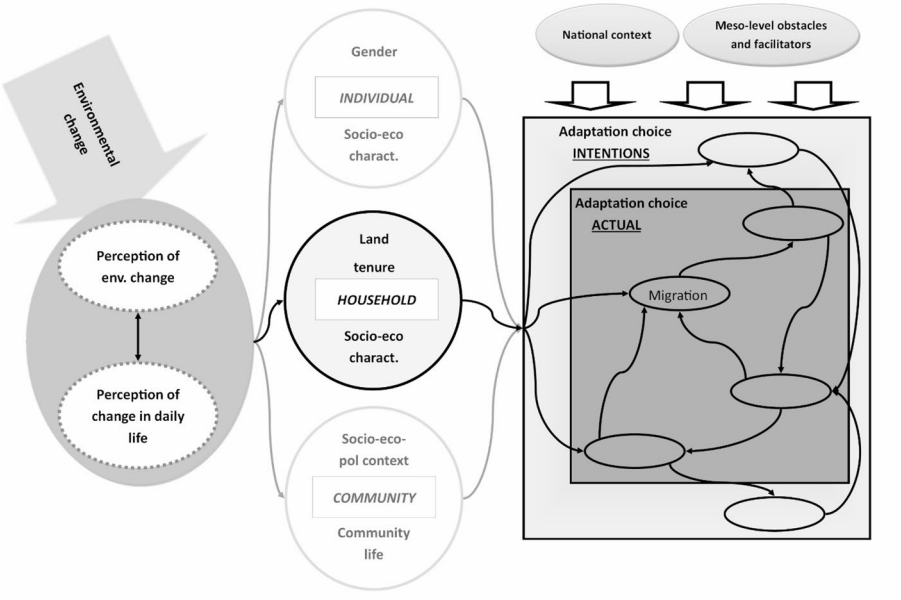

Fig. 1 Conceptual framework to explain adaptation to environmental change, including perception of environmental change along with perception of change in daily life

Western African context (Castells-Quintana et al. 2018). However, the individual and community levels are also acknowledged, as they may be more applicable in other regions or contexts.

Within households, certain characteristics influence both intentions and adaptation choices. Previous research has demonstrated the influence of socio-economic characteristics such as age, education, income, religion, or gender (Cordell et al. 1996; Codjoe et al. 2012; Schuman et al. 2018). As this framework is designed to study how farmers adapt to environmental change, land-related characteristics are also included. These factors affect how environmental change impacts households and consequently influence their adaptation choices.

The key innovation of this framework lies in its integration of perceived changes in daily life. A double-sided arrow links the two types of perceptions, suggesting a mutual influence. Environmental changes are likely to affect various aspects of daily life, such as harvest quality, land fertility and access to seeds. Conversely, when daily life is disrupted, individuals may become more aware of environmental changes, as they experience the consequences directly. These two types of perception may reinforce each other and are best understood when considered together. Therefore, special attention is given to potential multicollinearity issues in the regression models.

Although less detailed than in the framework of Black et al. (2011), national context and meso-level obstacles and facilitators also influence adaptation choices. These factors may help to explain which adaptation measures are adopted and when, thereby shaping the chronology of adaptation. Mendelsohn (2000) suggests that each adaptation measure carries a cost. While cost is often interpreted in monetary terms, it can also relate to time, accessibility or social implications. For example, migration may be discouraged by national policies that restrict visa availability (Ianos 1998). At the meso level, existing diasporic networks can reduce the cost of migration (Beine et al. 2011). At the micro level, the departure of a household member may result in a loss of labor force, which could be critical to local economic activities (Monica 2018). Therefore, to fully understand the decision-making process behind adaptation to environmental change, it is essential to consider all levels of influence.

Case study area

In 2008, the year during which the data for this study was collected, Senegal had a population of nearly 12 million inhabitants. Agriculture employed approximately 30% of the population, with rain-fed and subsistence farming being the dominant forms of agriculture in rural areas. This study focused on two regions: Kaolack and Louga (ANSD 2009).

Rural Senegal

In rural Senegal, agriculture and pastoralism are the two main economic activities (ANSD 2009). Pastoralism often complements rain-fed agriculture, which is highly dependent on environmental conditions and therefore less reliable. Nationally, 68% of Senegalese households own cattle, and this figure rises to 90% when considering

only rural areas (ANSD 2009). These statistics underscore the importance of environmental conditions for the subsistence and sustainability of rural livelihoods.

Environmental conditions in Senegal

Senegal is a sub-Saharan country characterized by a South-to-North decreasing gradient in average annual rainfall (Fig. 2). The central zones, which include the groundnut basin, receive between 300 mm and 700 mm of rainfall annually. Crops such as groundnut, millet, and sorghum can be cultivated under a rain-fed agricultural regime.

The majority of rainfall occurs during the rainy season, which spans from June to October (Faye et al. 2018). While the overall annual rainfall gradient remained relatively stable between 1979 and 2008 (Salack et al. 2011), the timing of rainfall has become increasingly variable, severely impacting agricultural activities. Recurring dry spells during the rainy season can cause major complications in crop growth and development (Salack et al. 2018), even when farmers apply fertilizers or reduce planting density (Faye et al. 2018).

Beyond precipitation, several additional environmental factors shape agricultural productivity and livelihoods in the groundnut basin (Traore et al. 2022). Seasonal temperatures are high, particularly during the pre-rainy season (April–June), with daily maxima often exceeding 30 °C, which can exacerbate water stress and influence crop development. Soil types in the region range from ferruginous tropical soils

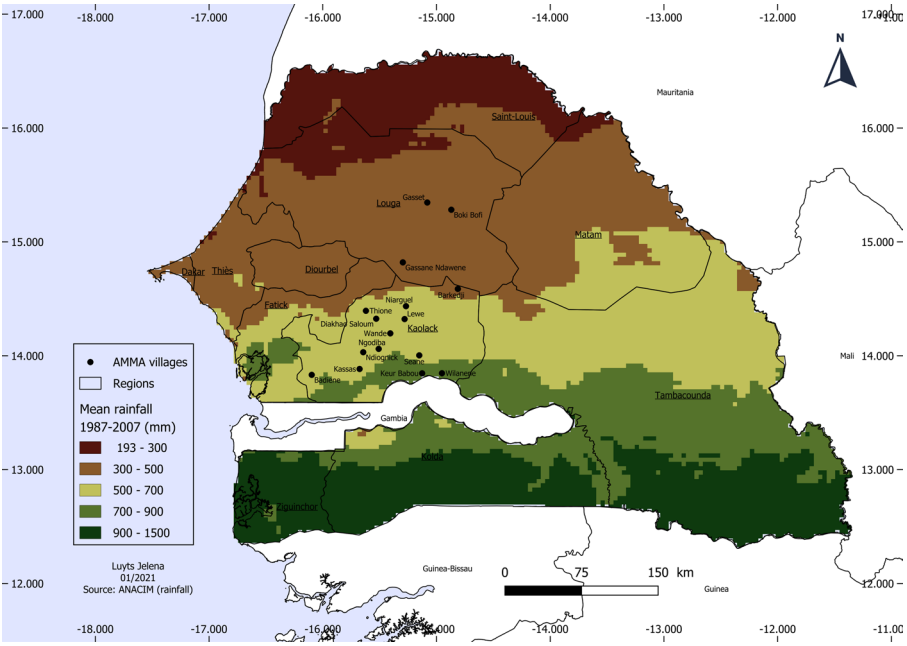

Fig. 2 Location of the villages where the AMMA questionnaire was collected. In the background, the average rainfall for the period 1987–2007 is represented according to the ANACIM monthly rainfall data

to brown callimorphic soils found in depressions, differing in fertility, water retention, and drainage capacity, all of which affect planting decisions and yields. The landscape includes low plateaus, imperfect plains, and gently rolling terrain, where topographic variation influences water runoff, soil erosion, and land accessibility for cultivation. Local variation in soil moisture and microclimate also leads to differences in the length of the growing period, impacting sowing dates and crop choice. Vegetation and land use are equally diverse, with natural tree savannahs and grasslands interspersed with cultivated fields and livestock areas. Anthropogenic activities such as agriculture and grazing modify the vegetation cover and contribute to local heterogeneity in resource availability.

Taken together, these factors create a complex and heterogeneous agro-ecological environment in the groundnut basin. Considering multiple dimensions of the environment—including rainfall, temperature, soils, topography, growing period, and land use—provides a more comprehensive understanding of the conditions shaping agricultural practices, livelihoods, and household adaptation strategies in the region.

Adaptations to environmental change in Senegal

The Senegalese population, especially those in rural areas who rely on rain-fed agriculture, must adapt to the environmental changes the country is undergoing. According to interviews conducted with Senegalese farmers by Mbow et al. (2008) as part of the AMMA project, common adaptation strategies include crop adjustments, off-farm activities, and migration. In this study, the focus is on internal migration, which is the most prevalent form of migration among rural populations in the region (Klöpf et al. 2025). In both regions examined – Louga and Kaolack – there was more out-migration than in-migration in 2008 (ANSD 2009).

To identify the most common adaptation strategies, Wiederkehr et al. (2018) found that on-farm adaptations as the most widely used. However, migration is also frequently cited and may be the first strategy considered in the region, according to Sall et al. (2011). These strategies can represent initial steps in the adaptation process and may be complemented over time. This idea of incremental adaptation is supported by several scholars (Juana et al. 2013; Voss 2021). Voss (2021) showed that on-farm adaptation is often a direct and rapid response to environmental change. If agricultural outputs remain insufficient, migration is likely to be adopted as a means of income diversification. While interviewees clearly link on-farm adaptation to environmental change, migration is not perceived in the same way (Voss 2021). The complexity of factors influencing the decision to migrate may explain why migration is often studied separately of other forms of adaptation.

Data

This study was made possible by the African Monsoon Multidisciplinary Analysis (AMMA) database. A total of 169 households were surveyed across 17 villages located within the groundnut basin of Senegal, specifically in the Louga and Kaolack regions. The dataset does not provide detailed documentation of the rationale behind

selecting exactly 169 households. Nevertheless, standard sample size calculations for proportions indicate that, with a 95% confidence level and an anticipated proportion of 0.5, an ideal sample size would be approximately 384 households, corresponding to a margin of error of ±5% (Gumuchian and Marois 2000). The actual sample of 169 households corresponds to a margin of error of approximately ± 7.5%. While the original survey designers' motivations are not fully documented, this sample size can be interpreted as a reasonable compromise between statistical precision and practical constraints typical of fieldwork in rural contexts.

The selected villages were chosen to capture variation in environmental exposure and livelihood conditions across the central groundnut basin. As detailed in the previous section, the region exhibits substantial agro-ecological diversity in terms of rainfall, temperature, soils, topography, growing period, and land use. This diversity ensures that the survey captures households experiencing different environmental conditions and livelihood contexts, thus enhancing the relevance of the data for analyzing adaptation strategies in response to environmental change.

The AMMA database focuses on agricultural and climate vulnerability in West Africa, with particular attention to adaptation strategies over the past 20 years (Mertz et al. 2011). Three groups of variables were used in this study: contextual variables (including socio-demographic and localization data), variables related to perceptions of environmental change over the previous 20 years, and variables related to perceptions of change in daily life over the same period. The full list of variables is provided in Appendix 1.

Adaptation intentions were assessed using two hypothetical scenarios presented to respondents. In the first scenario, participants were asked: "What would you do if there was a drought during a season?" (translated from French). In the second scenario, they were asked: "What would you do in the event of a permanent aridification of the climate?" (translated from French). Respondents could choose from a predefined list of adaptation strategies or suggest additional ones.

Because the AMMA survey was designed as a household-level survey rather than an individual questionnaire, the dataset contains only a limited set of socio-demographic variables. We included all available respondent characteristics that have been shown to influence adaptation decisions in the literature (see for example Deressa et al. 2009). These include household size, the highest education level attained by any household member, and village location along the rainfall gradient. While we acknowledge the importance of actual income or wealth in shaping adaptation intentions—as highlighted in the literature—such variables were not available in the dataset. Future research should aim to include direct measures or construct proxy indicators where possible to better capture economic status. While socio-economic resources—including financial ones—are known to influence adaptation processes, their absence does not undermine the objectives of the present study, which focuses on the role of perceptions in adaptation intentions rather than on identifying the determinants of adaptation.

Adding to the contextual variables, a new variable was created to reflect village location along the rainfall gradient. Based on rainfall amounts, three categories were defined following Henry et al. (2003): villages receiving less than 500 mm, those receiving between 500 and 700 mm, and those receiving over 700 mm annually. This

classification aligns with Senegal's rainfall gradient and is relevant for understanding crop choices and adaptation responses (see Fig. 2).

As previously defined, daily life includes household-level experiences such as land accessibility, soil fertility, and economic conditions. These variables were used to assess perceived changes over the past 20 years. See appendix 1 for the list of variables considered part of perceived change in daily life. The distinction between daily life and environmental change can be subtle – for example, soil fertility may be considered in both categories. In this study, the distinction is based on scale: household-level perceptions (e.g., fertility of owned land) are considered part of daily life, while broader, regional changes are categorized as environmental. This distinction is supported by Castro and Sen (2022) who theorized that "individuals, households, and communities prioritize preserving the lives that they have always lived to the best of their ability as long as possible.". Households, therefore, tend to respond to changes in their immediate living conditions.

A major step in data preparation involved managing missing values. Variables related to perceived change in daily life had, on average 23% of missing data, while those related to environmental change had about 5%. To address this, the random hot-deck imputation method was applied (Allison 2001). After imputation, response categories were grouped to ensure a minimum of 10–15 observations per category (Peduzzi et al. 1996). For more details, see Appendix 2.

Despite the age of the database and its limitations, it provides a valuable opportunity to assess the added value of introducing perceptions of change in daily life into studies of adaptations to environmental change. While living conditions have undoubtedly evolved in the study area since 2008, the aim of this study is not to analyze specific variables in detail, but to test the relevance of including this category of perception. If found useful, it is likely still relevant today, although further research will be needed to identify which specific variables should be considered.

Methods

A multivariate analysis was performed to evaluate the contribution of variables related to perceived change in daily life in explaining adaptation intention, alongside variables related to perceived environmental change. Several analytical approaches were considered, including discriminatory analysis, multiple regression analysis, and logistic regression analysis (Howell et al. 2008). Logistic regression was selected because it does not require independent variables to follow a normal distribution (Pohar et al. 2004).

Logistic regression models the probability $P(Y = 1)$ that an event occurs (e.g., that a household intends to adopt a certain adaptation strategy) as a function of a set of independent variables. The model is expressed as:

$$\ln\left[odds\left(Y = 1\right)\right] = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k$$

where *ln* denotes the natural logarithm, β_0 is the intercept, and β_i are the coefficients associated with each explanatory variable X_i. A positive coefficient ($\beta i > 0$) indi-

cates that as the predictor increases, the odds of the event (e.g., having an adaptation intention) also increase, whereas a negative coefficient ($\beta i < 0$) indicates the opposite. The exponential of each coefficient, e^{β_i}, represents the odds ratio—the multiplicative change in the odds of the event for a one-unit increase in X_i, holding all other variables constant.

Logistic regressions allow for the inclusion of both categorical and continuous variables (Ranganathan et al. 2017). It is also considered the most suitable for modeling a dichotomous dependent variable (Howell et al. 2008).

The objective of the logistic regression analysis was to identify the most suitable model to explain the dependent variable while maintaining parsimony (Pohar et al. 2004). In this study, three dependent variables were tested: the intention to migrate, the intention to adapt at the agricultural level, and the intention to implement a livestock adaptation. These categories are based on the adaptation types defined by Akinnagbe and Irohibe (2014). For each scenario, the two most frequently cited adaptations categories were selected (see Table 1). Migration intention was considered for both scenarios (a single drought and permanent aridification), while agricultural adaptation was tested only for the permanent aridification scenario, and livestock adaptation only for the single drought scenario.

Agricultural or crop adaptations included "searching for new crops", "new crop varieties", "less fertilization", "more fertilization", and "reducing cultivated areas". Livestock adaptations included "sale of animals" and "transhumance". The independent variables included socio-economic, demographic, and localization variables, as well as variables related to both types of perception. Adaptation categories were used instead of specific adaptations due to the limited number of observations in the dataset, but this approach still allows for assessing the relevance of including perceived change in daily life.

The regressions were implemented in R using the "glm" function with the specification "family = binomial(logit)". To identify the best-fitting model, the "stepAIC" function was used (Cama et al. 2016). This function performs stepwise model selec-

Table 1 Descriptive statistics: migration, crop-related and livestock related adaptations in Senegal

	Scenario	% of households who cited this strategy as one of their strategies	% of households who cited this strategy as the first
Migration as an adaptation strategy	One drought (temporary migration)	22,5%	16,6%
	Permanent aridification (permanent migration)	32,0%	25,4%
Livestock adaptation strategy	One drought	58,6%	30,8%
	Permanent aridification	18,9%	11,2%
On-farm adaptation strategy	One drought	7,7%	1,2%
	Permanent aridification	26,0%	17,7%

Source: African Monsoon Multidisciplinary Analysis database, questionnaire about adaptation strategies at household level (2008)

tion based on the Akaike Information Criterion (AIC). The results were also compared with hand tailored regression models to ensure their validity and relevance.

Multicollinearity was tested, and no variables with a Variance Inflation Factor (VIF) value above 10 were found (Neter et al. 1989). Comparing models is a complex task, and there is no consensus among statisticians on the best method. Because the models overlap, comparison becomes more challenging. Hancock et al. (2010) recommend combining several comparison methods to increase confidence in the results. Therefore, two indicators where used to compare models: the R^2 of McFadden, a pseudo R^2 metric, and the AIC. The adjusted R^2 index was preferred for its relative independence from the base rate of the binary outcome variable (Smith and McKenna 2013) and its conceptual proximity to the coefficient of determination in multiple linear regression (Menard 2000). It is based on the loglikelihood of the model, adjusted for the number of variables included. This adjustment allows for comparison between models with different numbers of variables. Although only the R^2 of McFadden is reported here, other pseudo R^2 values were calculated and led to similar conclusions. The AIC is also a good indicator for model comparison, as it does not necessarily decrease with the addition of more independent variables (Burnham and Anderson 2004). It is based on the principle of parsimony, favoring simpler models with strong explanatory power over more complex ones. A difference of at least two points in AIC is considered significant—i.e., a model with an AIC at least two points lower is significantly better than one with a higher AIC (Burnham and Anderson 2004).

To evaluate the added value of including perceived change in daily life, two logistic regression models were developed for each dependent variable. The environmental model included contextual variables and variables related to perceived environmental change. The complete model included all independent variables – contextual variables and both types of perception. A third model, the daily life model, was developed later to further explore the findings and assess whether daily life variables alone could be sufficient when environmental variables are unavailable. Detailed results of the regressions can be found in appendix 3.

It was expected that models including variables related to perceived change in daily life would have greater explanatory power than those that did not – reflected in lower AIC value and higher adjusted McFadden's R^2. Moreover, the complete models were expected to perform best overall. The models developed were relatively restrictive in terms of the variables considered, which may explain their modest explanatory power.

Results – Key findings and model performance

The multivariate results are organized around three adaptation categories, as defined by Akinnagbe and Irohibe (2014): migration, crop adaptation, and livestock adaptation. The frequency with which each category is chosen under the two hypothetical scenarios is summarized in Table 1. An interesting observation is the relatively small percentage of households that mention on-farm adaptation in response to a single drought. This contrasts with findings from Wiederkehr et al. (2018), where agricul-

Table 2 Summary of the R^2 of McFadden and AIC values for the various logistic regressions

Models (Groupe of independent variables)	MIGRATION				CROP ADAPTATION (permanent aridification)		LIVESTOCK ADAPTATION (one drought)	
	Permanent aridification		One drought					
	R^2 McFadden	AIC	R^2 McFadden	AIC	R^2 McFadden	AIC	R^2 McFadden	AIC
Environmental models	0.11	180	0.07	163	0.27	137	0.05	199
Complete models	0.16	169	0.16	147	0.31	129	0.11	185

tural adaptations often appear as the first strategy considered. However, it aligns more closely with Sall et al. (2011), who observed that migration is frequently considered first. Overall, at least one of these two strategies—migration or agricultural adaptation—emerges among the most common responses in both scenarios.

Analysis of variable significance reveals distinct patterns. In all models that include both types of perception, at least one variable related to perceived changes in rainfall is significant. For agriculturally related adaptations, four of the six rainfall variables are significant, reflecting the strong dependence of agricultural activity on rainfed systems. The influence of perceived changes in daily life is more complex but nonetheless evident. For instance, decreased income increases the likelihood of considering migration in the case of a seasonal drought, while reduced market accessibility raises the probability of migration in both scenarios. Household size is significant across models: larger households are more likely to consider both migration and agricultural adaptation. Land accessibility is significant only in the short-term scenario, where increased accessibility reduces the likelihood of migration and increases the likelihood of livestock adaptation; conversely, decreased accessibility reduces migration likelihood. Access to agricultural supplies—such as seeds, compost, or equipment—is significant for both migration and agricultural adaptation in the seasonal drought scenario: reduced access increases migration intentions while decreasing agricultural adaptation intentions.

A comparative assessment of the different model specifications shows that models combining both types of perception consistently outperform those relying solely on environmental perceptions. As summarized in Table 2 (see also the full model specifications in Appendix 3), the combined models display higher McFadden's R^2 values and lower AIC scores, with reductions exceeding the two-point threshold, indicating a substantial improvement in explanatory power. This superior performance is observed across both short-term and long-term scenarios and for all adaptation types considered, confirming that integrating perceptions of environmental change with perceptions of change in daily life markedly enhances the ability to explain intended adaptation choices.

To complete this research, a model based solely on daily life perceptions was developed and compared with the environmental model. Research often requires prioritizing certain variables during data collection, and this comparison provides guidance for future studies facing such constraints. The results indicate that considering perceptions of change in daily life either improves the explanatory power of the

model or results in no significant loss compared to environmental-only models (see Table 2).

In summary, rainfall-related perceptions emerge as the most frequently significant among environmental-change perceptions. Among daily-life perceptions, income, expenses, and household size are associated with migration intentions, while household size and access to agricultural supplies are linked to agricultural adaptation. Land accessibility perception is particularly relevant in short-term adaptation scenarios. These patterns indicate that both environmental and daily-life perceptions contribute to explaining adaptation intentions, with their relative importance varying by adaptation type and scenario.

Discussion

Interpretation of model performance and of the key findings

The highest McFadden's R^2 value was observed for the model linking agricultural adaptation intentions under the aridification scenario to all independent variables, reaching 0.37. Compared to pseudo R^2 values reported in studies of actual adaptation behavior—which rarely exceed 0.20 (e.g. Fosu-Mensah et al. 2012) — this suggests that intentions may be easier to explain than realized actions, consistent with findings by Niles et al. (2016). Nevertheless, other adaptation types did not reach a McFadden's R^2 of 0.20, which is unsurprising given that many variables included are closely tied to agricultural activity. Rainfall changes directly influence agricultural productivity in the study area, and a large proportion of daily-life variables concern agricultural and pastoral activities, such as access to seeds, compost, tenure, soil fertility, and equipment availability. Future research could therefore continue to explore other variables of perceived change and help identify the variables that best explain which adaptation is put into place by the households, with a potential distinction between types of adaptations.

These observations highlight the complexity of studying multiple adaptation strategies simultaneously. Migration, agricultural adaptation, and livestock adaptation each involve distinct drivers, even though some variables overlap. This implies that future research should carefully consider the specificities of each adaptation type and identify the variables most relevant for explaining why, how, and when households adopt particular strategies. In addition, adaptations take place over time, sometimes simultaneously, and influenced by previous successful or failed adaptations (Moser and Boykoff 2013) further suggesting the need for more research on these aspects.

Turning to variable-level interpretation, rainfall-related variables emerge as the most influential among environmental-change perceptions, which is consistent with the dominance of rainfed agriculture in the study area and with previous findings that rainfall changes are among the most frequently and accurately perceived by local populations (De Longueville et al. 2020).

Daily-life perceptions also show meaningful associations with adaptation intentions. Perceived declines in income increase migration intentions, reflecting the role of temporary migration in diversifying income sources and compensating for losses

in other activities (Reardon 1997; Castells-Quintana et al. 2018). Household size's positive influence on both migration and agricultural adaptation supports Deressa et al.'s (2011) argument that larger households benefit from a higher labor endowment, enabling flexibility to pursue multiple strategies simultaneously. Indeed, a greater number of available household members facilitates the redistribution of tasks, allowing some individuals to engage in migration while others maintain agricultural activities, and it also provides the workforce needed to implement labor-intensive agricultural responses. The effects of perceived land accessibility are more nuanced. Reduced perceived accessibility appears to limit migration, possibly because households lack resources to support mobility (Henry et al. 2004), while perceived increased accessibility may encourage investment in agriculture and livestock, reducing migration likelihood. Indeed, an actual increase in land accessibility could result in a higher need for labor force and a focus on agriculture. Similarly, perceived access to agricultural supplies influences both migration and agricultural adaptation: reduced access increases migration intentions while decreasing agricultural adaptation intentions, underscoring the role of input availability in shaping household decisions.

Overall, these findings suggest that considering perceptions of change in daily life alongside perceptions of environmental change provides complementary insights into household decision-making. Distinctions between short- and long-term scenarios and across adaptation types highlight the need for nuanced approaches to understanding adaptation processes. While livelihoods and contextual factors have evolved since data collection, these results offer a valuable foundation for future research on the drivers of adaptation strategies.

Empirical validation of the framework and prioritizing daily-life perceptions

As mentioned in the results, perceptions of change in daily life explain adaptation intentions as effectively as, and sometimes better than, environmental perceptions. This suggests that, when resources are limited, prioritizing daily-life perceptions may be more beneficial than focusing exclusively on environmental change. Daily-life perceptions are less influenced by social desirability bias (Félonneau and Becker 2008) and environmental change is rarely cited as a primary driver of adaptation (Koubi et al. 2016). Therefore, daily life perceptions are a more reliable basis for understanding household-level decision-making. Nevertheless, the analysis also shows that combining both types of perceptions yields the most robust models. If only one type can be collected, daily-life perceptions should be favored, particularly for migration and livestock adaptations, where they appear to have greater explanatory power than environmental perceptions. For crop adaptation, however, environmental perceptions remain equally important. This distinction could suggest that environmental factors exert a stronger influence on agricultural decisions, or that socio-economic and household-level changes play a more prominent role in shaping migration and livestock strategies. The first seems more likely since very general changes in daily life have been considered such as changes in income, expenses and household size, but also changes directly related to the agricultural and pastoral activity. Although the increase in explanatory power from daily-life perceptions was smaller than expected,

these findings underscore the need for further research to refine variable selection and explore the nuanced drivers of different adaptation strategies.

Looking more closely at the dependent variable for livestock adaptation, the environmental model performs worse than the other two. Notably, the daily-life model and the complete model yield almost identical results. This suggests that variables related to perceived changes in daily life exert a greater influence than those concerning perceived environmental change. Examining the final models confirms this pattern: only one variable of perceived environmental change is included in Model 3, whereas five variables related to perceived changes in daily life remain after selection based on AIC values. Even when considered separately, the environmental model includes only one significant variable of perceived environmental change. In this context, perceived changes in daily life should be prioritized, as they provide critical information for understanding livestock adaptation, whereas perceived environmental change offers limited explanatory power.

These findings also provide empirical validation for the framework proposed in this study, which integrates perceptions of environmental change with perceptions of change in daily life. The consistently superior performance of models combining both types of perception demonstrates that the framework effectively captures the factors shaping adaptation intentions. Moreover, the fact that models based solely on daily-life perceptions perform at least as well as environmental-only models highlights the practical relevance of incorporating daily-life experiences in analyses of household decision-making. Overall, these results confirm that the framework is useful for understanding the complex and context-specific ways in which individuals perceive change and choose adaptation strategies, offering guidance for both future research and the operationalization of complementary perception dimensions.

Limitations

Several limitations should be acknowledged when interpreting the findings of this study. First, the data were collected in 2008, which means that daily-life conditions and socio-economic contexts have likely evolved significantly since then. While the aim was to test the relevance of incorporating perceptions of daily life rather than to analyze specific variables in detail, this temporal gap limits the direct applicability of the results to current conditions.

Second, the AMMA dataset offers only a modest sample size of 169 households, providing exploratory insights rather than definitive conclusions. Furthermore, the sampling procedure at the village level was not fully documented, which may affect the representativeness of the data.

Third, the dataset lacked key socio-demographic variables such as gender, income, and religion, which have been shown to influence adaptation decisions. Gender was excluded because the survey was not conducted one-on-one. According to the AMMA survey guide, interviews were ideally conducted with the head of household, their spouse, and children present. This collective format makes it difficult to isolate individual-level responses and limits the inclusion of gender-specific data. Income was approximated using perceived evolution rather than direct measures, which may reduce accuracy. Moreover, variables related to perceived change in daily life had a

high proportion of missing data (approximately 23%), requiring imputation through the random hot-deck method. While this approach mitigates data gaps, it introduces uncertainty into the analysis.

Fourth, the survey design introduces several constraints. Adaptation intentions were assessed under hypothetical scenarios—a single seasonal drought and permanent aridification—rather than observed behaviors. While studies such as Maddison (2007) have linked observed environmental changes to the adaptations households implement in practice, our study examines projected adaptation behavior in response to predefined conditions. As a result, the findings capture households' intended responses rather than their realized actions, which may differ due to factors such as unforeseen constraints, temporal dynamics, or social and economic feedback. Although these results provide insight into how households anticipate adapting to environmental changes, they should be interpreted with caution, as intentions do not always translate into actual behavior.

Fifth, the explanatory power of the models remains modest, particularly for livestock adaptation, as reflected in low McFadden's R^2 values. This suggests that important variables may be missing, and that future research should expand the range of factors considered. Testing the proposed framework in other contexts and with updated, richer datasets will be essential to validate its broader applicability.

Finally, Senegal served as a case study, but the theoretical framework should be tested in other contexts to assess its broader applicability. Differences between factors influencing actual adaptation and adaptation intentions may also reflect the temporal sequence of adaptation processes. Understanding this chronology would be valuable for designing policies that align with household needs and can evolve over time.

Conclusion

This research sets out to examine whether incorporating perceptions of change in daily life enhances the understanding of households' intended adaptation choices in the face of environmental change. The findings confirm that models combining both types of perception—environmental and daily life—consistently outperform those based on a single dimension. This underscores the importance of adopting a multidimensional approach when studying adaptation processes, which are inherently complex and shaped by diverse factors (Black et al. 2011; Thober et al. 2018).

Building on this insight, comparing daily-life models with environmental models reveals a slightly higher explanatory power for the former, although complete models remain the most robust. This suggests that, when data collection is constrained, prioritizing daily-life perceptions may provide more reliable insights than focusing exclusively on environmental change. Nevertheless, the integration of both perspectives should be favored whenever possible, as they offer complementary information that enriches the analysis of adaptation intentions.

Finally, while this study relies on historical data and hypothetical scenarios, it provides a valuable framework for incorporating household perceptions into adaptation research. Future studies should test this approach in different contexts, expand the range of variables considered, and explore the translation of adaptation intentions into actual behavior over

time. Such efforts will help refine our understanding of adaptation dynamics and inform policies that support households in responding effectively to environmental change.

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Author contributions The first author performed the analyses and drafted the manuscript. All co-authors contributed to the interpretation of the results and provided comments and suggestions that helped improve both the analyses and the manuscript. All authors reviewed and approved the final version of the manuscript.

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Data availability The data that support the findings of this study are available from the AMMA Project part of the FP6-SUSTDEV programme but restrictions apply to the availability of these data, which were used under licence for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of the AMMA Project coordinators.

Declarations

Conflict of 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.

References

Abid M, Scheffran J, Schneider UA, Elahi E (2019) Farmer perceptions of climate change, observed trends and adaptation of agriculture in Pakistan. Environ Manage 63(1):110–123
Adams H (2016) Why populations persist: mobility, place attachment and climate change. Popul Environ 37(4):429–448
Adger WN, Barnett J, Brown K, Marshall N, O'brien K (2013) Cultural dimensions of climate change impacts and adaptation. Nature climate change 3(2):112–117.
Adger WN, Huq S, Brown K, Conway D, Hulme M (2003) Adaptation to climate change in the developing world. Progress Dev Stud 3(3):179–195
Akinnagbe OM, Irohibe IJ (2014) Agricultural adaptation strategies to climate change impacts in Africa: A review. Bangladesh J Agricultural Res 39(3):407–418
Allison PD (2001) Missing data. Sage Publications
ANSD (Agence Nationales de la Statistique et de la Démographie) (2009) Situation economique et sociale du Sénégal en 2008
Asante F, Guodaar L, Arimiyaw S (2021) Climate change and variability awareness and livelihood adaptive strategies among smallholder farmers in semi-arid northern Ghana. Environ Dev 39:100629
Balgah RA, Kimengsi JN (2022) A review of drivers of environmental non-migration decisions in Africa. Reg Envriron Chang 22(4):125
Beine M, Docquier F, Özden Ç (2011) Diasporas. J Dev Econ 95(1):30–41

Beye A, Diop W (2023) Adaptation to climate change in arid lands: Evidence from pastoral areas of Senegal. Clim Change Econ 14(01):2350001
Black R, Adger WN, Arnell NW, Dercon S, Geddes A, Thomas D (2011) The effect of environmental change on human migration. Glob Environ Change 21:S3–S11
Borderon M, Sakdapolrak P, Muttarak R, Kebede E, Pagogna R, Sporer E (2019) Migration influenced by environmental change in Africa. Demographic Res 41:491–544
Burnham KP, Anderson DR (2004) Multimodel inference: understanding AIC and BIC in model selection. Sociol methods Res 33(2):261–304
Cama M, Cristi Nicu I, Conoscenti C, Quénéhervé G, Maerker M (2016) The role of multicollinearity in landslide susceptibility assessment by means of Binary Logistic Regression: comparison between VIF and AIC stepwise selection. In: EGU General Assembly Conference Abstracts, p. 16839
Castells-Quintana D, del Pilar Lopez-Uribe M, McDermott TK (2018) Adaptation to climate change: A review through a development economics lens. World Dev 104:183–196
Castro B, Sen R (2022) Everyday adaptation: theorizing climate change adaptation in daily life. Global Environmental Change 75:102555.
Codjoe SNA, Atidoh LK, Burkett V (2012) Gender and occupational perspectives on adaptation to climate extremes in the Afram Plains of Ghana. Clim Change 110(1):431–454
Cordell DD, Gregory JW, Piché V (1996) Hoe and wage: a social history of circular migration system in West Africa, African modernization and development series. Westview, Oxford
Cuni-Sanchez A, Aneseyee AB, Baderha GK, Batumike R, Bitariho R, Imani G, Zafra-Calvo N (2025) Perceived climate change impacts and adaptation responses in ten African mountain regions. Nat Clim Change 15(2):153–161
Datta P, Behera B (2022) Climate change and Indian agriculture: A systematic review of farmers' perception, adaptation, and transformation. Environ Challenges 8:100543
De Groot C, Mulder CH, Das M, Manting D (2011) Life events and the gap between intention to move and actual mobility. Environ Plann A 43(1):48–66
De Longueville F, Hountondji YC, Kindo I, Gemenne F, Ozer P (2016) Long-term analysis of rainfall and temperature data in Burkina Faso (1950–2013). Int J Climatol 36(13):4393–4405
De Longueville F, Ozer P, Gemenne F, Henry S, Mertz O, Nielsen JØ (2020) Comparing climate change perceptions and meteorological data in rural West Africa to improve the understanding of household decisions to migrate. Clim Change 160(1):123–141
De Longueville F, Zhu Y, Henry S (2019) Direct and indirect impacts of environmental factors on migration in Burkina Faso: application of structural equation modelling. Popul Environ 40(4):456–479
Deressa TT, Hassan RM, Ringler C (2011) Perception of and adaptation to climate change by farmers in the Nile basin of Ethiopia. J Agricultural Sci 149(1):23–31
Deressa TT, Hassan RM, Ringler C, Alemu T, Yesuf M (2009) Determinants of farmers' choice of adaptation methods to climate change in the Nile Basin of Ethiopia. Glob Environ Change 19(2):248–255
Faye B, Webber H, Diop M, Mbaye ML, Owusu-Sekyere JD, Naab JB, Gaiser T (2018) Potential impact of climate change on peanut yield in Senegal, West Africa. Field Crops Res 219:148–159
Fielding KS, Terry DJ, Masser BM, Hogg MA (2008) Integrating social identity theory and the theory of planned behaviour to explain decisions to engage in sustainable agricultural practices. Br J Soc Psychol 47(1):23–48
Félonneau ML, Becker M (2008) Pro-envonmental attitudes and behavior: Revealing perceived social desirability. Revue Int de psychologie sociale 21(4):25–53
Fosu-Mensah BY, Vlek PL, MacCarthy DS (2012) Farmers' perception and adaptation to climate change: a case study of Sekyedumase district in Ghana. Environ Dev Sustain 14(4):495–505
Gemenne F, Blocher J (2017) How can migration serve adaptation to climate change? Challenges to fleshing out a policy ideal. Geographical J 183(4):336–347
Grothmann T, Grecksch K, Winges M, Siebenhüner B (2013) Assessing institutional capacities to adapt to climate change: integrating psychological dimensions in the Adaptive Capacity Wheel. Nat Hazards Earth Syst Sci 13(12):3369–3384
Grothmann T, Patt A (2005) Adaptive capacity and human cognition: the process of individual adaptation to climate change. Glob Environ Change 15(3):199–213
Gumuchian H, Marois C (2000) Chapitre 6. Les méthodes d'échantillonnage et la détermination de la taille de l'échantillon. Initiation à la recherche en géographie: Aménagement, développement territorial, environnement, 265–294
Hancock GR, Mueller RO, Stapleton LM (2010) The reviewer's guide to quantitative methods in the social sciences. Routledge

Henry S, Boyle P, Lambin EF (2003) Modelling inter-provincial migration in Burkina Faso, West Africa: the role of socio-demographic and environmental factors. Appl Geogr 23(2–3):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. Popul Environ 25(5):423–460
Hoffmann R, Wiederkehr C, Dimitrova A, Hermans K (2022) Agricultural livelihoods, adaptation, and environmental migration in sub-Saharan drylands: a meta-analytical review. Environ Res Lett 17(8):083003
Howell D, Bestgen Y, Yzerbyt V, Rogier M (2008) Méthodes statistiques en sciences humaines.
Ianos I (1998) The influence of economic and regional policies on migration in Romania. Romania: migration, socio-economic transformation and perspectives of regional development. Sudosteuropa-Studie 62:55–76
Juana JS, Kahaka Z, Okurut FN (2013) Farmers' perceptions and adaptations to climate change in sub-Sahara Africa: A synthesis of empirical studies and implications for public policy in African agriculture. J Agric Sci 5(4):121
Keles R (2012) The quality of life and the environment. Procedia-Social Behav Sci 35:23–32
Klöpf T, Scheven C, Vorhold P, Ungruhe C (2025) Researching migration in West Africa: A systematic and reflexive review. Comp Migration Stud 13(1):52
Kothari U, Arnall A (2019) Everyday life and environmental change. Geographical J 185(2):130–141
Koubi V, Spilker G, Schaffer L, Bernauer T (2016) Environmental stressors and migration: Evidence from Vietnam. World Dev 79:197–210
Maddison D (2007) The perception of and adaptation to climate change in Africa, (Vol. 4308). World Bank Publications
Maharjan A, de Campos RS, Singh C, Das S, Srinivas A, Bhuiyan MRA, Vincent K (2020) Migration and household adaptation in climate-sensitive hotspots in South Asia. Curr Clim Change Rep 6(1):1–16
Mallick B, Best K, Carrico A, Ghosh T, Priodarshini R, Sultana Z, Samanta G (2023) How do migration decisions and drivers differ against extreme environmental events? Environ Hazards 22(5):475–497
Mbow C, Mertz O, Diouf A, Rasmussen K, Reenberg A (2008) The history of environmental change and adaptation in eastern Saloum–Senegal—Driving forces and perceptions. Glob Planet Change 64(3–4):210–221
Menard S (2000) Coefficients of determination for multiple logistic regression analysis. Am Stat 54(1):17–24
Mendelsohn R (2000) Efficient adaptation to climate change. Clim Change 45(3):583–600
Mertz O, Halsnæs K, Olesen JE, Rasmussen K (2009a) Adaptation to climate change in developing countries. Environ Manage 43(5):743–752
Mertz O, Mbow C, Reenberg A, Diouf A (2009b) Farmers' perceptions of climate change and agricultural adaptation strategies in rural Sahel. Environ Manage 43(5):804–816
Mertz O, Mbow C, Reenberg A, Genesio L, Lambin EF, D'haen S, Sandholt I (2011) Adaptation strategies and climate vulnerability in the Sudano-Sahelian region of West Africa. Atmospheric Sci Lett 12(1):104–108
Monica C (2018) Advantages And Disadvantages Of Labor Migration. Annals Fac Econ 1(1):38–46
Morrissey J (2012) Rethinking the'debate on environmental refugees': from'maximilists and minimalists' to'proponents and critics'. J Political Ecol 19(1):36–49
Moser SC, Boykoff MT (2013) Climate change and adaptation success: the scope of the challenge. In Successful adaptation to climate change. Routledge; pp. 25–58.
Nelson DR, Adger WN, Brown K (2007) Adaptation to environmental change: contributions of a resilience framework. Annu Rev Environ Resour 32(1):395–419
Neter J, Wasserman W, Kutner MH (1989) Applied linear regression models
Nielsen JØ, Reenberg A (2010) Cultural barriers to climate change adaptation: A case study from Northern Burkina Faso. Glob Environ Change 20(1):142–152
Niles MT, Brown M, Dynes R (2016) Farmer's intended and actual adoption of climate change mitigation and adaptation strategies. Clim Change 135(2):277–295
O'Brien K (2012) Global environmental change II: From adaptation to deliberate transformation. Prog Hum Geogr 36(5):667–676
Okonya JS, Syndikus K, Kroschel J (2013) Farmers' perception of and coping strategies to climate change: Evidence from six agro-ecological zones of Uganda. J Agric Sci 5(8):252
Parrish R, Colbourn T, Lauriola P, Leonardi G, Hajat S, Zeka A (2020) A critical analysis of the drivers of human migration patterns in the presence of climate change: a new conceptual model. Int J Environ Res Public Health 17(17):6036

Peduzzi P, Concato J, Kemper E, Holford TR, Feinstein AR (1996) A simulation study of the number of events per variable in logistic regression analysis. J Clin Epidemiol 49(12):1373–1379
Perch-Nielsen SL, Bättig MB, Imboden D (2008) Exploring the link between climate change and migration. Clim Change 91(3):375–393
Pohar M, Blas M, Turk S (2004) Comparison of logistic regression and linear discriminant analysis: a simulation study. Metodoloski zvezki 1(1):143
Poudel S, Funakawa S, Shinjo H (2017) Household perceptions about the impacts of climate change on food security in the mountainous region of Nepal. Sustainability 9(4):641
Prabhugaonkar AA (2025) Maneuvering everyday urban spaces: transgender perceptions and challenges-a case of Pune (Doctoral dissertation, SPA Bhopal)
Priovashini C, Mallick B (2022) A bibliometric review on the drivers of environmental migration. Ambio 51(1):241–252
Ranganathan P, Pramesh CS, Aggarwal R (2017) Common pitfalls in statistical analysis: logistic regression. Perspect Clin Res 8(3):148
Reardon T (1997) Using evidence of household income diversification to inform study of the rural nonfarm labor market in Africa. World Dev 25(5):735–747
Salack S, Muller B, Gaye AT (2011) Rain-based factors of high agricultural impacts over Senegal. Part I: integration of local to sub-regional trends and variability. Theoret Appl Climatol 106(1):1–22
Salack S, Saley IA, Lawson NZ, Zabré I, Daku EK (2018) Scales for rating heavy rainfall events in the West African Sahel. Weather Clim extremes 21:36–42
Sall M, Tall SM, Tandian A, Samb A (2011) Changements climatiques, stratégies d'adaptation et mobilités. Evidence à partir de quatre sites au Sénégal
Schuman S, Dokken JV, Van Niekerk D, Loubser RA (2018) Religious beliefs and climate change adaptation: A study of three rural South African communities. Jàmbá: J Disaster Risk Stud 10(1):1–12
Simelton E, Quinn CH, Batisani et al (2013) Is rainfall really changing? Farmers' perceptions, meteorological data, and policy implications. Climate Dev 5(2):123–138
Smith TJ, McKenna CM (2013) A comparison of logistic regression pseudo R2 indices. Multiple Linear Regres Viewpoints 39(2):17–26
Thober J, Schwarz N, Hermans K (2018) Agent-based modeling of environment-migration linkages. Ecol Soc 23(2)
Traore VB, Ndiaye ML, Diallo S, Ndiaye RM, Diouf R, Sow ML (2022) Characterization of climatic aridity in the groundnut basin, Senegal. Algerian J Environ Sci Technol 8(1)
Van der Land V (2015) The environment-migration nexus reconsidered: Why capabilities and aspirations matter. Verlag nicht ermittelbar
Van der Land V, Romankiewicz C, van der Geest K (2018) Environmental change and migration: a review of West African case studies. Routledge handbook of environmental displacement and migration, p. 163–177
Vinke K, Bergmann J, Blocher J, Upadhyay H, Hoffmann R (2020) Migration as adaptation?. Migration studies 8(4):626–634.
Voss RC (2021) On- and non-farm adaptation in Senegal: understanding differentiation and drivers of farmer strategies. Clim Dev 1–15
Warner K (2011) Environmental change and migration: methodological considerations from groundbreaking global survey. Popul Environ 33(1):3
Wiederkehr C, Beckmann M, Hermans K (2018) Environmental change, adaptation strategies and the relevance of migration in Sub-Saharan drylands. Environ Res Lett 13(11):113003
Wolde SG, D'Odorico P, Rulli MC (2023) Environmental drivers of human migration in Sub-Saharan Africa. Global Sustain 6:e9
Yamamoto L, Esteban M (2017) Migration as an adaptation strategy for atoll island states. Int Migration 55(2):144–158
Yaro JA (2013) The perception of and adaptation to climate variability/change in Ghana by small-scale and commercial farmers. Reg Envriron Chang 13(6):1259–1272