



Pathways for effective engagement of the youth in climate and migration advocacy

Adil Salhi^{a,*}, Giovanni Marin^b, Elena Paglialunga^b, Mokgadi Phoebe Ramaloko^b, Samar Azzi-Achkouti^c, Nathalie Clauter^d, Anne-Laurence Pastorini^d

^a Geography and Development Group, Abdelmalek Essaadi University, FLSH, Martil, Morocco

^b Università di Urbino Carlo Bo, Italy

^c Holy Spirit University of Kaslik, Lebanon

^d Union of the Mediterranean Universities, Rome, Italy

ARTICLE INFO

Keywords:

Climate change
Migration
Youth engagement
Awareness
Behavioral profiling

ABSTRACT

Climate change and migration are increasingly interlinked global challenges, with particularly acute implications for the Mediterranean region. Despite youth are among the most exposed to these implications and expected to lead future responses, limited empirical research has examined how they perceive, interpret, and act upon the climate–migration nexus in diverse national contexts. This study addresses this gap by analyzing youth perceptions and behavioral dispositions across Italy, Morocco, and Lebanon, three Mediterranean countries with distinct socio-political and environmental settings. A structured questionnaire comprising 120 variables was administered to 1425 university students. The analysis proceeded in four stages: descriptive synthesis identified major trends, contingency testing assessed cross-country variations, structural equation modeling explored relationships between climate change awareness, migration perception, policy trust, and climate action engagement, and hierarchical clustering revealed youth attitudinal profiles. Findings reveal that media exposure outweighs formal education in shaping perceptions, though education remains key to deeper awareness. Climate change awareness significantly predicts climate engagement, particularly when mediated by trust in institutional responses. Demographics and national context significantly condition attitudes and behavior. Three attitudinal profiles emerged, skeptical pragmatists, informed adaptors, and committed advocates, highlighting the need for tailored engagement strategies. The findings underscore the need to strengthen policy credibility, enhance transdisciplinary education, and invest in youth-specific communication strategies. This study offers empirical grounding for inclusive, youth-centered approaches to climate and migration policy design.

1. Introduction

Climate change and migration have become increasingly interconnected global challenges, particularly in the Mediterranean region where environmental degradation, resource scarcity, and socio-economic instability converge. As climate impacts intensify, they

* Corresponding author.

E-mail addresses: asalhi@uae.ac.ma (A. Salhi), giovanni.marin@uniurb.it (G. Marin), elena.paglialunga@uniurb.it (E. Paglialunga), m.ramaloko@campus.uniurb.it (M.P. Ramaloko), samarazzi@usek.edu.lb (S. Azzi-Achkouti), n.clauter@uni-med.net (N. Clauter), al.pastorini@uni-med.net (A.-L. Pastorini).

<https://doi.org/10.1016/j.envdev.2025.101242>

Received 19 September 2024; Received in revised form 13 May 2025; Accepted 16 May 2025

Available online 17 May 2025

2211-4645/© 2025 Elsevier B.V. All rights are reserved, including those for text and data mining, AI training, and similar technologies.

not only exacerbate existing inequalities but also contribute to both voluntary and forced migratory movements (Balsari et al., 2020; Piguet et al., 2011). The Mediterranean, linking Europe, Africa, and the Middle East, serves as a geographic and political fault line, where the consequences of climate-induced pressures are particularly salient. Environmental stressors such as declining rainfall, rising temperatures, and desertification intersect with entrenched socio-political vulnerabilities, producing distinctive mobility patterns across borders (Bendandi, 2020; Cramer et al., 2018; Kwanhi et al., 2024; Salhi et al., 2025). While migration is frequently interpreted through an economic lens, mounting evidence highlights the role of ecological factors, especially in North Africa and the Levant, as critical drivers that compound risk and uncertainty (Hoffmann and Zens, 2024; Salhi et al., 2022).

Youth occupy a dual position within this context: they are disproportionately affected by climate-related risks, such as food insecurity, employment precarity, and displacement, while also representing key agents of resilience and transformation (Thiery et al., 2021). As active participants in educational, civic, and digital networks, youth are uniquely placed to influence climate action and migration discourse. Their potential contributions to sustainable transitions are increasingly acknowledged in international frameworks, although concrete mechanisms for integrating youth perspectives into institutional decision-making remain limited (Göpfert et al., 2019; Josefsson and Löw, 2025). This disjunction between capacity and representation has raised important questions about the roles that youth are prepared and willing to assume in relation to environmental and demographic challenges (Pickering et al., 2020; Van Den Hazel, 2019).

The available literature on youth engagement reveals considerable heterogeneity. Responses to climate change and migration are shaped by varying levels of awareness, psychological predispositions, and socio-cultural backgrounds (Geraci et al., 2024; Helbling et al., 2021). Research rooted in social psychology suggests that knowledge about environmental issues can lead to pro-sustainability behaviors, though this relationship is often moderated by subjective norms, emotional responses, and perceived behavioral control (Ogunbode et al., 2022; Wullenkord et al., 2021). Moreover, individuals' migration experiences and identities can affect how they relate to climate issues, revealing the need for more nuanced analytical models. Evidence from African case studies further suggests that social protection and youth-oriented climate resilience programs can play a role in mitigating migration intentions and promoting adaptive capacity (Ncube et al., 2024).

Beyond individual attitudes, socialization environments also exert powerful influences on youth perspectives. Family structures, educational institutions, and civic culture shape political engagement and environmental consciousness (Alfirević et al., 2023; Lawson et al., 2019). The intergenerational transmission of attitudes, ranging from progressive environmental ethics to inherited skepticism, contributes to how youth process information, engage in public discourse, and build trust in institutions. Notably, trust in government and perceived policy effectiveness have been identified as central determinants of collective action and willingness to engage in climate mitigation and migration governance (Urban and Duda, 2024).

Despite the growing literature, key gaps remain in understanding how these behavioral, institutional, and cultural factors converge in shaping youth engagement. Much of the existing evidence is geographically fragmented, with limited comparative research across Southern and Eastern Mediterranean societies (Santos et al., 2023). Furthermore, although the intersection between climate change and migration has received increasing geopolitical attention, relatively little is known about how young people internalize and respond to these overlapping challenges. In particular, questions remain about the formation of perceptions, the role of institutional trust, and the social-psychological pathways through which attitudes translate into action (Law and Le, 2023; Santos and Mourato, 2022). Given the diversity of socio-political contexts in the Mediterranean (ranging from Italy's institutional stability to Lebanon's chronic volatility and Morocco's status as a transit state) this region offers an ideal laboratory for comparative research.

To contribute to this evidence base, the present study investigates youth perceptions, behavioral intentions, and trust in climate-migration governance across Italy, Morocco, and Lebanon. Specifically, it analyzes how structural characteristics (e.g., educational background, country context), attitudinal and intentional variables (e.g., climate concern, migration outlook), and institutional trust interact to shape engagement. Using a latent variable modeling approach, the study identifies behavioral profiles and assesses their underlying determinants. The analysis is guided by the following research questions.

1. To what extent are youth perceptions of climate change and migration shaped by their demographic and institutional environments?
2. How do levels of climate change awareness and trust in public policies influence their willingness to engage in climate-related action?
3. Are there coherent attitudinal and behavioral profiles within Mediterranean youth populations that can inform targeted engagement strategies?

In response to these questions, the study tests four interrelated hypotheses.

- It is hypothesized that greater climate change awareness among youth is associated with stronger willingness to participate in climate mitigation and adaptation measures.
- It is hypothesized that the perception of climate change as a migration driver increases trust in government policies addressing both issues.
- It is hypothesized that institutional trust mediates the relationship between migration perception and engagement in climate action.
- It is hypothesized that demographic characteristics, including gender, national context, and academic orientation, significantly shape youth awareness, attitudes, and behaviors related to climate and migration.

By addressing these questions and hypotheses, the study aims to provide empirical insights into how Mediterranean youth navigate the complex nexus of climate change and migration, offering a foundation for more effective, inclusive, and future-oriented policy interventions.

2. Material and methods

2.1. Overview

To operationalize the stated hypotheses, the study adopted three interrelated objectives. The first was to assess youth knowledge, attitudes, and actions regarding climate change, focusing on how their awareness aligns with global climate scenarios. The second objective examined their willingness to engage in climate change mitigation and adaptation, encompassing both individual behavioral efforts and support for collective measures, such as public taxation for energy transition and compliance with stricter environmental policies. The third objective evaluated attitudes toward both incoming migration (especially climate-induced displacement) and migration as a potential adaptive response. This dual framing treats migration both as a risk indicator and as a form of social coping, thereby enriching the analysis of youth positionality within the climate–migration nexus.

The empirical strategy was structured to systematically address these objectives and test the study's four hypotheses. To this end, a four-stage analytical design was adopted, integrating descriptive and inferential procedures with multivariate modeling and typological classification. First, descriptive synthesis was employed to identify general patterns in climate change and migration perceptions across the three countries. Second, contingency testing using Pearson's Chi-square test evaluated the statistical significance of observed cross-national differences. Third, structural equation modeling (SEM) tested causal relationships among four core constructs (climate change awareness, migration perception, trust in institutional policies, and climate action engagement) while also assessing mediation and demographic influence. Finally, hierarchical clustering was conducted on latent construct scores to uncover distinctive attitudinal profiles and engagement typologies.

Country selection was guided by the goal of capturing the socio-political heterogeneity of the Mediterranean region. Italy represents a high-income European setting characterized by institutional continuity and a longstanding history of immigration (Zincone, 2006). Morocco serves as a strategic North African transit country, marked by political stability and significant environmental vulnerability (Okacha et al., 2024; Pérez-Cutillas and Salhi, 2024; Salhi et al., 2024a). Lebanon, by contrast, exemplifies a middle-income context shaped by chronic political fragility and a high concentration of refugees, reflecting complex migration dynamics (Kelley, 2017). This comparative design enables the isolation of cross-cultural contrasts while preserving the broader regional coherence of the study.

2.2. Surveying

The target population was composed of university students, selected as a demographic likely to combine cognitive maturity, information access, and active civic awareness. Their inclusion was also instrumental due to their positionality as future stakeholders in climate governance (Filho et al., 2023). The sample was not probabilistically selected and cannot be considered nationally representative. Consequently, the study is explicitly framed as a pilot, exploratory investigation aimed at testing conceptual models and generating insights to inform future representative research, a scientifically valid approach in exploratory social inquiry (Cornesse et al., 2020; Shorten and Moorley, 2014; Zack et al., 2019).

The questionnaire development process drew on a systematic review of existing tools available through the GESIS – Leibniz Institute for the Social Sciences, a widely recognized repository of validated instruments. Through thematic screening of 64,668 surveys and over 550,000 variables, 120 relevant questions were selected based on theoretical coverage, prior use, and clarity. These were grouped into seven thematic sections: (a) demographic information, (b) general knowledge about climate change and migration, (c) attitudes and perceptions toward climate change, (d) perceptions of migration, (e) views on the intersection of climate and migration, (f) personal actions and engagement, and (g) evaluations of government and institutional responses (Table 1).

Subsequent revisions involved the elimination of redundant or overlapping questions and the addition of ad hoc items to capture country-specific or emerging issues (Nichols et al., 2022). The resulting instrument was reviewed by a multidisciplinary panel of scholars in migration, climate change, and behavioral economics. A pilot test was conducted with a small group of university students from each participating country to refine phrasing and detect ambiguity. The final questionnaire was translated from English into French and Italian, reviewed for semantic consistency, and then uploaded to Google Forms.

The survey was launched on July 26 and closed on September 10, 2023. It was distributed through official university mailing lists and the Erasmus Student Network (ESN) branches in Italy and Morocco. While response rates could not be rigorously tracked, the final valid sample comprised 1425 completed questionnaires (Italy $n = 1162$; Lebanon $n = 135$; Morocco $n = 128$), each screened for eligibility (nationality, age, and current academic status). The data were anonymized, cleaned, and formatted for subsequent analysis. Respondents answered using a combination of nominal and ordinal response formats, including dichotomous (Yes/No) and 5-point Likert-type scales (e.g., Strongly Disagree to Strongly Agree), depending on the construct being measured. These formats were consistent across the three countries.

Ethical compliance was ensured through voluntary, anonymous participation. No personal identifiers were collected, and the study protocol adhered to accepted social science research ethics guidelines. The questionnaire underwent internal ethical review by the author's institutional panel and was confirmed to pose minimal risk to participants.

2.3. Data analysis

The analytical strategy followed a four-stage design aligned with the conceptual framework and hypotheses of the study. All statistical analyses were performed using the Jamovi software environment (version 2.4.11), which integrates the R-based lavaan module (Rosseel, 2012) for latent modeling, for latent modeling, and complemented by tools for inferential testing and clustering.

2.3.1. Descriptive and inferential analysis

Initial analysis employed descriptive statistics (frequencies, means, and standard deviations) to outline participant demographics and general response distributions (Park et al., 2009). Cross-tabulations and Chi-square tests were then conducted to assess national-level variation and determine whether observed differences across countries were statistically significant (Franke et al., 2011). This stage aimed to establish foundational trends and guide the modeling strategy in subsequent steps (Siperstein et al., 2007).

2.3.2. Contingency testing

To assess the statistical relevance of national differences, Pearson's Chi-square tests were conducted on all categorical variables across the three country groups. This step tested the independence of response distributions and provided empirical support for between-country comparisons in subsequent modeling (Hong et al., 2017).

Table 1

Demographic characteristics and perceptions on climate change and migration. This table presents the demographic breakdown and the responses to various factors related to climate change and migration. The data includes valid and missing responses, frequency percentages, and chi-square (χ^2) values indicating significant variations across different countries. Significance is explained by p-values: *p < 0.1, **p < 0.05, ***p < 0.01.

	Code	Factor	Valid	Missing	Frequency (%)	χ^2
a) Demographics	A1	Age	1425	0	63.298 20.351 5.754 10.596	137.0***
	A2	Gender	1385	40	64.260 35.740	51.0***
	A3	Country of Residence	1425	0	81.544 9.474 8.982	
	A4	Field of Study	1404	21	2.778 40.171 20.655 36.396	109.0***
b) General questions on climate change and migration	B1	Familiarity: Climate Change	1425	0	0.491 40.211 59.298	22.7***
	B2	Familiarity: Migration	1425	0	5.754 53.825 40.421	73.2***
	B3	Change in Weather	1425	0	4.281 95.719	0.9
	B4	Internal Migration	1425	0	70.386 29.614	112.6***
	B5	External Migration	1425	0	53.193 46.807	19.4***
	B6	CC More Migration	1285	140	41.089 13.930 17.665 24.825 2.490	72.7***

(continued on next page)

Table 1 (continued)

	Code	Factor	Valid	Missing	Frequency (%)	χ^2
c) Perceptions of and Attitudes to Climate Change	C1	Climate Always Change	1425	0		1.8
		No			56.351	
		Yes			43.649	
	C2	CC Unreliable Evidence	1425	0		253.5***
		Agree			4.982	
		Disagree			34.316	
		Neutral			7.439	
		Strongly agree			2.947	
		Strongly disagree			50.316	
	C3	Responsibility: Developed Countries	1425	0		112.5***
		No			86.246	
		Yes			13.754	
	C4	CC Impact Developing Countries	1355	70		27.7***
		Agree			24.280	
		Disagree			31.661	
		Neutral			10.258	
		Strongly agree			9.004	
		Strongly disagree			24.797	
	C5	CC Reduce Disasters	1425	0		111.3***
		No			95.228	
		Yes			4.772	
	C6	Concern: Climate Impact	1425	0		73.7***
		Neutral			3.088	
		Not concerned at all			0.842	
		Not very concerned			1.404	
		Somewhat concerned			30.246	
		Very concerned			64.421	
	C7	Have Formal Education CC	1425	0		19.0***
		No			52.842	
		Yes			47.158	
	C7bis	Have Formal Education Migr	1425	0		
		No			72.632	
		Yes			27.368	
	C8	CC Should be Taught	1425	0		19.0***
		No			5.684	
		Yes			94.316	
	C10	CC responsible for Recent Hydroclimate Risks	1388	37		95.3***
		Agree			41.931	
		Disagree			2.738	
		Neutral			8.501	
		Strongly agree			45.677	
		Strongly disagree			1.153	
	C11	Media Alarmism	1403	22		129.4***
		Agree			16.964	
		Disagree			34.569	
		Neutral			17.177	
		Strongly agree			7.341	
		Strongly disagree			23.949	
	C12	Media Reporting Increase	1378	47		175.2***
		Agree			7.112	
		Disagree			43.832	
		Neutral			10.522	
		Strongly agree			1.669	
		Strongly disagree			36.865	
	C15	Sea Level Rise Impact	1425	0		7.9**
		No			55.509	
		Yes			44.491	

(continued on next page)

Table 1 (continued)

	Code	Factor	Valid	Missing	Frequency (%)	χ^2
d) Perceptions of and Attitudes to Migration Flows	D1	Climate-driven Migration	1425	0		50.9***
		No			86.807	
		Yes			13.193	
	D2	Perception of Migration Impacts	1312	113		8.3*
		Both positive and negative			65.244	
		Mostly negative			24.085	
		Mostly positive			10.671	
	D3	More International Cooperation Needed	1425	0		63.3***
e) Perceptions of and Attitudes to Climate Change and Migration		No			7.228	
		Yes			92.772	
	D4	Recent Extent of Migration	1231	194		14.7***
		Have decreased			4.630	
		Have increased			78.798	
		Unchanged			16.572	
	E1	CC Affects Migration Patterns	1425	0		46.6***
		Agree			43.789	
		Disagree			7.228	
		Neutral			26.175	
		Strongly agree			21.333	
		Strongly disagree			1.474	
	E2	Concern: Climate Migration	1425	0		74.2***
		Neutral			31.368	
		Not concerned at all			2.526	
		Not very concerned			8.351	
		Somewhat concerned			40.632	
		Very concerned			17.123	
	E3	Countries to take Measures for Climate Migration	1425	0		8.3**
		No			24.421	
		Yes			75.579	
	E4	Legal Protection of Climate Migrants	1332	93		45.9***
		Agree			40.916	
		Disagree			8.183	
		Neutral			14.489	
		Strongly agree			33.784	
		Strongly disagree			2.628	
	E5	Radical Changes Needed	1425	0		73.3***
		Agree			28.912	
		Disagree			2.807	
		Neutral			6.737	
		Strongly agree			60.281	
		Strongly disagree			1.263	
	E6	Bad Economic Impact of Migration	1425	0		87.2***
		No			89.053	
		Yes			10.947	

(continued on next page)

Table 1 (continued)

	Code	Factor		Valid	Missing	Frequency (%)	χ^2
f) Personal Actions and Engagement	F1	Personal Importance of CC	Not at all important	1425	0	0.772	65.4***
			Not very important			4.421	
			Quite important			33.053	
			Very important			61.754	
	F2	CC Personal Impact	No	1425	0	12.842	35.4***
			Yes			87.158	
	F3	Personal Awareness Actions	No	1425	0	31.649	20.8***
			Yes			68.351	
	F4	Personal Mitigation Actions	No	1425	0	10.246	72.5***
			Yes			89.754	
	F5	Consider Migrate due to CC	No	1425	0	67.860	20.0***
			Yes			32.140	
	F6	Economic Sacrifices for the Environment	Agree	1425	0	47.088	42.0***
			Disagree			5.333	
			Neutral			18.175	
			Strongly agree			27.439	
			Strongly disagree			1.965	
	F7	Job Sacrifices for the Environment	Agree	1425	0	24.561	31.7***
			Disagree			24.632	
			Neutral			32.982	
			Strongly agree			10.175	
			Strongly disagree			7.649	
	F9	Your Action Makes a Difference	Agree	1403	22	9.123	48.0***
			Disagree			45.759	
			Neutral			13.542	
			Strongly agree			3.564	
			Strongly disagree			28.011	
	F10	Mandatory Reduction of Energy Consumption	Agree	1418	7	41.890	60.1***
			Disagree			8.533	
			Neutral			16.573	
			Strongly agree			30.324	
			Strongly disagree			2.680	
	F12	View on the Use of Extreme Activism	Major effect	1425	0	11.930	72.2***
			Minor effect			24.211	
			Moderate effect			27.088	
			Neutral			19.509	
			No effect			17.263	
	F13	Effectiveness of Youth Activism	No	1425	0	34.807	29.0***
			Yes			65.193	
	F14	Experience Calamity	No	1425	0	52.842	50.3***
			Yes			47.158	
g) Perception of Government Policies	G1	Government Measures Sufficient	No	1286	139	96.267	19.8***
			Yes			3.733	
	G2	Government Honest Towards CC	Agree	1286	139	8.009	13.6**
			Disagree			41.991	
			Neutral			22.706	
			Strongly agree			1.944	
			Strongly disagree			25.350	
	G3	Government Doing Enough Effort	Agree	1286	139	28.460	39.2***
			Disagree			2.955	
			Neutral			8.165	
			Strongly agree			58.709	
			Strongly disagree			1.711	

2.3.3. Structural equation modeling (SEM)

Structural Equation Modeling was used to test causal relationships among four endogenous latent constructs.

- Climate Change Awareness (CCA): operationalized through four items: familiarity with climate change (B1 question in Table 1), perception of changing weather patterns (B3), knowledge of climate-induced migration (B5), and exposure to formal education on climate-migration issues (C7).
- Migration Perception (MP): including familiarity with migration flows (B2), belief in climate as a migration driver (D1), and support for related public measures (E3).
- Climate Action Engagement (CAE): comprising self-reported mitigation behavior (F4), willingness to incur economic costs (F6), and active participation in climate initiatives (F8).
- Policy Trust and Effectiveness (PTE): based on perceptions of government action sufficiency (G2), honesty in climate policy (G1), and belief in the need for more institutional effort (G3).

Demographic variables (gender, age, field of study, country) were modeled as an exogenous latent factor to evaluate their combined structural influence. This modeling choice followed from observed correlations in the descriptive phase and aimed to capture the interactive effect of structural background conditions on youth engagement. Each demographic variable was numerically coded using theory-informed ordinal categories (Foldnes and Grønneberg, 2022; Kim et al., 2019). This approach was grounded in established SEM practice for pilot datasets where demographic interactions are hypothesized to exert compound effects (Garrido et al., 2022). The dataset was screened for completeness, and responses with missing values on key latent construct items were excluded through listwise deletion to ensure the validity of SEM estimates (Amusa and Hossana, 2024).

Model fit was evaluated using conventional indices: χ^2 test, Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR) (Lai and Green, 2016; Salhi et al., 2024b). Information-theoretic criteria (AIC, BIC) were also reported (Vrieze, 2012). All parameters were interpreted using standardized path coefficients, and both direct and indirect effects were estimated where mediation was hypothesized (e.g., MP → PTE → CAE) (Hayes and Preacher, 2010).

2.3.4. Hierarchical clustering and typology development

In the final stage, hierarchical clustering was used to identify latent profiles within the dataset (Farrelly et al., 2017). The decision to use hierarchical clustering (Ward's method with correlation-based distance) was based on the categorical and ordinal nature of the variables and the exploratory, non-representative character of the dataset (Leese and Landau, 2006). Latent Profile Analysis (LPA), though initially considered, was rejected due to its reliance on normally distributed, continuous input variables and minimum sample size requirements (Spurk et al., 2020; Wang et al., 2021). Our approach allowed for the extraction of meaningful groupings even under distributional irregularities.

A dendrogram was constructed to visualize cluster composition and relational distances. Cluster stability was validated using Approximately Unbiased (AU) and Bootstrap Probability (BP) p-values. Clusters with AU > 95 % were interpreted as statistically reliable (Suzuki and Shimodaira, 2006). These profiles were then analyzed in terms of their climate awareness, migration perceptions, action tendencies, and policy trust, offering an interpretive typology of youth engagement.

3. Results

3.1. Descriptive synthesis

The demographic breakdown of the results reveals significant differences in age, gender, and fields of study across the three countries (Fig. 1a). In Italy and Lebanon, the majority of respondents are aged 18–24, with a fairly even split between males and females, and a higher representation from science and law respondents. Morocco and Lebanon show a balanced age distribution but have a higher proportion of males, with respondents primarily from humanities and social science backgrounds.

Interestingly, familiarity with climate change and migration is more uniformly distributed across the three countries, with Italy leading in the “very familiar” category. Opinions on whether climate change causes more migration are mixed, with a notable percentage of respondents from Morocco and Italy agreeing, while Lebanese participants are more neutral (Fig. 1b).

There is a broad consensus across all three countries that climate change is responsible for recent hydroclimatic risks, although the strength of this agreement varies (Fig. 1c). Italians and Moroccan respondents are more likely to strongly agree, while Lebanese are more divided. Media alarmism about climate change is perceived differently; a significant portion of respondents from Lebanon and Morocco agree that the media exaggerates the issue, whereas Italian respondents are more skeptical of this claim.

Perceptions of migration show considerable agreement (Fig. 1d). In all three countries, the majority view migration as both negative and positive, the recent extent of migration is perceived to have increased notably, and the need for international cooperation is recognized.

The intersection of climate change and migration is a critical issue, with respondents from all three countries acknowledging that climate change affects migration patterns (Fig. 1e). Likewise, there is a consensus for the need for legal protection for climate migrants and that radical changes are needed to address these issues, particularly among Moroccan and Italian respondents.

When it comes to personal sacrifices for the environment, participants from Italy and Morocco are more willing to make economic sacrifices compared to their Lebanese counterparts (Fig. 1f). There is disagreement about the effectiveness of individual actions in

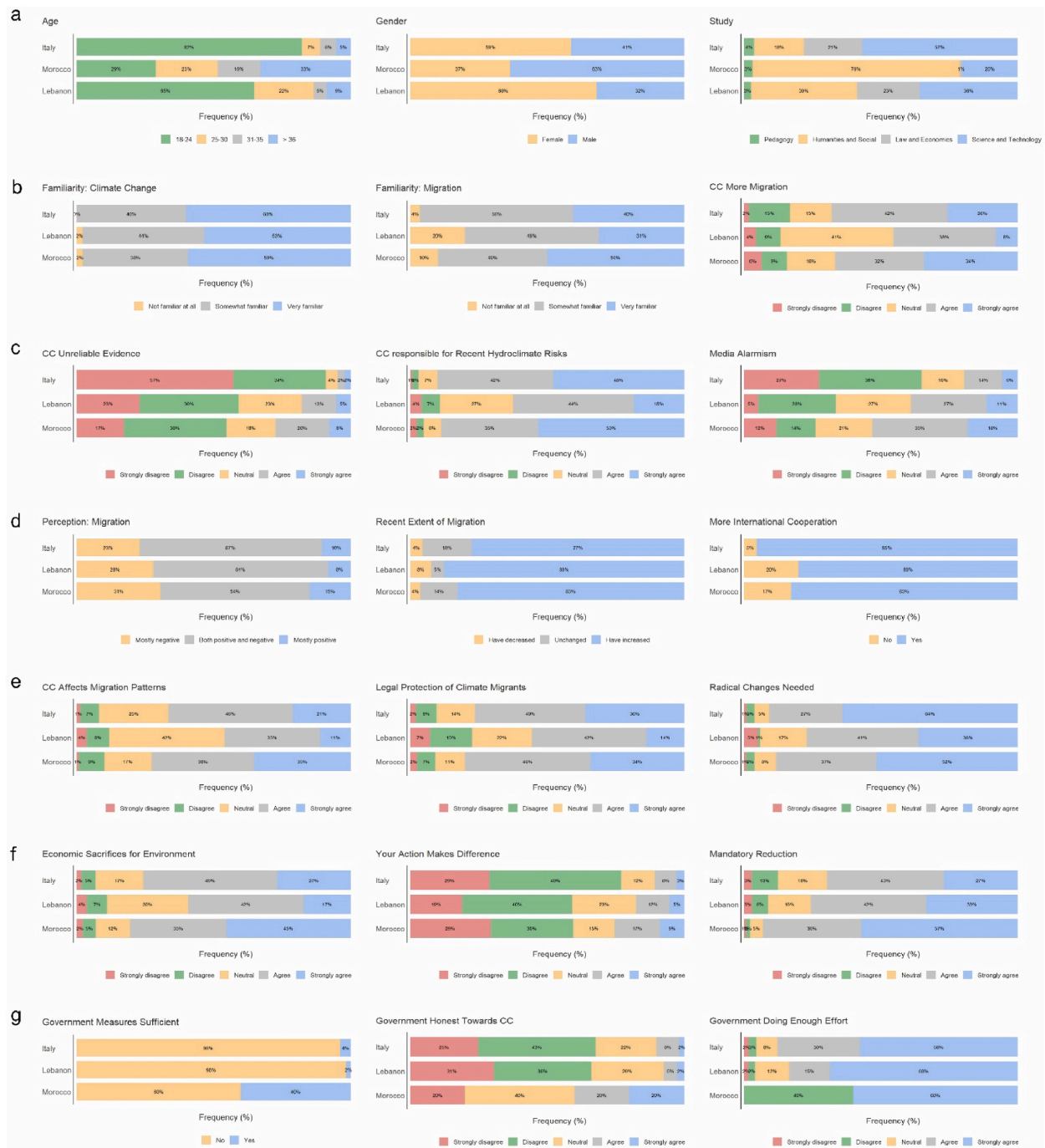


Fig. 1. Descriptive plots of some significant survey results. a: demographic information; b: general questions on climate change and migration; c: perceptions and attitudes towards climate change; d: perceptions and attitudes towards migration flows; e: perceptions and attitudes towards the intersection of climate change and migration; f: personal actions and engagement; g: perception of government policies.

making a difference. The idea of mandatory reductions to combat climate change is more positively received in Morocco than in Lebanon and Italy.

The perception of government measures and honesty towards climate change is another area of interest (Fig. 1g). Lebanese respondents are the most critical, expressing strong disagreement that their government is doing enough or being honest about climate change efforts. Italian and Moroccan respondents are slightly more positive but still show a significant level of skepticism.

While descriptive statistics provide valuable insights into apparent elements such as demographic differences and general attitudes,

they fall short in establishing the strength and significance of each variable and the correlations among two or more variables. Therefore, the relevance of inferential statistics described next is crucial for a deeper understanding of these relationships and their implications.

3.2. Cross-country analysis of perceptions and attitudes

Our analysis employed Pearson's Chi-squared test to evaluate the independence of responses across different countries. The null hypothesis posited no difference in the relative frequency of answers across categories, with countries being the focal category. The results revealed statistically significant differences across respondents from different countries for the majority of variables. However, for 13 out of 120 variables, this difference was not significant, indicating a p-value greater than 0.05 (Table 1). The variables that did not show significant differences are particularly telling. Five of these pertained to the sources of information utilized by respondents to learn about climate change, suggesting uniformity in information dissemination across the different countries. Similarly, perceptions regarding recent changes in weather patterns and extreme weather events did not vary significantly, nor did views on the natural variability of climate change and the necessity of climate change education in schools and universities. This uniformity extends to the perception of migration flows across the Mediterranean and the perceived importance of inequality and uneven development as drivers for migration.

The lack of significant variability in these factors may suggest a consensus or a shared cultural understanding of climate change and its impacts. It could also indicate that climate change and its consequences are being experienced and acknowledged uniformly by the youth in the Mediterranean countries. The homogeneity in educational needs and perceptions of natural climate variability points towards a common educational framework or public discourse that shapes these views.

In contrast, the analysis of gender and age group differences revealed a higher degree of heterogeneity, with 42 and 62 variables showing non-significant heterogeneity, respectively. This suggests that while there is variability within countries based on gender and age, the country dimension is a more dominant factor in explaining the attitudes of respondents towards climate change.

The findings underscore the importance of the country dimension in understanding climate change and migration attitudes (Fig. 2a). Respondents from all three countries declared a high level of familiarity with the concept of climate change. The majority have observed changes in weather patterns or extreme weather events in the past 5–10 years, indicating a regional awareness of climate shifts. A significant minority attributes climate change to natural causes, reflecting a degree of skepticism about human influence. This skepticism is further evidenced by the varied perceptions of greenhouse gas liability and the role of developed countries in emissions. The consensus that climate change will not reduce the frequency and severity of natural disasters aligns with IPCC projections, revealing an informed student body.

The disparity in formal education on climate change and migration issues across the countries highlights the need for a more standardized educational approach. The overwhelming support for climate change education in schools and universities, coupled with the reliance on the internet and television as primary information sources, suggests avenues for targeted educational interventions.

The intricate patterns of cross-country variability in climate change perceptions and migration dynamics observed among respondents offer a rich ground for hypothesis generation (Fig. 2a, b). The significant differences in perceptions about climate change's role in migration, its economic impacts, the degree of personal concern and action, and the perception of government discourse and measures reflect the complex interplay of cultural, educational, and socio-economic factors (Fig. 2c, d).

- One hypothesis that emerges is the pivotal role of education in shaping climate change perceptions. The variability in formal education levels on climate change and migration issues across the countries suggests that educational systems significantly influence respondents' understanding and attitudes. This is supported by the high reliance on the internet and television as information sources, which may not provide the depth and rigor of formal education.
- Another hypothesis concerns the economic impact of migration. The mixed perceptions, especially the view of migration as predominantly negative in Morocco, could be hypothesized to stem from the varying economic realities and media narratives prevalent in each country. This suggests that economic conditions and media portrayal of migration may shape public opinion more than the actual migration trends.
- The consensus on the need for international cooperation to manage migration flows points to a shared recognition of the transnational nature of climate change and migration challenges. This implies that respondents are aware of the limitations of national policies and the necessity for a collaborative approach to address these global issues.
- The results also suggest a hypothesis regarding legal protections for climate migrants. The majority agreement across all countries indicates a universal moral stance on human rights, while the higher disagreement in Lebanon may reflect a more immediate experience with migration issues, possibly leading to a more complex view on the subject.

These four hypotheses have broader implications for policy and education. They suggest that policymakers and educators should consider the nuanced perceptions and attitudes toward climate change and migration when designing interventions. Tailored educational programs that address the specific informational needs and misconceptions in each country could be more effective in fostering informed and proactive attitudes.

The shared perceptions across countries, as indicated by the non-significant differences in 13 out of 120 variables (Table 1), offer a glimpse into the collective consciousness regarding climate change. This suggests that a few aspects of climate change discourse have penetrated public awareness to such an extent that they are recognized similarly across diverse cultural and national backgrounds. These aspects include the perceived necessity of climate change education and the lack of perceived differences in recent weather

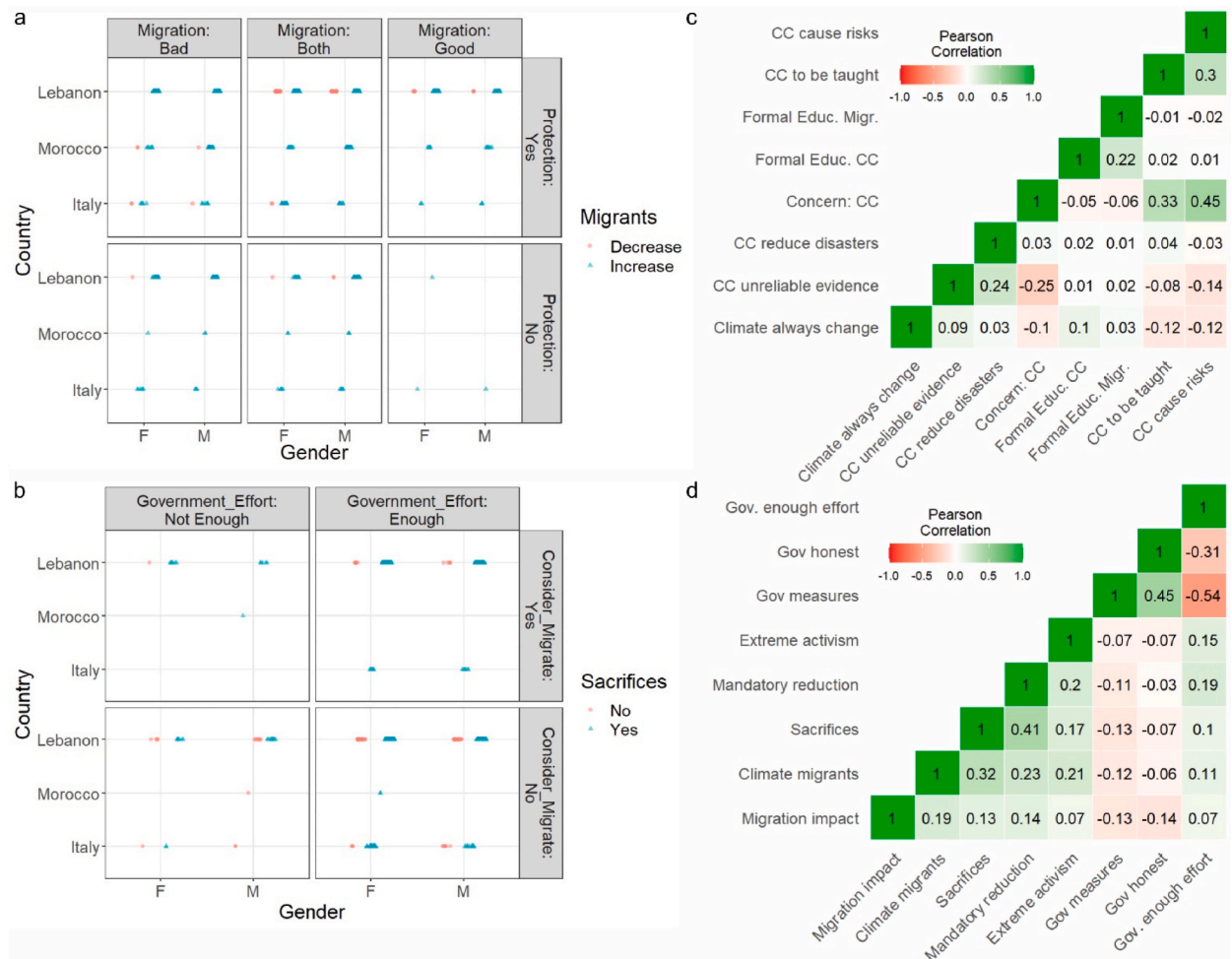


Fig. 2. Influence of demographic factors on migration perception and climate action engagement, and correlation among variables. This figure illustrates the impact of demographic factors, particularly gender and country of residence, on perceptions of migration and climate action engagement, and the correlations between different climate and migration-related variables. The analysis is divided into four plots, each addressing different aspects of these perceptions and correlations. a: Migration perception as a function of its economic impact (bad, good, or both), the need for legal protection for climate migrants (yes or no), and the recent extent of migrants (decrease or increase). b: Climate action engagement as a function of government efforts (enough or not), the willingness to consider migration due to climate change (yes or no), and the willingness to make economic sacrifices for the sake of the environment (yes or no). c: Correlation heatmap showing Pearson's correlations between variables related to climate change perceptions and education. d: Correlation heatmap showing Pearson's correlations between variables related to government efforts, climate migrants, and personal actions. The strength of the correlation is highlighted with a color scale ranging from darker green (strong positive correlation) to white (no correlation) to darker red (strong negative correlation).

patterns and extreme weather events.

The divergent perceptions, on the other hand, provide a rich tapestry of individual and national narratives. The significant differences reflect the unique socio-economic, cultural, and educational contexts of each country. For instance, the varied views on the natural variability of climate change and the responsibility for greenhouse gas emissions underscore the influence of local educational content, media narratives, and personal experiences with climate change.

3.3. Analysis of the demographic exogenous latent factor and its impacts

The previous findings serve as a critical precursor to the implementation of structural equation modeling (SEM). The latter allows for a deep analysis of the relationships between observed variables and latent ones to construct a model that captures the intelinks between demographic factors, climate change awareness, migration perception, climate action engagement, and policy trust and effectiveness among youth. The model was rigorously tested with a variety of parameters and combinations until an optimal fit was achieved (Fig. 3). The fit indices demonstrate the model robustness, with a Chi-square (χ^2) value of 367, degrees of freedom (df) of 104, and a p-value of less than 0.001. The Comparative Fit Index (CFI) is 0.92, and the Tucker-Lewis Index (TLI) is 0.91, both confirming the

good fit. The Root Mean Square Error of Approximation (RMSEA) is 0.06, and the Standardized Root Mean Square Residual (SRMR) is 0.05, further affirming the model's adequacy.

Findings show the demographic factor, a latent variable, was influenced by participants' field of study, country of residence, gender, and age, each coded numerically based on assumptions about their relative impacts on the latent variables.

It was challenging to interpret each field of study given the respondents were free to enter information, resulting in a wide variety of specializations without specific data on the modules taught. Therefore, we decided to classify them into four broader fields of study: science and technology, law and economics, humanities and social science, and education and pedagogy. The field of study was coded numerically, with science and technology fields assigned the highest value of 4, reflecting the assumption that these fields are most engaged with climate change issues. Law and economics received a value of 3, followed by humanities and social science with a value of 2, and education and pedagogy with a value of 1, based on the assumption that these fields are less frequently engaged with climate change and migration. However, the analysis revealed a significant negative influence of the field of study on the demographic factor (-2.59), suggesting that the initial assumptions underestimated the engagement of fields like pedagogy, humanities, and social science with climate change and migration issues (Fig. 3). This indicates that respondents in these fields (humanities, social science, and pedagogy) may be more involved or aware of climate change and migration than initially assumed.

Countries were coded based on their World Development Indicators from the World Bank, with Italy assigned the highest value (3), followed by Morocco (2), and Lebanon (1). The influence of the country of residence was strongly positive (4.39), indicating the substantial role of socio-economic context in shaping perceptions and engagement with climate change and migration. Gender was coded with females as 1 and males as 2. The significant negative influence (-4.27) indicates that females had a greater impact on the demographic factor, which may reflect higher levels of concern or engagement with these issues among young women. Age had a non-

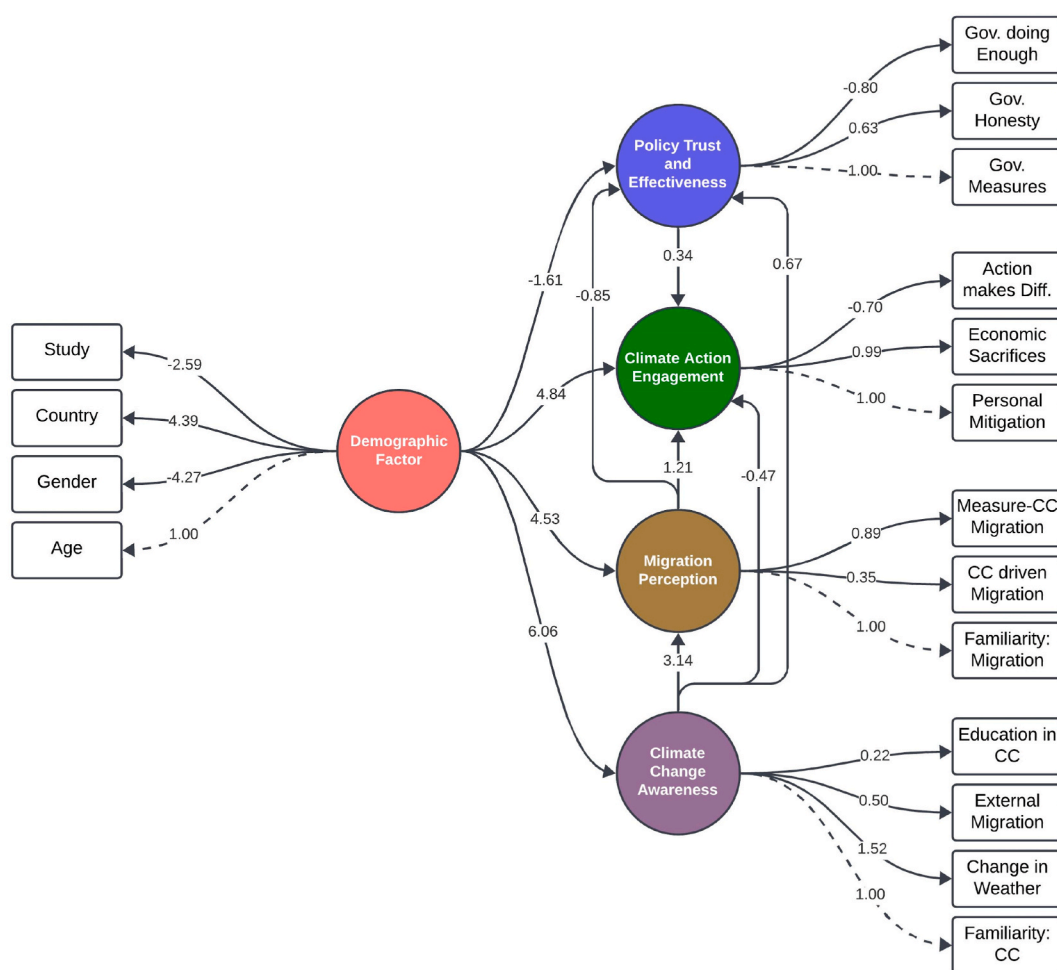


Fig. 3. Structural equation model (SEM) analyzing the influence of demographic factors on latent variables. This figure summarizes how demographic factors, including field of study, country of residence, gender, and age, impact various aspects of climate change and migration perceptions. It highlights the significant effects of demographic assets on Climate Change Awareness (CCA), Migration Perception (MP), Climate Action Engagement (CAE), and Policy Trust and Effectiveness (PTE). The pathways depict how enhancing climate change awareness influences migration perception and engagement in climate action, emphasizing the importance of building trust in policies.

significant influence, likely due to the narrow age range among the youth participants, which did not allow for significant contrasts within the population.

3.4. Analysis of endogenous latent variables and their interrelations

Climate Change Awareness (CCA) was significantly influenced by several observed variables (Fig. 3). Formal education on climate change had a positive but relatively low influence (0.22), suggesting that while education contributes to awareness, other factors might be more impactful. The ability to link climate change with external migration had a stronger positive influence (0.50), indicating that understanding the connections between climate change and migration enhances awareness. The perception of weather pattern changes had the highest positive influence (5.12), highlighting the role of personal experiences and media in raising awareness. Familiarity with climate change concepts, although positive, was not statistically significant, suggesting that mere familiarity may not be sufficient for deeper awareness. The demographic factor had a significant positive influence on CCA (6.06), indicating that better socio-economic indicators, the presence of active young females, and the overall demographic context significantly enhance climate change awareness.

Migration Perception (MP) was influenced by familiarity with migration concepts, which had a positive but non-significant influence. The belief in specific measures for climate migration had a significant positive influence (0.89), highlighting the importance of recognizing climate migration. The perception of climate-driven migration also had a significant positive influence (0.35). The demographic factor positively influenced MP (4.53), indicating that demographic characteristics significantly shape perceptions of migration. Interestingly, CCA had a positive direct influence on MP (3.14), implying that higher awareness of climate change may enhance the ability to perceive migration peculiarities.

Climate Action Engagement (CAE) was shaped by personal mitigation actions, which, though positive, were not statistically significant. The willingness to make economic sacrifices showed a strong and significant positive influence (0.79), indicating a commitment to addressing climate change through economic means. The belief that individual actions make a difference had a significant negative impact (−0.70), suggesting that frustration over perceived ineffectiveness drives greater engagement in climate actions. However, excessive frustration could lead to passivity, a critical point for future interventions. The demographic factor positively influenced CAE (4.84), suggesting that better demographic settings might increase engagement in climate actions.

Policy Trust and Effectiveness (PTE) was influenced by the belief in the sufficiency of government measures, which was positive but not significant. The perception of government honesty had a significant positive influence (0.63). However, the belief that governments could do more had a strong negative impact (−1.00), indicating significant dissatisfaction with current governmental actions on climate change. The demographic factor had a significant negative influence on PTE (−1.61), suggesting that better demographic settings could lead to lower trust in institutional policies. However, PTE positively influenced CAE (0.34), highlighting the positive role of institutional trust in motivating climate action engagement.

The demographic factor exhibited significant positive impacts on CCA (6.06), MP (4.53), and CAE (4.84) while negatively impacting PTE (−1.61). This suggests that demographic assets (such as better socio-economic context, higher levels of involvement among young women, and increased integration of humanities and social sciences) may enhance climate change awareness, shape perceptions of migration, and increase climate action engagement. Conversely, these same assets suggest a predisposition toward a lack of trust in institutional policies.

Climate Change Awareness (CCA) pathways showed a positive direct impact on MP (3.14), and PTE (0.67), underscoring the importance of enhancing climate change awareness to foster better perception of migration and trust in policy. Notably, CCA negatively influences CAE directly but turns positive when passed through PTE, emphasizing the need to build trust in policies to enhance climate action engagement.

Migration perception (MP) pathways indicated a direct positive impact on CAE (1.21) and indirect influence through PTE (firstly negative to PTE (−0.85) then positive to CAE (0.34)). This suggests that enhancing migration perception directly boosts engagement in climate action and indirectly does so when policy trust issues remain solved.

These findings empirically confirm the hypothesis that higher levels of climate change awareness are positively associated with greater climate action engagement. Likewise, the results support the hypothesis that migration perception enhances trust in government responses to climate and migration issues. The hypothesis suggesting that trust in policy mediates the relationship between migration perception and climate engagement is also validated by the structural model. Finally, the analysis confirms the hypothesis that demographic factors (including gender, national context, and academic background) exert a significant influence on perceptions, intentions, and behavioral responses related to both climate and migration.

3.5. Clustering analysis of youth engagement in climate action and migration advocacy

The hierarchical clustering analysis provides a comprehensive understanding of how various topics related to climate action and migration advocacy are perceived by the youth. The cluster dendrogram (Fig. 4), created using Ward's method and correlation-based distance measures, reveals significant insights into the clustering logic and the stability of these groupings. Clusters with high Approximately Unbiased (AU) p-values (greater than 95 %) are highlighted with red rectangles, indicating their stability and reliability. These clusters represent groups of topics that are closely related, providing robust thematic areas within the broader discourse on climate change and migration. The dendrogram shows that certain topics merge at a low height with high AU p-values, indicating a strong similarity between them. Conversely, clusters merging at higher heights indicate greater dissimilarity among the topics grouped at that level.

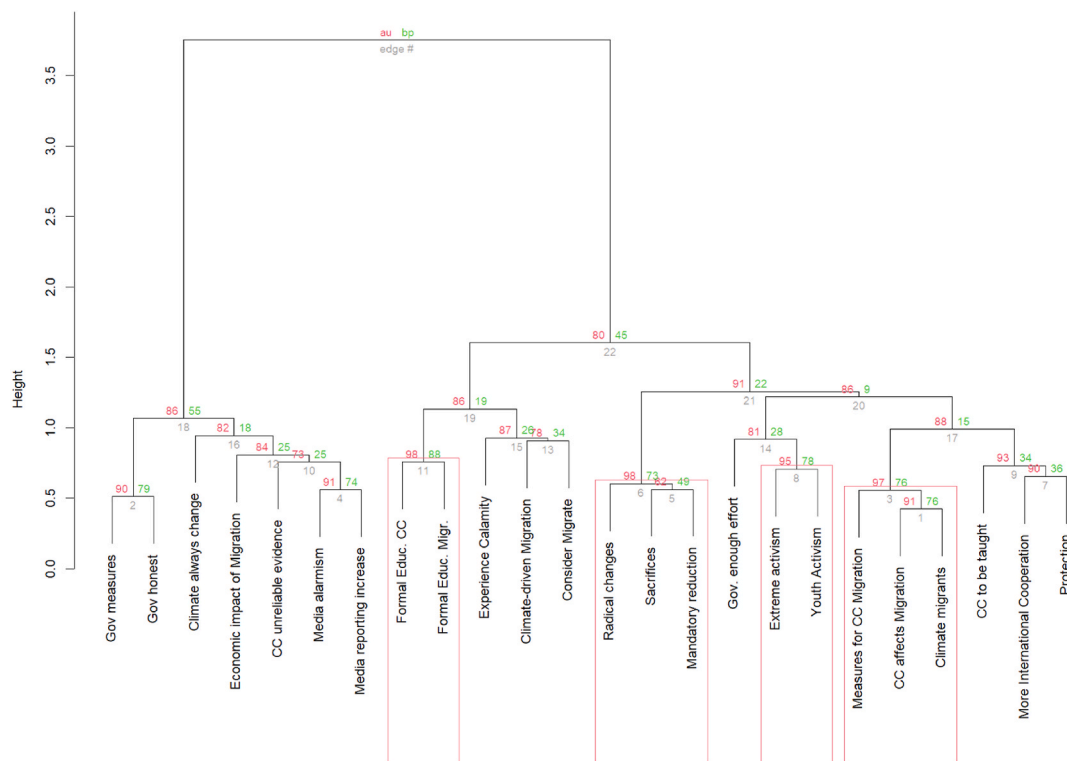


Fig. 4. Cluster dendrogram with p-values for hierarchical clustering of climate change and migration-related factors. The dendrogram illustrates the hierarchical clustering of various observed factors, with the height representing the dissimilarity between clusters. The clustering was performed using Ward's method, and the distance measure is based on correlation. Each leave (bottom label) represents an individual factor. The height at which two branches merge indicates the level of dissimilarity between the clusters they represent. The greater the height, the more dissimilar the clusters. AU (Approximately Unbiased in %) p-value (red value beside each branch) is a measure of the stability of the clusters. High AU p-values (greater than 95 %) suggest that the clusters are statistically highly significant and stable. BP (Bootstrap Probability in %) p-value (green value beside each branch) is the probability of a cluster appearing in the bootstrap resampling. Clusters with high AU and BP values at lower heights are particularly robust and meaningful. Edge numbers correspond to specific branches providing a reference for discussing particular clusters. Red rectangles highlight clusters that are considered statistically significant, based on their high AU p-values. These rectangles encompass clusters with strong support, suggesting that these groupings are robust and meaningful.

The highlighted clusters (red rectangles) provide significant insights into key groupings of related topics. Specifically, youth groups with formal education in climate change and migration exhibit a strong connection (branch 11 in the cluster dendrogram). This suggests that formal education in these topics improves the ability to understand and engage in their advocacy. Additionally, groups endorsing radical changes to address climate migration are closely linked with those willing to make economic sacrifices and support mandatory energy consumption reductions (branch 6). This indicates that deep personal engagement in the climate and migration cause correlates with a readiness to commit to personal and collective imperatives.

Furthermore, clusters in favor of extreme activism are closely related to those supporting the effectiveness of youth activism (branch 8), suggesting that engagement in activism fosters acceptance of its various forms. Groups advocating for new measures for climate migration are related to those acknowledging the impact of climate change on migration and the need for legal protection for climate migrants (branch 3). This implies that recognizing the cause-and-effect relationship between climate change and migration promotes sympathy and support for climate migrants.

The cluster dendrogram also reveals three major youth groups based on their shared characteristics.

- Group 1 (branch 18): This group trusts the honesty of their governments and the measures they are taking, is skeptical about climate change, and considers migration detrimental to their country's economy.
- Group 2 (branch 19): This group has formal education in climate and/or migration, understands the cause-and-effect relationship between climate change and migration, has experienced personal climatic calamities, and may consider migrating due to climate change impacts.
- Group 3 (branch 21): This group supports imposed personal and collective commitments, views activism as a means to improve collective response, sympathizes with climate migrants, and perceives institutional efforts as sufficient.

These groups are identified as 'skeptical pragmatists' (Group 1), 'informed adaptors' (Group 2), and 'committed advocates' (Group

3). Interestingly, Groups 2 and 3 (branch 22) exhibit a strong meaningful relation (AU of 80 %), indicating ease of transition between these groups. This suggests a direct pathway for engaging the youth more deeply in climate-migration advocacy or, inversely, towards a balanced assimilative structure. This pathway likely involves controlling the quality and spread of formal education in climate change and migration across disciplines and countries, enabling individuals to navigate between different levels of engagement.

These empirically derived typologies offer interpretive depth to the structural findings, aligning closely with the study's guiding hypotheses. The segmentation of youth into skeptics, adaptors, and committed advocates illustrates how climate awareness, migration perception, trust in institutions, and demographic context converge to shape meaningful behavioral profiles. In doing so, the typology complements the hypothesis-driven modeling by highlighting real-world groupings that reflect the diversity and complexity of youth engagement across Mediterranean settings.

4. Discussion and conclusion

This study set out to examine the behavioral profiles and perceptions of youth across three Mediterranean countries (Italy, Morocco, and Lebanon) regarding the interconnected challenges of climate change and migration. Anchored in a comparative framework and guided by latent variable modeling, the analysis sought to evaluate four core hypotheses: that climate change awareness enhances climate action engagement; that migration perception influences institutional trust; that trust mediates the relationship between migration perception and action; and that demographic factors shape attitudinal and behavioral responses.

The findings broadly confirm the proposed hypotheses and offer new insights into the ways in which structural, attitudinal, and institutional variables interact in shaping youth engagement. First, the study confirms that youth perceptions of climate change are significantly informed by educational exposure, but also by experiential and media-based knowledge. While formal education showed a positive influence on climate change awareness, the impact of perceived weather anomalies and awareness of climate-induced migration was more substantial. This underscores the importance of integrating real-world experiential learning with structured curricula, as emotional salience and contextual immediacy appear to enhance cognitive engagement with climate issues (Karpudewan and Mohd Ali Khan, 2017; Pierce and Widen, 2017).

The results also suggest that the dominant sources of climate-related information (namely, internet and television) play a crucial role in shaping perceptions, yet may lack the scientific depth required to foster resilient understanding. Previous studies have cautioned against the pitfalls of shallow digital information environments that amplify alarmism or misinformation (Arias, 2019; Rich, 2024). Thus, expanding cross-disciplinary climate education programs, particularly within university systems, emerges as a strategic imperative (DeCamp, 2024; Vila Subirós and Salhi, 2022).

A second set of findings concerns migration perception. The strong alignment between the latter and policy trust supports the hypothesis that affective and cognitive engagement with migration informs broader institutional evaluations. This was particularly evident in Morocco and Italy, where respondents displayed greater empathy toward climate migrants and stronger support for regulatory measures. In contrast, youth in Lebanon, where migration pressures are experienced more immediately through refugee influxes, expressed more uncertainty, perhaps reflecting local fatigue and policy complexity. These findings reaffirm the importance of local context in migration discourse (Ghosh and Orchiston, 2022).

Institutional trust itself emerged as a critical mediator, not only enhancing climate action engagement but also conditioning how climate awareness translates into behavioral intent (Salhi, 2023). Respondents with greater trust in government reported higher willingness to act (even when perceiving systemic inadequacies) suggesting that perceived honesty and responsiveness, more than policy sufficiency alone, sustain public engagement (Hügel and Davies, 2020; Lacey et al., 2018). Notably, this trust is not uniformly distributed: higher socio-economic conditions and female representation were associated with greater awareness and action but also with lower trust in institutions. This paradox invites closer research into how youth reconcile institutional skepticism with civic mobilization, a dynamic observed in other climate justice movements (Castiglione et al., 2022).

The clustering analysis further deepens this narrative. Three distinct groups (i.e., skeptical pragmatists, informed adaptors, and committed advocates) reflect varying levels of engagement and ideological orientation. Of particular interest is the fluidity between the latter two groups, suggesting that with appropriate educational and participatory interventions, youth can move from informed reflection to active advocacy (Neas, 2023). This transition appears facilitated by climate literacy, exposure to migration narratives, and personal experience of climate-related risks.

In light of these insights, several implications emerge. First, youth engagement cannot be addressed monolithically. National context, education systems, and socio-economic positioning all mediate how climate and migration are understood and acted upon (Koubi et al., 2022). Second, policy responses must prioritize institutional transparency and inclusiveness to rebuild trust and strengthen collective commitment (Gomm et al., 2024; Salhi, 2023). Third, formal education (especially when contextually adapted) remains a powerful lever for fostering resilience and cross-border solidarity (Feinstein and Mach, 2020).

The methodological framework offers a replicable model for exploratory studies, while the empirical findings enrich the debate on climate-induced migration and youth agency in transitional societies. Nonetheless, some limitations must be acknowledged. The non-probabilistic, pilot nature of the sample precludes national generalizability. The reliance on self-reported measures may also introduce social desirability bias. Future research should expand the geographic scope, refine variable selection through confirmatory factor analysis, and employ longitudinal designs to track evolving perceptions. Additionally, latent profile analysis could complement the clustering approach once continuous and normally distributed data are available.

Definitely, the findings affirm the critical role of youth in navigating the dual pressures of climate change and migration. Their capacity for reflection, their sensitivity to institutional cues, and their differentiated engagement pathways make them indispensable stakeholders in future climate governance. To fully harness this potential, targeted education, trust-building policy frameworks, and

participatory civic spaces are required. Empowering youth with knowledge, empathy, and trust in responsive institutions will enable Mediterranean societies to more effectively navigate the growing risks and emerging opportunities at the intersection of climate change and migration.

CRedit authorship contribution statement

Adil Salhi: Investigation, Formal analysis, Resources, Data Curation, Validation, Visualization, Writing – original draft, Writing – review & editing. **Giovanni Marin:** Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data Curation, Writing – original draft, Project administration, Funding acquisition. **Elena Paglialunga:** Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data Curation, Writing – original draft, Project administration, Funding acquisition. **Mokgadi Phoebe Ramaloko:** Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data Curation, Writing – original draft, Project administration, Funding acquisition. **Samar Azzi-Achkouti:** Investigation, Formal analysis, Writing – review & editing. **Nathalie Clauter:** Conceptualization, Methodology, Formal analysis, Investigation, Resources, Writing – original draft, Project administration, Funding acquisition. **Anne-Laurence Pastorini:** Conceptualization, Methodology, Formal analysis, Investigation, Resources, Writing – original draft, Project administration, Funding acquisition.

Code availability

Codes are available from the corresponding author upon reasonable request.

Funding

This research was supported by the Italian Ministry of Foreign Affairs and International Cooperation (MAECI).

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.

Acknowledgments

The authors thank Mariam Traore Chazalnoel, IOM Senior Policy Officer, with a specific expertise in Migration, Environment and Climate Change for their careful review of the questionnaire and their insightful comments and suggestions.

Data availability

Data are available from the corresponding author upon reasonable request. The GESIS – Leibniz Institute for the Social Sciences archive is available at <https://search.gesis.org>. The World Development Indicators are available from the World Bank at <https://databank.worldbank.org>.

References

- Alfirević, N., Arslanagić-Kalajdžić, M., Lep, Ž., 2023. The role of higher education and civic involvement in converting young adults' social responsibility to prosocial behavior. *Sci. Rep.* 13, 2559.
- Amusa, L.B., Hossana, T., 2024. An empirical comparison of some missing data treatments in PLS-SEM. *PLoS One* 19, e0297037.
- Arias, E., 2019. How does media influence social norms? Experimental evidence on the role of common knowledge. *PSRM* 7, 561–578.
- Balsari, S., Dresser, C., Leaning, J., 2020. Climate change, migration, and civil strife. *Curr. Environ. Health Rep.* 7, 404–414.
- Bendandi, B., 2020. Migration induced by climate change and environmental degradation in the central Mediterranean Route. *Migration in west and North Africa and across the Mediterranean: trends, risks, development and governance*, pp. 318–329.
- Castiglione, A., Brick, C., Holden, S., Miles-Urdan, E., Aron, A.R., 2022. Discovering the psychological building blocks underlying climate action—a longitudinal study of real-world activism. *R. Soc. Open Sci.* 9, 210006.
- Cornesse, C., Blom, A.G., Dutwin, D., Krosnick, J.A., De Leeuw, E.D., Legleye, S., et al., 2020. A review of conceptual approaches and empirical evidence on probability and nonprobability sample survey research. *J. Surv. Statist. Methodol.* 8, 4–36. <https://doi.org/10.1093/jssam/smz041>.
- Cramer, W., Guiot, J., Fader, M., Garrahou, J., Gattuso, J.-P., Iglesias, A., et al., 2018. Climate change and interconnected risks to sustainable development in the Mediterranean. *Nat. Clim. Change* 8, 972–980.
- DeCamp, E., 2024. Integrating climate change across the disciplines: review of a faculty learning community and student climate literacy assessment model. *Environ. Educ. Res.* 30, 2159–2177. <https://doi.org/10.1080/13504622.2024.2309588>.
- Farrelly, C.M., Schwartz, S.J., Amodeo, A.L., Feaster, D.J., Steinley, D.L., Meca, A., et al., 2017. The analysis of bridging constructs with hierarchical clustering methods: an application to identity. *J. Res. Pers.* 70, 93–106.
- Feinstein, N.W., Mach, K.J., 2020. Three roles for education in climate change adaptation. *Clim. Policy* 20, 317–322. <https://doi.org/10.1080/14693062.2019.1701975>.
- Filho, W.L., Yayeh Ayal, D., Wall, T., Shiel, C., Paco, A., Pace, P., et al., 2023. An assessment of attitudes and perceptions of international university students on climate change. *Climate Risk Manag.* 39, 100486. <https://doi.org/10.1016/j.crm.2023.100486>.
- Foldnes, N., Grønneberg, S., 2022. The sensitivity of structural equation modeling with ordinal data to underlying non-normality and observed distributional forms. *Psychol. Methods* 27, 541.

- Franke, T.M., Ho, T., Christie, C.A., 2011. The chi-square test: often used and more often Misinterpreted. *Am. J. Eval.* 33, 448–458. <https://doi.org/10.1177/1098214011426594>.
- Garrido, M., Hansen, S.K., Yaari, R., Hawlena, H., 2022. A model selection approach to structural equation modelling: a critical evaluation and a road map for ecologists. *Methods Ecol. Evol.* 13, 42–53. <https://doi.org/10.1111/2041-210X.13742>.
- Geraci, A., Giordano, G., Cucinella, N., Cannavò, M., Cavarretta, M.V., Alesi, M., et al., 2024. Psychological dimensions associated with youth engagement in climate change issues: a person-centered approach. *Curr. Psychol.* 43, 25836–25846. <https://doi.org/10.1007/s12144-024-06263-3>.
- Ghosh, R.C., Orchiston, C., 2022. A systematic review of climate migration research: gaps in existing literature. *SN Soc. Sci.* 2, 47. <https://doi.org/10.1007/s43545-022-00341-8>.
- Gomm, S., Hr, A., Dennis, K., Keith, S.E., Bernauer, T., 2024. Procedural inclusiveness can mitigate trust challenges in environmental policymaking. *J. Eur. Publ. Pol.* 1–27. <https://doi.org/10.1080/13501763.2024.2413458>.
- Göpfert, C., Wamsler, C., Lang, W., 2019. A framework for the joint institutionalization of climate change mitigation and adaptation in city administrations. *Mitig. Adapt. Strategies Glob. Change* 24, 1–21.
- Hayes, A.F., Preacher, K.J., 2010. Quantifying and testing indirect effects in simple mediation models when the constituent paths are nonlinear. *Multivariate Behav. Res.* 45, 627–660.
- Helbling, M., Auer, D., Meierrieks, D., Mistry, M., Schaub, M., 2021. Climate change literacy and migration potential: micro-level evidence from Africa. *Clim. Change* 169, 9.
- Hoffmann, R., Zens, G., 2024. Interrelated drivers of migration intentions in Africa: evidence from Afrobarometer surveys. *Environ. Dev.* 52, 101096. <https://doi.org/10.1016/j.envdev.2024.101096>.
- Hong, Q.N., Pluye, P., Bujold, M., Wassef, M., 2017. Convergent and sequential synthesis designs: implications for conducting and reporting systematic reviews of qualitative and quantitative evidence. *Syst. Rev.* 6, 61. <https://doi.org/10.1186/s13643-017-0454-2>.
- Hügel, S., Davies, A.R., 2020. Public participation, engagement, and climate change adaptation: a review of the research literature. *Wiley Interdisciplin. Rev. Clim. Change* 11, e645.
- Josefsson, J., Löw, J., 2025. Representing children and youth in global migration governance: mobilization, corporatist representation and partnerships. *Globalizations* 22, 410–425. <https://doi.org/10.1080/14747731.2024.2416341>.
- Karpudewan, M., Mohd Ali Khan, N.S., 2017. Experiential-based climate change education: fostering students' knowledge and motivation towards the environment. *Int. Res. Geogr. Environ. Educ.* 26, 207–222. <https://doi.org/10.1080/10382046.2017.1330037>.
- Kelley, N., 2017. Responding to a refugee influx: lessons from Lebanon. *J. Migrat. Human Secur.* 5, 82–104. <https://doi.org/10.1177/233150241700500105>.
- Kim, S., Lu, Z., Cohen, A.S., 2019. Reliability for tests with items having different numbers of ordered categories. *Appl. Psychol. Meas.* 44, 137–149. <https://doi.org/10.1177/0146621619835498>.
- Koubi, V., Schaffer, L., Spilker, G., Böhmelt, T., 2022. Climate events and the role of adaptive capacity for (im-)mobility. *Popul. Environ.* 43, 367–392. <https://doi.org/10.1007/s11111-021-00395-5>.
- Kwanhi, T., Modiba, F.S., Mago, S., Matindike, S., Damiyano, D., 2024. Conceptualizing climate-induced migration in Africa. *Environ. Dev.* 52, 101049. <https://doi.org/10.1016/j.envdev.2024.101049>.
- Lacey, J., Howden, M., Cvitanovic, C., R, M.C., 2018. Understanding and managing trust at the climate science–policy interface. *Nat. Clim. Change* 8, 22–28. <https://doi.org/10.1038/s41558-017-0010-z>.
- Lai, K., Green, S.B., 2016. The problem with having two watches: assessment of fit when RMSEA and CFI disagree. *Multivariate Behav. Res.* 51, 220–239. <https://doi.org/10.1080/00273171.2015.1134306>.
- Law, S.F., Le, A.T., 2023. A systematic review of empirical studies on trust between universities and society. *J. High Educ. Pol. Manag.* 45, 393–408. <https://doi.org/10.1080/1360080X.2023.2176598>.
- Lawson, D.F., Sk, T., Nils, P.M., Cs, J., Erin, S., Strnad, R., 2019. Evaluating climate change behaviors and concern in the family context. *Environ. Educ. Res.* 25, 678–690. <https://doi.org/10.1080/13504622.2018.1564248>.
- Leese, M., Landau, S., 2006. Model-based clustering using S-PLUS. *Int. J. Methods Psychiatr. Res.* 15, 146–156. <https://doi.org/10.1002/mpr.191>.
- Ncube, T., Lahlmangaihzuali, Z., Una, M., Nam, N., Theresa, L., Alexandra, K., et al., 2024. Understanding the climate, migration, social protection nexus from a youth mobility dimension: can social protection address the drivers of climigration? *Clim. Dev.* 1–22. <https://doi.org/10.1080/17565529.2024.2380380>.
- Neas, S., 2023. Narratives and impacts of formal climate education experienced by young climate activists. *Environ. Educ. Res.* 29, 1832–1848. <https://doi.org/10.1080/13504622.2023.2193684>.
- Nichols, E., Petrone, K., Vickers, B., Gebrehiwet, H., Surek-Clark, C., Leitao, J., et al., 2022. Mixed-methods analysis of select issues reported in the 2016 World Health Organization verbal autopsy questionnaire. *PLoS One* 17, e0274304. <https://doi.org/10.1371/journal.pone.0274304>.
- Ogunbode, C.A., Doran, R., Hanss, D., Ojala, M., Salmela-Aro, K., van den Broek, K.L., et al., 2022. Climate anxiety, wellbeing and pro-environmental action: correlates of negative emotional responses to climate change in 32 countries. *J. Environ. Psychol.* 84, 101887. <https://doi.org/10.1016/j.jenvp.2022.101887>.
- Okacha, A., Salhi, A., Bouchouou, M., Fattasse, H., 2024. Enhancing flood forecasting accuracy in Data-Scarce regions through advanced modeling approaches. *J. Hydrol.* 645, 132283. <https://doi.org/10.1016/j.jhydrol.2024.132283>.
- Park, H.S., Kk, A., Sandi, S., Martell, D., 2009. Separating subjective norms, university descriptive and injunctive norms, and U.S. Descriptive and injunctive norms for drinking behavior intentions. *Health Commun.* 24, 746–751. <https://doi.org/10.1080/10410230903265912>.
- Pérez-Cutillas, P., Salhi, A., 2024. Long-term hydroclimatic projections and climate change scenarios at regional scale in Morocco. *J. Environ. Manag.* 371, 123254. <https://doi.org/10.1016/j.jenvman.2024.123254>.
- Pickering, G.J., Schoen, K., Botta, M., Fazio, X., 2020. Exploration of youth knowledge and perceptions of individual-level climate mitigation action. *Environ. Res. Lett.* 15, 104080. <https://doi.org/10.1088/1748-9326/abb492>.
- Pierce, J., Widen, H., 2017. Visceral pedagogy: teaching challenging topics emotionally as well as cognitively. *J. Geogr.* 116, 47–56. <https://doi.org/10.1080/00221341.2016.1189586>.
- Piguet, E., Pécoud, A., PdJRSQ, Guchteneire, 2011. *Migration and Climate Change: an Overview*, vol. 30, pp. 1–23.
- Rich, G.J., 2024. *Handbook of Media Psychology: the Science and the Practice*.
- Rosseel, Y., 2012. Lavaan: an R package for structural equation modeling. *J. Stat. Software* 48, 1–36. <https://doi.org/10.18637/jss.v048.i02>.
- Salhi, A., 2023. Leveraging emotional connections for climate change action: the power of solidarity and a common cause. *Mitig. Adapt. Strategies Glob. Change* 28, 22. <https://doi.org/10.1007/s11027-023-10059-4>.
- Salhi, A., Benabdelouahab, S., Heggy, E., 2024a. Growing soil erosion risks and their role in modulating catastrophic floods in North Africa. *Int. J. Appl. Earth Obs. Geoinf.* 133, 104132. <https://doi.org/10.1016/j.jag.2024.104132>.
- Salhi, A., Benabdelouahab, S., Heggy, E., 2025. Soil erosion susceptibility maps and raster dataset for the hydrological basins of North Africa. *Sci. Data* 12, 65. <https://doi.org/10.1038/s41597-025-04406-0>.
- Salhi, A., Larifi, I., Salhi, H., Heggy, E., 2024b. Flooding in semi-unformal urban areas in North Africa: environmental and psychosocial drivers. *Sci. Total Environ.*, 172486. <https://doi.org/10.1016/j.scitotenv.2024.172486>.
- Salhi, A., Vila Subirós, J., Insalaco, E., 2022. Spatial patterns of environmental degradation and demographic changes in the Mediterranean fringes. *Geocarto Int.* 1–17. <https://doi.org/10.1080/10106049.2022.2090619>.
- Santos, A.C., Patricia, A., Dj, R., Carmel, C., Mmh, S., Agoritsa, P., et al., 2023. Social and emotional competencies as predictors of student engagement in youth: a cross-cultural multilevel study. *Stud. High Educ.* 48, 1–19. <https://doi.org/10.1080/03075079.2022.2099370>.
- Santos, C., Mourato, J.M., 2022. Voices of contention: the value of development narratives in the age of climate (change) migration misconceptions. *Clim. Dev.* 14, 13–24. <https://doi.org/10.1080/17565529.2021.1877103>.
- Shorten, A., Moorley, C., 2014. Selecting the sample. *Evid. Base Nurs.* 17, 32–33.

- Siperstein, G.N., Parker, R.C., Bardon, J.N., Widaman, K.F., 2007. A national study of youth attitudes toward the inclusion of students with intellectual disabilities. *Except. Child.* 73, 435–455. <https://doi.org/10.1177/001440290707300403>.
- Spurk, D., Hirschi, A., Wang, M., Valero, D., Kauffeld, S., 2020. Latent profile analysis: a review and “how to” guide of its application within vocational behavior research. *J. Vocat. Behav.* 120, 103445. <https://doi.org/10.1016/j.jvb.2020.103445>.
- Suzuki, R., Shimodaira, H., 2006. Pvcust: an R package for assessing the uncertainty in hierarchical clustering. *Bioinformatics* 22, 1540–1542.
- Thiery, W., Lange, S., Rogelj, J., Schleussner, C.-F., Gudmundsson, L., Seneviratne, S.I., et al., 2021. Intergenerational inequities in exposure to climate extremes. *Science* 374, 158–160. <https://doi.org/10.1126/science.abi7339>.
- Urban, J., Duda, E., 2024. Using the Campbell Paradigm to understand the role of institutional trust in environmental policy support. *Int. J. Sociol.* 54, 476–509.
- Van Den Hazel, P., 2019. The role of youth in the climate change debate. *Eur. J. Publ. Health* 29, ckz185. <https://doi.org/10.1093/eurpub/ckz185.158>, 158.
- Vila Subirós, J., Salhi, A., 2022. El Antropoceno: una interpretación desde la geografía. *Doc. Anal. Geogr.* 68, 493–503.
- Vrieze, S.I., 2012. Model selection and psychological theory: a discussion of the differences between the Akaike information criterion (AIC) and the Bayesian information criterion (BIC). *Psychol. Methods* 17, 228.
- Wang, Y., Kim, E., Yi, Z., 2021. Robustness of latent profile analysis to measurement noninvariance between profiles. *Educ. Psychol. Meas.* 82, 5–28. <https://doi.org/10.1177/0013164421997896>.
- Wullenkord, M.C., Tröger, J., Hamann, K.R.S., Loy, L.S., Reese, G., 2021. Anxiety and climate change: a validation of the Climate Anxiety Scale in a German-speaking quota sample and an investigation of psychological correlates. *Clim. Change* 168, 20.
- Zack, E.S., Kennedy, J., Long, J.S., 2019. Can nonprobability samples be used for social science research? A cautionary tale. *Surv. Res. Method.* 13, 215–227. <https://doi.org/10.18148/srm/2019.v13i2.7262>.
- Zincone, G., 2006. The making of policies: immigration and immigrants in Italy. *J. Ethnic Migrat. Stud.* 32, 347–375. <https://doi.org/10.1080/13691830600554775>.