

Factors affecting psychological distance to climate change adaptation: A case of urban communities in Islamabad, Pakistan

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ABSTRACT

Psychological distance plays a crucial role in shaping climate risk perception and motivating adaptation actions. Understanding the psychological distance dimensions and the determinants influencing adaptation decisions is therefore essential. This study assesses psychological distance to climate change adaptation across four dimensions: spatial, temporal, social, and hypothetical. Data was collected from three urban communities situated in Islamabad, Pakistan, from a random sample of 600 households. An indicator-based approach, supported by descriptive statistics and the composite index method, was applied to calculate psychological distance and its dimensions. The relationship between the dimensions was examined using Pearson's correlation, and multiple regression was employed to identify socioeconomic determinants. Findings indicate that households perceived a moderate level of psychological distance from climate change impacts at both the community and national levels. They also expressed confidence in adaptation as a protective measure. Spatial and hypothetical dimensions showed moderate distance, whereas temporal and social dimensions reflected relatively lower distance. The results suggest that urban communities hold an uncertain yet receptive stance toward adaptation. Regression analysis revealed that gender and education of the household head significantly and positively influenced psychological distance, highlighting the role of social and educational factors in shaping perceptions. Significant correlations were observed among the four dimensions of psychological distance. The study highlights the importance of reducing psychological distance through targeted awareness and education initiatives. Policy-makers should prioritize community-based programs, gender-sensitive outreach, and education-driven campaigns to strengthen motivation and enhance the willingness of urban households to adopt climate change adaptation measures.

1. Introduction

Climate change is recognized as a global threat and challenge, with impacts most pronounced in vulnerable urban areas (Carter et al., 2015; IPCC, 2022; Spickett et al., 2011; Wamsler et al., 2013; Waseem et al., 2023). Estimates suggest that climate change-induced extreme events have resulted in 3700 million deaths, disturbed 8000 million population, and caused financial losses amounting to \$3600 billion globally (Birkmann et al., 2022; Pörtner et al., 2022). Additionally, climate change is accelerating the frequency and intensity of extreme events worldwide, with profound implications for both natural and human systems (Waseem & Rana, 2023). Recent empirical evidence suggests

that the global mean surface temperature has risen by approximately 1.1 °C since the pre-industrial period, with warming rates intensifying in recent decades and breaking successive records (NOAA, 2024). Rising temperatures coupled with climate change-induced extreme events have elevated heat-related morbidity and mortality (Dong, Jiang, et al., 2025), increased the spread of vector-borne diseases, and increased mental health burdens, especially among socially and economically vulnerable populations (Dong, Zhu, et al., 2025; Rocque et al., 2021). Furthermore, recent economic estimates suggest that damages driven by climate change, such as infrastructure losses and reduced productivity, pose escalating challenges to global economies and sustainable development (World Meteorological Organization (WMO), 2024).

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Asia, which hosts more than half of the global population, is among the most vulnerable regions to these impacts. The IPCC reports that the continent faces rising surface air temperatures, intensified monsoon variability, accelerated glacier retreat, and increasing coastal hazards, all of which disproportionately affect its rapidly growing urban areas (IPCC, 2022). These risks are compounded by rapid urbanization, inadequate infrastructure, and deep socioeconomic inequalities (Shah et al., 2023; Waseem & Rana, 2025c). South Asia, in particular, has witnessed unprecedented heatwaves and rainfall extremes in recent years, events increasingly attributed to anthropogenic climate change (Chen et al., 2025; Rana et al., 2021; Waseem et al., 2023).

Climate change disproportionately affects developing countries like Pakistan, where a large portion of the population is susceptible, and the government has limited capacity to effectively cope with and manage extreme events, such as floods (Shah et al., 2019). The country faces severe impacts from climate change, including mega floods, glacial lake outburst floods, heatwaves, droughts, and wildfires. Despite having a minimal carbon footprint, the frequency, severity, and onset of extreme events are increasing each year (Ali et al., 2022a; United Nations, 2010). As a result, the German Watch's Climate Risk Index 2025 ranked Pakistan from the 8th-most-affected to the 1st-most-affected country in 2022 (Adil et al., 2025; Shah et al., 2022; Waseem & Rana, 2025b). The impacts are further exacerbated by factors such as uncontrolled urbanization, limited capacities, poor urban planning, and increasing susceptibility levels (Waseem & Rana, 2023). For instance, the 2022 monsoon flooding exemplified these impacts, resulting in 1033 deaths, affecting 33 million people, and destroying 2 million houses (United Nations, 2022). Furthermore, the 2025 flooding events have been unusually frequent, severe, and intense, resulting in 807 reported deaths, 1091 injuries, and damage to 7938 houses as of August, with figures continuing to rise (HHRD, 2025). The recurrent and large-scale disruptions underscore the need for anticipatory adaptation (Waseem & Rana, 2025b). Addressing the impacts of extreme events, however, requires not only technical and structural measures but also a comprehensive understanding of the psychological dimension, including how individuals view climate change risks and perceive adaptation as a viable response (Gupta, 2020; Rana et al., 2020; Rana et al., 2021; UNHABITAT, 2024).

Beyond direct impacts, the IPCC has highlighted significant indirect effects on human, economic, and environmental domains (Carter et al., 2015). Approximately 3.6 billion people worldwide live in areas susceptible to the impacts of climate change (Shi et al., 2016). Promoting adaptation measures and strategies is crucial to minimizing these effects (Granceri Bradaschia et al., 2024). However, the effectiveness of these measures is closely linked to the community's ability to perceive climate risks (Liu et al., 2023; Rana et al., 2023). To understand community perceptions, the concept of psychological distance, defined as the extent to which individuals perceive an attribute or phenomenon as being distinct from themselves, is widely applied in climate science research (Liberman et al., 2007; Trope & Liberman, 2010). In the context of climate change, the concept is termed psychological distance to climate change (PDC), while for adaptation, it is termed psychological distance to adaptation (PDA) (Keller et al., 2022; Singh et al., 2017; Spence et al., 2012; Van Lange & Huckelba, 2021).

Psychological distance to adaptation helps explain individuals' commitment to pro-environmental activities and shapes their engagement with adaptive behaviors. When people perceive climate change as a direct personal threat, they are more likely to adapt. However, fostering such responses remains challenging, as widespread commitment and intrinsic motivation at the individual level are essential for effective adaptation (Maiella et al., 2020). The literature suggests that adaptation behavior is primarily shaped by individuals' perceptions of the effectiveness of adaptation measures in reducing climate-related risks, their capacity to participate in adaptation activities, and their perceived psychological distance from climate change (Bechtoldt et al., 2021). Empirical evidence from South Asian urban communities

suggests that awareness of adaptation is critical to improving willingness, which ultimately translates into effective adaptation against extreme events (Waseem & Rana, 2025d). At the same time, sociocultural preferences, previous experiences with climate-related hazards, and perceived responsibility are also crucial in promoting climate adaptation behavior (van Valkengoed & Steg, 2019). Evidence from Australian communities revealed that sustainable lifestyle changes cannot rely solely on external sanctions or incentives but must also account for intrinsic motivation and self-determination. The psychological perspective on adaptation emphasizes the dynamic interaction between internal and external factors, underscoring the importance of promoting behaviors that are both environmentally sustainable and psychologically meaningful (Bradley & Reser, 2017).

Despite its recognition as a global threat, the risks and impacts of climate change are often perceived as distant and fragmented across spatial and temporal dimensions (Spence & Pidgeon, 2010). Such negative risk perceptions hinder public decision-making and pose challenges for institutions seeking to promote effective adaptation practices (Haden et al., 2012). To ensure effective adaptation, it is crucial to understand PDA and the population characteristics influencing adaptation decisions (Krosnick et al., 2006; Lorenzoni et al., 2007). This understanding also enhances risk communication and supports the development of strategies that improve adaptive capacity among vulnerable populations (Azadi et al., 2019; Yazdanpanah et al., 2023; Zhou et al., 2024). Although the limited integration of psychological dimensions has long remained a critical gap in adaptation policies (Reser et al., 2011), recent literature reflects a growing interest in understanding and embedding the psychological dimension within climate change adaptation planning (Arneaud, 2025; Waseem et al., 2023).

Considerable research has examined perceptions of climate change and adaptation from different perspectives (Fonte & Ferreira, 2024). Climate change adaptation has been studied in various areas, including agriculture, the economy, the environment (Rana, Lodhi, et al., 2022), and governance (Mahmood et al., 2021). Empirical studies have explored the factors influencing climate risk perception and adaptive behavior of the communities (Azadi et al., 2019; Farhan et al., 2022; Shah et al., 2022). Similarly, perceived awareness, willingness, self-efficacy, and the capacity to adapt across multiple dimensions have also been quantified (Waseem & Rana, 2025a, 2025d). Studies have also investigated the prevalent adaptation strategies (Khan et al., 2020; Nixon et al., 2022) and challenges (Waseem & Rana, 2025b) associated with adaptation to climate change. The impacts on psychological distance to climate change are examined in terms of the built environment (Aslam & Rana, 2022a), urban informality (Rana et al., 2023), policy support (Singh et al., 2017), pro-environmental behavior (Chen, 2019a), and community participation (Jones et al., 2017). Additionally, studies have also evaluated the benefits of reducing psychological distance to climate change (Corner et al., 2015; Duan et al., 2022; Guillard, Fleury-Bahi, & Navarro, 2021).

Although a considerable body of literature has examined climate change perceptions and the psychological dimension of climate change, the psychological distance to adaptation remains underexplored (McDonald et al., 2015). Limited attention is paid to how different dimensions of psychological distance shape adaptation decisions, particularly within urban communities (Stewart, 2024). This study addresses this gap by examining the psychological distance to climate change adaptation in the context of urban communities of Islamabad, Pakistan. It enhances understanding of how people perceive adaptation, explores the interrelationships between the dimensions of psychological distance, and identifies socioeconomic determinants that influence the psychological distance to adaptation. By situating psychological distance within the broader discourse of adaptation, the study contributes to both theory and policy, offering insights for community engagement strategies and tailored interventions aimed at strengthening urban resilience.

2. Theoretical framework

2.1. Conceptualizing adaptation to climate change

IPCC defines adaptation as “the process of adjustment to actual or expected climate and its effects” (IPCC, 2018). Adaptation to inevitable climate risks is a significant component of the global response to addressing climate change (Fankhauser, 2017; Liu et al., 2023). Unlike mitigation, which focuses on a specific problem, adaptation has a broader scope, encompassing various scales (from community to global) and involving diverse actors (including governments, individuals, households, etc.) (Berrang-Ford et al., 2011). The literature classifies adaptation into time-based (anticipatory or reactive) and planning-based (planned or autonomous) (Jones & Boyd, 2011). Adaptation may take the form of either incremental adjustments or transformative changes, contingent on the magnitude of the transition induced by implemented measures or actions (Pachauri et al., 2014). Adaptation measures range from behavioral changes (e.g., using raincoats to protect from rainfall) to structural (e.g., constructing elevated houses for flood protection) to ecological (e.g., converting rooftops into green or blue roofs to reduce monsoon flooding impacts) to institutional (e.g., implementing emergency wayfinding and risk signage) (IPCC, 2018).

2.2. Construal-level theory (CLT), psychological distance, and its dimensions

The construal-level theory (CLT) by Trope and Liberman (2010) explains how people plan for the distant future by constructing mental representations, or construals, of distant objects. It characterizes psychological distance as the extent to which an individual perceives something as distant from them. A less distant event requires low-level construal, and a more distant event requires high-level construal (Liberman et al., 2007). Its dimensions refer to how the distance from an object is interpreted (Trope & Liberman, 2010). CLT assumes that these dimensions are interrelated and mentally associated. *Spatial distance* is the perceived physical distance between an individual and a specific location or object (McDonald et al., 2015; Steynor & Pasquini, 2019). Distant locations are represented more abstractly, whereas nearby locations are represented more concretely. *Temporal distance* is the distance in time between the present moment and a past or future moment (McDonald et al., 2015; Steynor & Pasquini, 2019). Distant past or future events are considered abstractly, focusing on broader and more general aspects, while near-future or recent-past events are construed more concretely and precisely. The perceived closeness or remoteness in social relationships is termed *social distance* (McDonald et al., 2015; Steynor & Pasquini, 2019). Socially distant people are thought of in more abstract terms compared to socially close people. *Hypothetical distance* is the perceived likelihood of an event occurring (McDonald et al., 2015; Steynor & Pasquini, 2019). Less likely events are perceived abstractly, whereas more certain events are construed more concretely. To conclude, psychological distance refers to the perception regarding when (temporal distance) and where (spatial distance) the event occurs, to whom (social distance) it occurs, and whether (hypothetical distance) the event occurs (Bakhsh et al., 2018; Stewart, 2024; Trope & Liberman, 2010). Since these dimensions influence perception and behavioral patterns, the significance of psychological distance is recognized and studied in different contexts (McDonald et al., 2015; Rana et al., 2023; Spence et al., 2012).

2.3. Psychological distance to climate change adaptation

The psychological distance to climate change (PDC) refers to how a person perceives climate change (close or farther), based on their knowledge and experience. This perception is a subjective, egocentric experience, with the reference point being the self, either in the present or the future. Perceived climate change impacts that are psychologically

close are construed as concrete or tangible events. In contrast, impacts perceived as distant or future are construed as distant or intangible (Haden et al., 2012). In the context of adaptation, psychological distance influences the ability and willingness to adapt and implement preventive measures to reduce climate change impacts. The distance is closely associated with knowledge of climate change, trust, and the ability to perceive its impacts (Singh et al., 2017). It can manifest in different dimensions, including spatial, temporal, social, and hypothetical, that contribute to shaping an individual's risk perception and either encourage or discourage them from taking protective measures against the hazards (Liberman et al., 2007; McDonald et al., 2015; Singh et al., 2017; Trope & Liberman, 2010) (Fig. 1).

Several studies have assessed PDC in various contexts, including flood risk perception (Rasool et al., 2022), willingness to save energy (Spence et al., 2011), mitigation (Haden et al., 2012), climate policy preferences (Leiserowitz, 2006), challenges to climate policies (Lorenzoni et al., 2007), impacts on the built environment (Aslam & Rana, 2022b), risk and climate change communication (Berger et al., 2019; Ngo et al., 2020), pro-environmental behavior (Chen, 2019b), sustainability (Garcia et al., 2022), public health (Acharibasam & Anuga, 2018), climate education (Gubler et al., 2019), climate anxiety (Pfausch & Gray, 2017; Jackson et al., 2023), and climate engagement (Schuldt et al., 2018). Studies have found that people who perceive climate change as a real phenomenon and consider themselves at risk of climate change impacts show pro-environmental behavior to respond to climate change impacts (Brügger et al., 2015; Carmi & Kimhi, 2015; Chen, 2019a, 2019b; Duan et al., 2022; Kim et al., 2022; Sacchi et al., 2016; Steynor et al., 2021; van Valkengoed et al., 2023; Wang et al., 2019). The distance is directly associated with risk perception: greater perceived distance is linked to hope, whereas reduced perceived distance is associated with traits such as fear, worry, and determination (Chu & Yang, 2019; Lin & Zhang, 2025; Verplanken et al., 2020). Similarly, distance is also argued to be a critical element in achieving and enhancing climate policy support (Hine et al., 2013; Nicolaj & Hendrickx, 2003; Rosentrater et al., 2012; Rubio Juan & Revilla, 2021). However, studies have also reported no effect of psychological distance on pro-environmental behavior and support for climate change policies (Fesenfeld & Rinscheid, 2021; González-Hernández et al., 2023; Halperin & Walton, 2018; Rodríguez-Cruz & Niles, 2021). Thus, validating its subjectivity and differences of opinion depending on the varying socioeconomic characteristics of the communities (Rana et al., 2023). However, research on PDC has predominantly focused on evaluating its effects on mitigation, with limited exploration of how psychological distance influences adaptation behavior (Haden et al., 2012).

In the context of adaptation behavior, several studies have found that low psychological distance is associated with adaptive behavior and an enhanced willingness to adapt (Flórez Bossio et al., 2022; Guillard, Navarro, et al., 2021; Halperin & Walton, 2018; Maiella et al., 2020). Studies have also suggested incorporating the psychological distance to adaptation (PDA) into awareness campaigns to motivate people to transform their willingness into action (Guillard, Fleury-Bahi, & Navarro, 2021; Singh et al., 2017). Understanding and reducing the distance to adaptation has been identified as a crucial prerequisite for achieving effective climate change adaptation (Singh et al., 2017). However, studying the phenomenon concerning settlement types, including formal and informal, as well as rural and urban, can offer a broader understanding, as studies have found an influence of the formal and informal nature of settlements on psychological distance to adaptation (Aslam & Rana, 2022a). Although several studies have examined the relationship between climate change assessment and adaptation, limited research has examined psychological distance from an adaptation perspective (Evans et al., 2014; Guillard, Fleury-Bahi, & Navarro, 2021; Haden et al., 2012; Pahl & Bauer, 2011). This study fills this gap by assessing the psychological distance to adaptation in the context of urban communities.

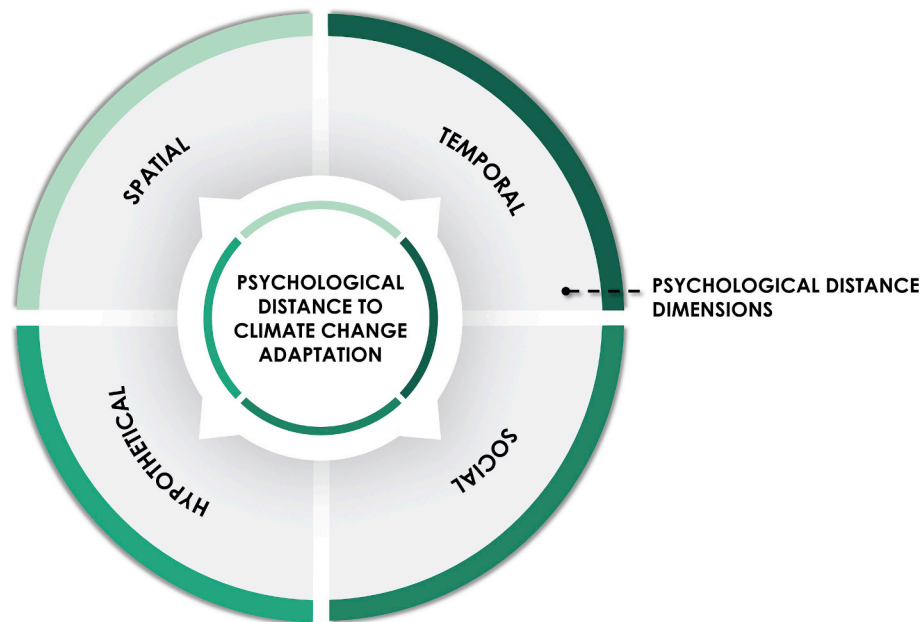


Fig. 1. Psychological distance and its dimensions.

2.4. Socioeconomic determinants of adaptation

While making decisions to adapt to climate change impacts, several socioeconomic actors are involved. There has been very limited reporting on factors influencing PDA. These factors require investigation and discussion, as understanding them can inform the formulation of effective adaptation strategies and policies. The literature has highlighted significant under-reporting of women and children as a growing concern in adaptation studies. The number of children in a household significantly influences adaptation (Rana et al., 2023). Studies have reported both a negative (Flórez Bossio et al., 2022; Hulkkonen et al., 2024) and a positive (Hunter et al., 2004) influence of gender. However, studies have also reported no influence of gender (Berrang-Ford et al., 2011). It has been observed that age is negatively associated with adaptation (Hulkkonen et al., 2024; Whitmarsh, 2008). Conversely, other research highlights a positive relationship (Rana et al., 2023). Additionally, household size has been identified as a factor influencing adaptation levels, showing a positive and significant impact (Fankhauser, 2017; Rana et al., 2023). In the case of income, a positive and partially significant influence was observed (Whitmarsh, 2008). Consequently, households with lower incomes are accustomed to dealing with climate anxiety, suggesting that income may limit climate change adaptation (Fankhauser, 2017; Rana et al., 2023). Regarding education, a negative relationship was observed between the household head's education level and adaptation (Rana et al., 2023). The literature has also noted a positive correlation between the number of years spent living in the community and adaptation (Guo et al., 2018). Experience with extreme events, such as floods, has a positive association with adaptation. It has been observed that people who have encountered flood events in the past feel less distant (Spence et al., 2011; Whitmarsh, 2008). However, another study reported a negative relationship between past flood experiences and adaptation (Rana et al., 2023).

3. Research methodology

3.1. Selection of the study area

This study was conducted in Islamabad, Pakistan's administrative capital. Covering an area of 906.50 Sq.Kms, Islamabad ranks 9th in population and is located at 33° 41' 35" N, 73° 03' 50" E. Planned by the

Greek architect and planner C. A. Doxiadis, the city is divided into 5 zones, each with defined land-use patterns (Capital Development Authority, 1960, 1992). The impacts of climate change have led to rapid changes in Islamabad's climatic conditions, particularly in rainfall and temperature patterns. Urban flooding events have become more frequent, making the communities located near hazard sources more susceptible (Ali et al., 2022b). Therefore, three urban communities were selected for this study based on their proximity to flood hazard sources (Fig. 2). Chak Shahzad is situated in Zone-4 along a natural stream (nullah), Gumrah Kas Nullah. Sector E-11/D-12 is situated in Zone-1 at the foothills of Margallah Hills, whereas River/Soan Garden is situated in Zone-5 along the Soan River.

3.2. Sampling and data collection

The sample size for the study was computed using Yamane's sample size formula (Eq.1), where the sample size is denoted by "n", the level of precision is denoted by "e", and "N" is the total population size (Yamane, 1967). Due to its simplicity, the method is widely used in studies relating to psychological distance and climate change (Rasool et al., 2022). The population of Islamabad, Pakistan, is reported as 2,363,863 in the 7th Population and Housing Census conducted by the Pakistan Bureau of Statistics, Government of Pakistan (Pakistan Bureau of Statistics (PBS), 2023). Using this figure as the base population, a sample size of 400 was calculated, with a 95% confidence level and a 5% margin of error. However, it was increased to 600, with 200 samples from each selected community, to ensure suitable and equal representation.

A simple random sampling technique was adopted for data collection. The primary reasons for selecting a simple random sampling technique were the limited geographical extent and reduced selection bias during data collection. Households were taken as the primary unit of analysis, and data were collected from one respondent per household. Before recording their response, the aim of the survey was communicated to the respondents. No personal information was collected to ensure the anonymity of the respondents. Furthermore, the respondents were briefed about the adaptation measures that include behavioral adaptation measures (covering shoes, placing buckets at leakages, traveling using cars during rain, moving things to safer places, using umbrellas and raincoats), structural adaptation measures (wire rugs, wall paneling, wallpapers, rubber bars, waterproof paints, and house

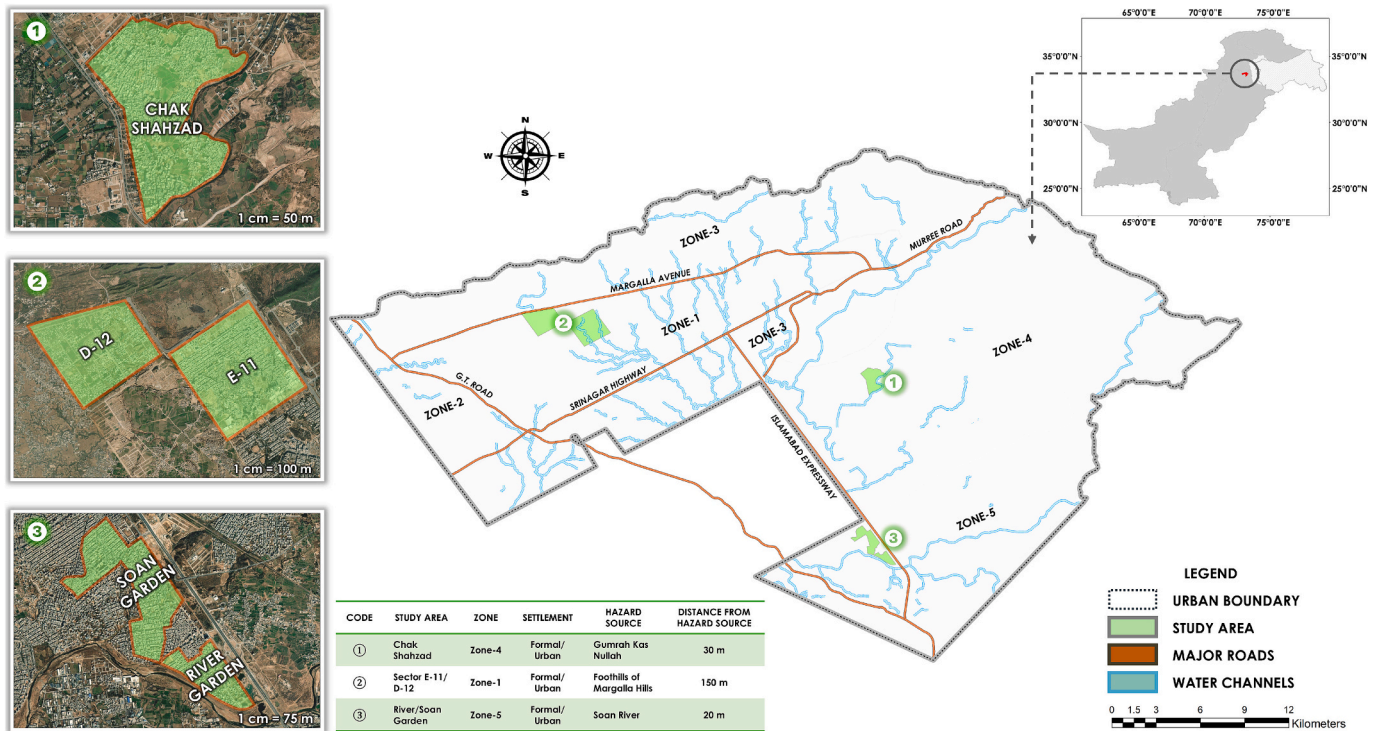


Fig. 2. Study area map.

construction at height), and ecological adaptation measures (green/blue roofs/walls, rain gardens, rainwater harvesting systems, wetlands, basins, swales, and green street furniture) (Waseem & Rana, 2025b).

The questionnaire was pretested using 15 responses, 5 from each community, from the 19th of March to the 13th of April 2024. Subsequently, the questionnaire survey was performed from the 10th of May to the 13th of June 2024. The data collection process continued until 600 valid and complete 600 responses were received. During this process, a total of 65 incomplete questionnaires were discarded.

$$n = \frac{N}{1 + N(e)^2} \tag{1}$$

3.3. Indicators selection and questionnaire design

Indicators were selected based on an extensive literature review of climate change and adaptation studies (Table 1). The study data were collected using a structured questionnaire survey. The questionnaire was designed to cover basic socioeconomic information, details of adaptation planning, risk and vulnerability indicators, risk perception, psychological distance to adaptation, and adaptation challenges. For this study, data on socioeconomic factors and psychological distance to adaptation are used to generate results. The study comprised 12 indicators, which were categorized into four dimensions: geographical, temporal, social, and hypothetical. Using these indicators, a structured questionnaire was organized. Responses were recorded on a 5-point Likert scale, where 5 corresponded to the highest score, and 1 corresponded to the lowest. The questionnaire was kept as concise as possible to ensure maximum participation while maintaining the respondent's confidentiality.

3.4. Index construction

The psychological distance to adaptation is an abstract, qualitative, and subjective phenomenon. Literature defines the construction of indices as a helpful tool for quantifying and measuring these qualitative

aspects. Empirical evidence suggests that indices have been used to measure psychological distance between communities (Rana et al., 2023; Rana, Sikander, et al., 2022; Rasool et al., 2022). A composite weighted index (CI) was used to construct the indices for this study. Each indicator was mapped to a 1 to 5 Likert scale, where 1 indicated a very low score (less distant) and 5 the highest score (most distant). The standard CI eq. (Eq.2) served as the base equation for constructing the study indices. In the first step, individual indexes for the four dimensions-spatial (Eq.3), temporal (Eq.4), social (Eq.5), and hypothetical (Eq.6) were formulated. The outputs of these equations were then used to calculate PDA using Eq. 7.

$$CI = \frac{W_1 + W_2 + W_3 + \dots + W_n}{n} = \sum_{i=1}^n \frac{W_i}{n} \tag{2}$$

$$Spatial\ Distance\ Index\ (SPD) = \sum_{i=1}^4 \frac{SPDW_i}{4} \tag{3}$$

$$Temporal\ Distance\ Index\ (TD) = \sum_{i=1}^2 \frac{TDW_i}{2} \tag{4}$$

$$Social\ Distance\ Index\ (SD) = \sum_{i=1}^3 \frac{SDW_i}{3} \tag{5}$$

$$Hypothetical\ Distance\ Index\ (HD) = \sum_{i=1}^3 \frac{HDW_i}{3} \tag{6}$$

$$Psychological\ Distance\ to\ Climate\ Change\ Adaptation\ (PDA) = \sum_{i=1}^4 \frac{SPD + TD + SD + HD}{4} \tag{7}$$

3.5. Data analysis

The survey data were entered into SPSS V22.0 using coded variables

Table 1
Dimensions and indicators of the study.

S#	Label	Indicators	Empirical evidence
SPATIAL DISTANCE (SPD)			
1	SPD1	Climate change adaptation at the community level <i>Question: How likely is your local community to experience climate change impacts due to a lack of adaptation measures?</i>	(Maiella et al., 2020; Rana et al., 2023; Rasool et al., 2022; Spence et al., 2012)
2	SPD2	Climate change adaptation at the city/region level <i>Question: How likely is your city/region to experience climate change impacts due to a lack of adaptation measures?</i>	(Maiella et al., 2020; Rana et al., 2023; Rasool et al., 2022; Spence et al., 2012)
3	SPD3	Climate change adaptation at the country/national level <i>Question: How likely is your country to experience climate change impacts due to a lack of adaptation measures?</i>	(Maiella et al., 2020; Rana et al., 2023; Rasool et al., 2022; Spence et al., 2012)
4	SPD4	Climate change adaptation at the global level <i>Question: How likely is the world to experience climate change impacts due to a lack of adaptation measures?</i>	(Maiella et al., 2020; Rana et al., 2023; Rasool et al., 2022; Spence et al., 2012)
TEMPORAL DISTANCE (TD)			
5	TD1	Lack of adaptation practices leading to the present climate change impacts in the country <i>Question: To what extent do you believe the country is failing to address climate change impacts through adaptation practices?</i>	(Maiella et al., 2020; Rana et al., 2023; Rasool et al., 2022; Spence et al., 2012)
6	TD2	Lack of adaptation practices leading to future climate change impacts in the country <i>Question: To what extent do you believe the future generations will fail to address climate change impacts through adaptation practices?</i>	(Maiella et al., 2020; Rana et al., 2023; Rasool et al., 2022; Spence et al., 2012)
SOCIAL DISTANCE (SD)			
7	SD1	Perceived protection at the household level <i>Question: Will implementing adaptation measures not likely protect you and your family from climate change impacts?</i>	(Maiella et al., 2020; Rana et al., 2023; Rasool et al., 2022; Spence et al., 2012)
8	SD2	Perceived protection at the community level <i>Question: Will implementing adaptation measures not likely protect your neighbors/friends and relatives from climate change impacts?</i>	(Maiella et al., 2020; Rana et al., 2023; Rasool et al., 2022; Spence et al., 2012)
9	SD3	Perceived social inequality to climate change impacts <i>Question: How much do you think climate change disproportionately affects vulnerable communities in your country?</i>	(Maiella et al., 2020; Rana et al., 2023; Rasool et al., 2022; Spence et al., 2012)
HYPOTHETICAL DISTANCE (HD)			
10	HD1	Trust in adaptation measures <i>Question: How uncertain are you that adaptation measures are one of the solutions to climate change?</i>	(Maiella et al., 2020; Rana et al., 2023; Rasool et al., 2022; Spence et al., 2012)

Table 1 (continued)

S#	Label	Indicators	Empirical evidence
11	HD2	Adaptation to reduce climate change threats <i>Question: How uncertain are you that adaptation measures will reduce the global climate change threat?</i>	(Maiella et al., 2020; Rana et al., 2023; Rasool et al., 2022; Spence et al., 2012)
12	HD3	Need for adaptation <i>Question: To what extent do you believe there is no need to promote climate change adaptation?</i>	(Maiella et al., 2020; Rana et al., 2023; Rasool et al., 2022; Spence et al., 2012)

before commencing data analysis. Frequency distribution was applied to construct the socioeconomic profile of the respondents based on the equal interval data classes created through visual binning. Indicator-based analysis was performed using descriptive statistics, particularly mean and standard deviation (SD). Differences between the indicators were ascertained using a one-way ANOVA (F-test).

For dimension-based analysis, the indicators were grouped into four dimensions: spatial, temporal, social, and geographical. The index values were obtained using SPD (Eq. 3), TD (Eq. 4), SD (Eq. 5), and HD (Eq. 6). The results for the overall dimensions were used as input for Eq. 7 to calculate PDA. The significance of the indices was evaluated using one-way ANOVA (F-test).

The relationship among the dimensions was assessed using Pearson's correlation at the 1% significance level, a widely used method for assessing the relationship between variables (Idowu & Zhou, 2023). Multiple regression analysis was used to examine the socioeconomic determinants of psychological distance. The numeric indicators of gender, age, household head's education level, household size, number of children, monthly household income, number of past flood experiences, number of years living in the community, and study area were regressed with the output of Eq.7 in STATA 13.0 to develop the model (Flórez Bossio et al., 2022; Rana et al., 2020). Dummy variables were created for gender, household head's education level, number of past flood experiences, and selected communities to include categorical information. Before estimation, the heteroscedasticity was tested using the Breusch-Pagan/Cook-Weisberg test. Heteroscedasticity was addressed using robust standard errors, as they provide consistent and reliable estimates of the variance even when the error variance is not constant (Stock & Watson, 2008). The extent of impact was evaluated using the unstandardized regression coefficient (β), with a positive β indicating a positive impact and a negative β indicating a negative impact. The p -value was used to determine the significant indicators.

4. Results

4.1. Socioeconomic profile of respondents

Respondents of this study were predominantly male (72.20%), with ages ranging from 19 to 55 years (Table 2). Most of the respondents, aged 20–28, were from Chak Shahzad (79.50%) and River/Soan Garden (83.00%), whereas 45.50% of respondents in Sector E-11/D-12 belonged to the 38–46 age group. Female participation varied across communities, with the highest rate observed in River Garden/Soan Garden (43.50%) and the lowest in Sector E-11/D-12 (6.50%). Overall, the male share in the sample was notably higher than the general male-to-female distribution of Islamabad's population (52.8% male versus 47.2% female) reported in the 7th population and housing census (2023) (Pakistan Bureau of Statistics (PBS), 2023). This difference reflects sociocultural dynamics, in which males are more frequently represented as household heads in survey contexts than they actually are in the study communities. Most household heads had a bachelor's degree obtained after 16 years of education (71.30%), followed by a matriculation

Table 2
Socioeconomic profile of respondents.

Socioeconomic indicators	Chak Shahzad n (%)	Sector E-11/D-12 n (%)	River/Soan Garden n (%)	Overall communities n (%)
Age				
≤ 19	28 (14.00%)	2 (1.00%)	16 (8.00%)	46 (7.70%)
20–28	159 (79.50%)	23 (11.50%)	166 (83.00%)	348 (58.00%)
29–37	12 (6.00%)	52 (26.00%)	14 (7.00%)	78 (13.00%)
38–46	1 (0.50%)	91 (45.50%)	4 (2.00%)	96 (16.00%)
≥ 47	0 (0.00%)	32 (16.00%)	0 (0.00%)	32 (5.30%)
Household size				
1	0 (0.00%)	0 (0.00%)	10 (5.00%)	10 (1.70%)
2–6	111 (55.50%)	157 (77.00%)	95 (47.50%)	360 (60.00%)
7–11	66 (33.30%)	46 (23.00%)	79 (39.50%)	191 (31.80%)
12–16	17 (8.50%)	0 (0.00%)	15 (7.50%)	32 (5.30%)
≥ 17	6 (3.00%)	0 (0.00%)	1 (0.50%)	7 (1.20%)
Number of children in a household				
0	62 (31.00%)	15 (7.50%)	63 (31.50%)	140 (23.30%)
1–2	74 (37.00%)	147 (73.50%)	65 (32.50%)	286 (47.70%)
3–5	39 (19.50%)	36 (18.00%)	48 (24.00%)	123 (20.50%)
6–7	16 (8.00%)	2 (1.00%)	17 (8.50%)	35 (5.80%)
≥ 8	9 (4.50%)	0 (0.00%)	7 (3.50%)	16 (2.70%)
Gender				
Male	133 (66.50%)	187 (93.50%)	113 (56.50%)	433 (72.20%)
Female	67 (33.50%)	13 (6.50%)	87 (43.50%)	167 (27.80%)
Past flood experience				
Yes	56 (28.00%)	61 (30.50%)	55 (27.50%)	172 (28.70%)
No	144 (72.00%)	139 (69.50%)	145 (72.50%)	428 (71.30%)
Household head's education level				
Illiterate	0 (0.00%)	3 (1.50%)	8 (4.00%)	11 (1.80%)
Under-matric	0 (0.00%)	13 (6.50%)	10 (5.00%)	23 (3.80%)
Matriculation	19 (9.50%)	29 (14.50%)	35 (17.50%)	83 (13.80%)
Graduate	151 (75.50%)	143 (71.50%)	134 (67.00%)	428 (71.30%)
Post-graduate	30 (15.00%)	12 (6.00%)	13 (6.50%)	55 (9.20%)
Monthly household income (in PKR)^a				
≤ 50,000	15 (7.50%)	4 (2.00%)	29 (14.50%)	48 (8.00%)
50,001-150,000	94 (47.00%)	61 (30.50%)	86 (43.00%)	241 (40.20%)
150,001-250,000	50 (25.00%)	89 (44.50%)	42 (21.00%)	181 (30.20%)
250,001-350,000	14 (7.00%)	31 (15.50%)	12 (6.00%)	57 (9.50%)
≥ 350,001	27 (13.50%)	15 (7.50%)	31 (15.50%)	73 (12.20%)
Number of years living in the community				
≤ 5	129 (64.50%)	158 (79.00%)	139 (69.50%)	426 (71.00%)
5.1–10	40 (20.00%)	39 (19.50%)	61 (30.50%)	140 (23.30%)
10.1–15	10 (5.00%)	3 (1.50%)	0 (0.00%)	13 (2.20%)
≥ 15	21 (10.50%)	0 (0.00%)	0 (0.00%)	21 (3.50%)

^a Average monthly household income in Chak Shahzad (Rs. 214,915; \$773.32*), Sector E-11/D-12 (Rs. 213,515, \$768.28*), River/Soan Garden (Rs. 205,805, \$740.54*), and Overall (Rs. 211,411.67, \$760.72*).

* \$1 = PKR277.91 (22nd of June 2024).

degree (13.80%). Most households in Chak Shahzad (47.00%) and River/Soan Garden (43.00%) had monthly incomes ranging from Rs. 50,001 to Rs. 150,000 (\$180.00–\$538.35) (FBR, 2025). Whereas Sector E-11/D-12 households had a monthly income ranging from Rs. 150,001 to Rs. 250,000 (approximately \$538.36–\$897.25). The households were found to have a mean monthly income of Rs. 211,411.67 (\$760.72). The highest mean monthly income was observed in Chak Shahzad (Rs. 214,915.00; \$773.32), while River Garden/Soan Garden had the lowest (Rs. 205,805.00; \$740.54). Most of the households (60.00%) had a household size between 2 and 6. Respondents from River Garden/Soan Garden reported the highest percentage (5%) of single-living households, and 3% of the households from Chak Shahzad reported a household size greater than 17 persons. Notably, no single-person households were reported in Chak Shahzad and Sector E-11/D-12. The absence of single-person households in the sample aligns with the demographic reality of Islamabad, as the census (2023) reported an average household size of 5.7 members (Pakistan Bureau of Statistics (PBS), 2023). This reflects the predominance of family-based households, and their absence in the sample does not affect the study's overall findings. Most households (47.70%) had 1–2 children, followed by those with no children (23.30%). About 71.30% of households reported no prior flooding experience. 30.50% of households in Chak Shahzad had experienced floods, while River Garden/Soan Garden had the lowest number (27.50%). Most of the households (71.00%) have been residing in the selected communities for less than 5 years, reflecting the relatively recent development of these urban localities after 2005. Only a small share of households in Chak Shahzad (10.50%) reported long-term residence in the community for more than 15 years.

4.2. Indicator-based analysis of psychological distance to climate change adaptation

Descriptive statistics (mean and standard deviation) were used to compare perceptions across selected urban communities regarding indicators for each PDA dimension. A one-way ANOVA (F-test) was conducted to determine variation across the three selected communities. The spatial distance (SPD) dimension was evaluated using four indicators: adaptation to climate change at the community level (SPD1), city/region level (SPD2), country/national level (SPD3), and global level (SPD4) (Table 3). Significant differences were observed in adaptation at the community level (SPD1) and the national level (SPD3). Overall, respondents from all communities reported moderate or uncertain responses at both the community (F = 5.918, p = 0.00) and national (F = 3.324, p = 0.03) levels. However, Chak Shahzad (mean = 3.41) had a high mean score, indicating greater spatial distance to climate change adaptation at the community level.

The second aspect, temporal distance (TD), was measured using two indicators: lack of adaptation practices leading to present climate change impacts in the country (TD1) and future climate change impacts in the country (TD2) (Table 3). Significant differences were observed for both indicators, TD1 (F = 12.72, p = 0.00) and TD2 (F = 11.11, p = 0.00). Communities were observed to be temporally distant in their foresight regarding the benefits of adaptation measures in reducing climate change impacts in both the present and the future, with mean values of 2.88 for TD1 and 2.85 for TD2. Respondents from Sector E-11/D-12 were found to be moderately distant or uncertain, while Chak Shahzad was the least temporally distant, with mean scores of 2.65 for TD1 and 2.64 for TD2, highlighting their trust in the efficacy of adaptation measures in addressing present and future climate change impacts.

Social distance (SD) in relation to climate change adaptation was assessed using three indicators: perceived protection at the household level (SD1), perceived protection at the community level (SD2), and

Table 3
Indicator-based analysis.

Indicators	Descriptive Statistics	Chak Shahzad	Sector E-11/D-12	River Garden/Soan Garden	ANOVA (F-test) ^a	Overall
SPATIAL DISTANCE (SPD)						
SPD1	Mean	3.41	3.10	3.29	F = 5.91, $\rho = 0.00^{***}$	3.27
	SD	1.11	0.40	0.99		0.90
SPD2	Mean	3.28	3.13	3.09	F = 2.17, $\rho = 0.11$	3.17
	SD	1.12	0.48	1.03		0.92
SPD3	Mean	3.33	3.12	3.14	F = 3.32, $\rho = 0.03^{**}$	3.20
	SD	1.15	0.46	0.97		0.91
SPD4	Mean	3.09	3.12	2.97	F = 1.65, $\rho = 0.19$	3.06
	SD	1.01	0.47	0.96		0.85
TEMPORAL DISTANCE (TD)						
TD1	Mean	2.65	3.13	2.85	F = 12.72, $\rho = 0.00^{***}$	2.88
	SD	1.21	0.41	1.04		0.97
TD2	Mean	2.64	3.10	2.81	F = 11.11, $\rho = 0.00^{***}$	2.85
	SD	1.19	0.43	1.11		0.99
SOCIAL DISTANCE (SD)						
SD1	Mean	2.85	3.06	2.88	F = 3.37, $\rho = 0.03^{**}$	2.93
	SD	1.12	0.44	0.93		0.88
SD2	Mean	2.84	3.10	2.84	F = 5.71, $\rho = 0.00^{***}$	2.93
	SD	1.09	0.49	0.98		0.90
SD3	Mean	2.65	3.07	2.77	F = 11.69, $\rho = 0.00^{***}$	2.83
	SD	1.10	0.44	0.99		0.91
HYPOTHETICAL DISTANCE (HD)						
HD1	Mean	3.09	3.24	3.03	F = 3.01, $\rho = 0.05^{**}$	3.12
	SD	1.06	0.53	1.07		0.92
HD2	Mean	2.94	3.14	3.00	F = 2.86, $\rho = 0.05^{**}$	3.03
	SD	1.02	0.40	0.99		0.86
HD3	Mean	2.64	3.13	2.77	F = 13.81, $\rho = 0.00^{***}$	2.85
	SD	1.19	0.45	1.06		0.98

** Significant at 5%.

*** Significant at 1%.

^a One-way ANOVA (F-test) across three selected communities.

perceived social inequality in relation to climate change impacts (SD3) (Table 3). A significant difference was found in all social distance indicators, with values $F = 3.371$ ($p = 0.03$) for SD1, $F = 5.710$ ($p = 0.00$) for SD2, and $F = 11.692$ ($p = 0.000$) for SD3. Respondents from Sector E-11/D-12 were moderately distant regarding whether adaptation measures will protect themselves (mean = 3.06) and their neighbors/friends/relatives (mean = 3.10) from climate change impacts. In contrast, respondents from Chak Shahzad and River/Soan Garden were less socially distant, believing that adaptation measures would likely protect themselves and their social group. Regarding perceived social inequality (SD3), a similar response was observed across the communities. Sector E-11/D-12 was found to be moderately distant or uncertain (mean = 3.07), whereas Chak Shahzad (mean = 2.65) was the least socially distant, followed by River/Soan Garden (mean = 3.07). Overall, respondents were found to be moderately distant or uncertain about social distance.

Regarding hypothetical distance (HD), three indicators were used: trust in adaptation measures (HD1), adaptation that reduces climate change impacts (HD2), and the need for adaptation (HD3) (Table 3). ANOVA (F-test) revealed significant differences among communities across all three indicators. Respondents from all three communities were found to be moderately distant or uncertain about adaptation as a solution to climate change ($F = 3.019$, $p = 0.05$) and about its contribution to reducing global threats to the climate ($F = 2.63$, $p = 0.05$). Overall, the communities reported the need to promote climate change adaptation (mean = 2.85), with Chak Shahzad being the least distant (mean = 2.64), followed by River/Soan Garden (mean = 2.77). However, Sector E-11/D-12 reported a moderate or uncertain response with a mean score of 3.13.

4.3. Dimension-based analysis of psychological distance to climate change adaptation

A dimension-based analysis was conducted, comprising four dimensions and overall PDA, using descriptive statistics (mean and SD). To

determine significant differences among the three selected urban communities, a one-way ANOVA (F-test) was applied, revealing significant variation across all dimensions (Fig. 3). Moderate and significant spatial ($F = 3.61$, $\rho = 0.02$) and hypothetical ($F = 8.14$, $\rho = 0.00$) distances were observed in the communities. Additionally, the communities exhibited the least distance in terms of both temporal ($F = 15.52$, $p = 0.00$) and social ($F = 9.36$, $p = 0.00$) dimensions. Overall, responses from urban communities revealed moderate and significant PDA ($F = 6.12$, $\rho = 0.00$).

4.4. Relationship between psychological distance dimensions

Pearson's correlation test was conducted to examine the relationships among the psychological distance dimensions (Fig. 4). Spatial distance had a weak correlation with temporal, social, and hypothetical distance. Temporal distance was moderately correlated with both social and hypothetical distances. A moderate correlation was observed among social, temporal, and hypothetical distances.

4.5. Socioeconomic determinants influencing psychological distance to climate change adaptation

Socioeconomic and community indicators, including categorical variables, were regressed with PDA to develop a regression model explaining determinants influencing PDA. Dummy variables were created for gender, household head's education level, past flood experience, and selected communities. The Breusch-Pagan/Cook-Weisberg test was conducted to detect heteroscedasticity (Table 4). The reported heteroscedasticity ($\rho = 0.000$) was addressed by applying robust standard errors to generate reliable estimates (Table 4). The regression model was statistically significant, confirming that predictors jointly explain variation in PDA. River/Soan Garden showed a significant influence relative to Sector E-11/D-12. Chak Shahzad was not found statistically significant, indicating that socioeconomic indicators in this community do not significantly influence PDA.

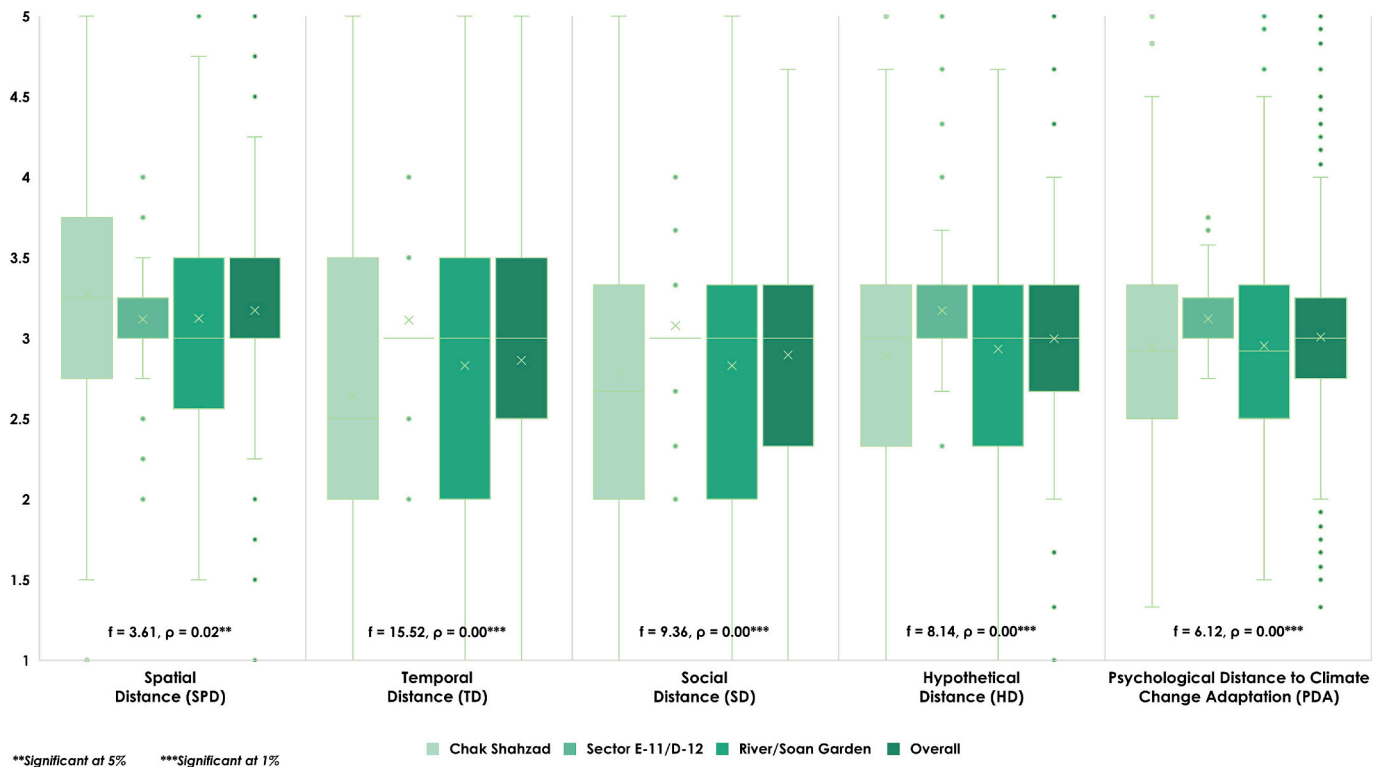


Fig. 3. Dimension-based analysis.

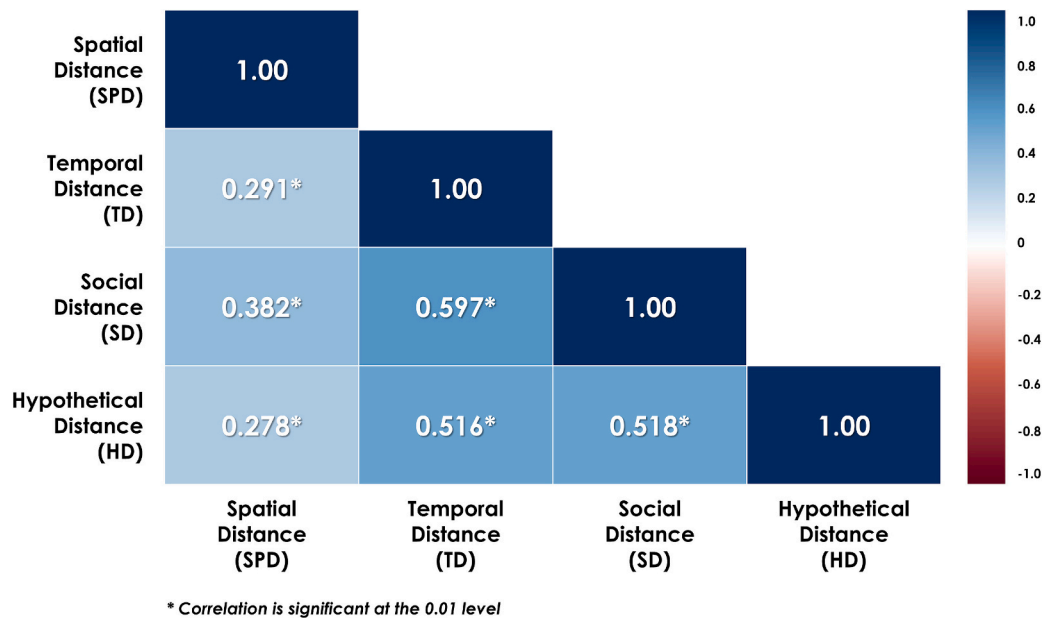


Fig. 4. Correlation between PDA dimensions.

Gender exhibited a significant positive influence, suggesting that males perceive climate change adaptation as more distant compared to females. Age, income, past flood experiences, and number of years living in the community had no significant influence. Household head's education level also showed a positive and significant influence, indicating that higher educational attainment leads to a lesser psychological distance. Household size exerted a significant negative influence. The number of children had a positive and significant influence. Regarding spatial variation, households in River/Soan Garden reported significantly lower PDA than those in Sector E-11/D-12.

5. Discussion

Assessing psychological distance to adaptation in urban communities revealed significant key findings. Respondents demonstrated a moderate level of detachment from climate change at both the community and national levels. These findings align with those of Rana et al. (2023), which indicate that formal settlements perceive climate change impacts at these levels. Additionally, it complements the findings of Jamieson (2005), which suggest that climate change impacts are highly anticipated among populations in developing countries. This moderate

Table 4
Socioeconomic factors influencing PDA.

Socioeconomic indicators	Model		
	β	Robust SE	p -value
Breusch-Pagan/Cook-Weisberg test for heteroskedasticity: $\chi^2 = 128.09$, $df = 10$, p -value = 0.000***			
$R^2 = 0.083$, $SE = 0.542$, F -value = 6.36, p -value = 0.000***			
Gender (male)	0.212	0.059	0.000***
Age	-0.003	0.002	0.254
Household head's education level (illiterate)	0.639	0.181	0.000***
Household size	-0.025	0.011	0.029**
Number of children	0.037	0.017	0.030**
Monthly income	1.32e-07	1.74e-07	0.448
Number of flood experiences (yes)	-0.009	0.050	0.855
Number of years living in the community	-0.003	0.005	0.590
HS1 (Chak Shahzad)	-0.115	0.070	0.104
HS3 (River/Soan Garden)	-0.133	0.060	0.027**
Constant	3.105	0.130	0.000***

** Significant at 5%.

*** Significant at 1%.

distance can be attributed to extreme weather events occurring locally or nationally. Although the population experiences these events, distinguishing whether they are caused by climate change is challenging. Similarly, media coverage of extreme events often focuses on the losses and damage rather than the underlying causes, leaving the public uncertain about whether such events are a result of climate change. However, the respondents stressed the importance of promoting climate change adaptation as a necessary response to increasing risks.

Regarding psychological distance dimensions, respondents reported moderate and significant levels of spatial and hypothetical distance. Poor climate risk perception can be a major reason for the moderate distances, as higher climate risk perception results in shorter psychological distances (Zhou et al., 2024). Despite observing extreme events in the city, people were found to be least distant in terms of both temporal and social distance, as the occurrence of such events has increased in Islamabad. Overall, the communities reported a moderate to uncertain psychological distance from climate change adaptation. Similar responses were observed in studies conducted in the other major urban areas of Pakistan (Rana et al., 2023; Rasool et al., 2022). This situation demands strategies and efforts to enhance adaptation awareness to reduce psychological distance.

Regarding the interrelationship among psychological distance dimensions, the literature reported a moderate correlation between spatial distance (SPD) and social distance (SD) (Rana et al., 2023). However, the study found a weak correlation between these two dimensions. Furthermore, the study supports a weak correlation between spatial (SPD) and temporal (TD) and/or hypothetical (HD) distances. While the previous study reported no significant correlation between social distance (SD) and hypothetical distance (HD), this study found that all psychological distance dimensions were significantly correlated (Rana et al., 2023).

In terms of socioeconomic indicators, the gender and education level of household heads were found to have a positive influence (Flórez Bossio et al., 2022; Hulkkonen et al., 2024). This relationship can be explained by the fact that gender and education are key factors that affect vulnerability to natural hazards and shape cognitive risk judgments (Waseem & Rana, 2023). In terms of psychological distance dimensions, individuals with higher educational attainment are more likely to perceive climate change as a real and immediate concern (hypothetical), seeing it as an issue that is already occurring (temporal) rather than a distant or theoretical problem (Sundblad et al., 2007). They are also more likely to recognize that climate change impacts can

affect their community (spatially) and impact their associated social groups (socially) (Clayton et al., 2023). The educational attainment of the household head is the strongest predictor of climate change risk perceptions, and it is directly linked to increased awareness (Lee et al., 2015). This awareness of climate change impacts contributes to a greater willingness to promote and implement adaptation measures.

Gender also had a positive influence, indicating that women are less psychologically distant from climate change adaptation compared to men (Hulkkonen et al., 2024). Women tend to perceive higher risks and feel more vulnerable to the impacts of climate change, believing in its reality and the urgency of adaptation (hypothetical) (Hunter et al., 2004; Sundblad et al., 2007). They view climate change as an immediate and pressing issue (temporal) affecting their households (spatial) (McCright, 2010). Additionally, their caregiving roles foster greater concern for the well-being of others (social), which often leads to increased awareness of and engagement in adaptation efforts (Lee et al., 2015). The number of children also had a significant influence, consistent with previous studies' findings (Rana et al., 2023). As the number of children increases, parents may perceive climate change as a less immediate threat (hypothetical) that may not directly impact their household (spatial) (Hoffman, 2011). Consequently, they may shift their focus from long-term environmental concerns to immediate needs (temporal), prioritizing stable living conditions, education, health, and safety over broader adaptation measures (social).

While previous literature has reported a positive association between household size and adaptation, this study found a negative, significant association (Rana et al., 2023). Larger households tend to have higher risk perceptions, supported by collective information sharing, which reduces the perceived distance. Such households perceive climate change as more immediate and relevant, and this increased environmental awareness facilitates the adoption of adaptation measures (Fankhauser, 2017). These households are also more socially engaged with community members, and their shared concerns help reduce social distance.

The literature has reported both positive (Spence et al., 2011; Whitmarsh, 2008) and negative (Rana et al., 2023) influences of prior flood experiences; however, this study found no significant effect in the selected communities. Similarly, the study observed no significant impact of age, contrasting with previous studies that reported both positive (Rana et al., 2023) and negative (Hulkkonen et al., 2024; Whitmarsh, 2008) influences. Although the literature reported a positive association between the number of years living in the community and PDA, this study found no significant association in the selected communities (Guo et al., 2018). This outcome can be attributed to the fact that the selected communities were established after 2005, meaning that the majority of households are relatively recent settlers. As a result, the differences in residence duration are not pronounced enough to influence psychological distance, since both recent and earlier settlers share comparable environmental conditions and flood experiences. Contrary to the positive relationship reported in the literature (Whitmarsh, 2008), this study found no significant association between monthly household income and PDA.

The study has certain limitations that should be acknowledged. Psychological distance is a multifaceted concept, and its assessment through a limited set of indicators may not fully capture its complexity. Future research should therefore include a broader range of indicators for a more comprehensive understanding. Sociocultural constraints also limited female participation during data collection, potentially influencing the gender balance of responses. Future studies can focus on this aspect to ensure proper representation of gender perspectives. Moreover, the absence of single-person households in Chak Shahzad and Sector E-11/D-12 is a minor limitation. Although it reflects the family-based household structure reported in the census for Islamabad and is unlikely to bias the findings, it does reduce household diversity. The study focuses solely on formal communities, leaving out informal settlements that may exhibit different adaptation behaviors and

perceptions of psychological distance. Comparative studies between formal and informal settlements would be particularly valuable. Ultimately, this study highlights the social aspect of psychological distance, while future research could also examine institutional, economic, political, and religious dimensions to provide a more comprehensive understanding.

6. Conclusion and policy recommendations

This study assessed psychological distance to adaptation (PDA) in urban communities of Islamabad and identified the socioeconomic factors shaping it. Findings show that communities exhibit a moderate or uncertain PDA, with relatively lower distances in the temporal and social dimensions compared to the spatial and hypothetical dimensions. The gender and education of household heads, as well as the number of children in a household, positively influenced PDA, whereas household size negatively influenced it. However, no significant influence of age, income, past flood experience, or years of community residence was observed. This study extends the theoretical application of psychological distance theory to climate change adaptation in the Global South, demonstrating how socioeconomic realities influence adaptation perceptions and provide an alternative lens to traditional vulnerability assessments. It also contributes to the existing body of knowledge by demonstrating the interplay between different PDA dimensions and their relationships with socioeconomic characteristics.

From a policy perspective, the findings highlight the need for targeted, multidimensional, and context-specific adaptation strategies explicitly grounded in community perceptions of PDA. As a priority, the PDA assessments should be formally integrated into the National Adaptation Plan (NAP) and local climate action plans prepared by the Ministry of Climate Change and Environmental Coordination (MoCC&EC). Incorporating these assessments would help align adaptation priorities with community perceptions, thereby enhancing the relevance, effectiveness, and operational feasibility of adaptation policies. At the urban scale, the proposed strategies outlined in adaptation and climate action plans should be systematically incorporated into the revision of the Islamabad Master Plan, prepared by the Capital

Development Authority (CDA), the primary urban development agency. Embedding PDA-informed adaptation measures into land-use planning, zoning regulations, and development control standards would ensure adaptive responses are implemented across both existing and future urban growth phases. In addition, integrating adaptation requirements into planning parameters and building control regulations would institutionalize climate-responsive design in forthcoming development projects.

As the lowest tier responsible for disaster risk management, the Islamabad Capital Territory Administration (ICTA) and Metropolitan Corporation Islamabad (MCI) should implement localized climate awareness campaigns, supported by risk visualization tools and scenario-based communication material developed in collaboration with the National Disaster Management Authority (NDMA). These measures would reduce temporal distance by making climate risks more immediate and tangible to urban communities. To address spatial distance, CDA should initiate pilot adaptation projects at the city and neighborhood levels, informed by localized hazard mapping and risk assessments, thereby demonstrating place-specific adaptation solutions. Fig. 5 summarizes the proposed policy recommendations for each PDA dimension and key institutions involved in their implementation.

Participatory planning mechanisms, such as structured community consultations, stakeholder forums, and co-design workshops, should be institutionalized within the governance frameworks of MoCC&EC, CDA, ICTA, and MCI to reduce social distance. This can also foster collective ownership of adaptation initiatives. Furthermore, climate risk awareness and communication strategies should be tailored to key socioeconomic characteristics, particularly education level and gender, to reduce hypothetical distance and reinforce adaptation as an immediate and shared necessity. Strengthening collaboration channels with academic institutions and non-governmental organizations can further support evidence-based policymaking and context-sensitive implementation. While these recommendations are derived from the Islamabad context, they offer transferable insights for other formal urban communities confronting increasing climate-induced extreme events.

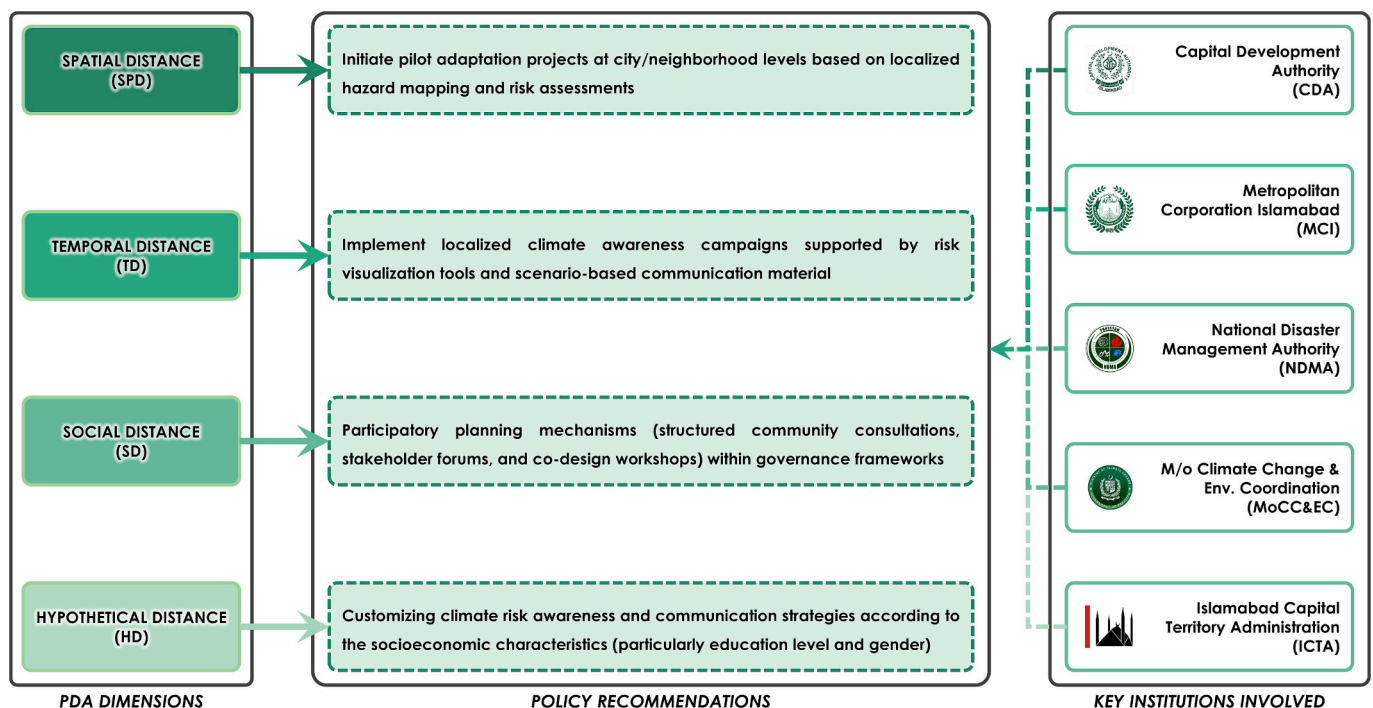


Fig. 5. Policy recommendations.

CRedit authorship contribution statement

Hassam Bin Waseem: Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Irfan Ahmad Rana:** Writing – review & editing, Supervision, Methodology, Conceptualization.

Declaration of competing interest

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

Data availability

Data will be made available on request.

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