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## Review Article

## Resilient infrastructure planning in refugee and internally displaced person settlements: A systematic review of scholarly and grey literature

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## ABSTRACT

Refugee and internally displaced persons (IDPs) settlements are increasingly exposed to shocks such as rapid population influxes and extreme weather events, yet infrastructure planning in these contexts remains largely focused on static, reactive responses, often overlooking resilience. This study examines how resilience is conceptualized in infrastructure planning for refugee and IDP settlements and identifies the key constraints to its enhancement. To address this, we conduct a systematic literature review of scholarly ( $n = 75$ ) and grey literature ( $n = 30$ ), including only studies focused on infrastructure planning in refugee or IDP settlements. The selected studies are analyzed using a framework that categorizes them by infrastructure sectors, resilience dimensions, and constraints.

The findings reveal an uneven focus across infrastructure sectors, with shelter, energy, and WASH dominating the literature. Resilience in the scholarly literature is primarily conceptualized through robustness, adaptability, and transformability, with limited integration of preparedness and recovery, and these dimensions are rarely addressed holistically. Furthermore, resilience is constrained by interrelated factors, like resource limitations, weak coordination among actors, land ownership, and institutional constraints.

These results highlight the need for integrated, cross-sectoral planning approaches that incorporate under-explored infrastructure sectors, address underemphasized resilience dimensions, and embed refugee and IDP settlements within host countries' regional planning frameworks to alleviate constraints to resilience enhancement.

## 1. Introduction

Forced displacement of people has become an escalating global challenge over the past two decades. As of June 2024, the global number of forcibly displaced people reached 122.6 million, a steep increase from the 44 million reported in 2010 [1]. Of these displaced persons, 32 million were registered as *refugees* by the United Nations High Commission for Refugees (UNHCR), while 72.1 million were *Internally Displaced Persons (IDP)* [1]. According to UNHCR [2], a refugee is “someone who has been forced to flee their country because of persecution, war, or violence.” In contrast, an IDP is defined as “a person who has been forced to flee their home for the same reasons as a refugee but has not crossed an international border.”

Around 22% of refugees live in settlements, often referred to as *camp*s [3]. IDPs also reside in these settlements, though to a lesser extent due to more localized displacement patterns [4]. Although the legal

status of refugees and IDPs differ, their settlements are often planned and managed under similar standards [5–7]. We here focus exclusively on planned refugee and IDP settlements, which are purpose-built for refugees and IDPs. We exclude other forms of settlements, such as collective centers and transit centers as their initial functionality is not to serve refugees and IDPs, but instead are temporary housing created by repurposing existing buildings within normal communities [8].

Historically, refugee and IDP settlements have been conceived as temporary solutions. Their main objective is to provide emergency shelter and basic services through standardized planning frameworks, for instance, via the Handbook for Emergencies UNHCR [9]. These planning frameworks prioritize the rapid deployment of essential infrastructure, relying on rigid, grid-based layouts, often with limited consideration of climate, and long-term adaptability [10]. While effective for addressing immediate needs rapidly, these planning frameworks are less adequate for protracted refugee and IDP settlements, where

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refugees and IDPs live for extended periods in time [11,12]. This reality challenges the notion of strictly planning such settlements as short-term solutions.

The prolonged nature of refugee and IDP settlements happens against the backdrop of climate change and rapid fluctuations in the number of people hosted within them. Easton-Calabria et al. [13] found that each of the 860 displaced people sites they analyzed, hosting millions of displaced people, was exposed to at least one climate-related hazard out of seven considered. Further, demand shocks are a frequent reality of refugee and IDP settlements. For instance, in 2017, the sudden arrival of hundreds of thousands of Rohingya refugees into Cox's Bazar led to overcrowding and limited access to essential infrastructure services such as clean water, sanitation, and health care [14]. In response, scholars such as Jahre et al. [15], De Rooij et al. [16] and Dampha et al. [17] have critiqued the short-sighted nature of current planning approaches for refugee and IDP settlements, which overlook the exposure to such shocks, suggesting a shift to resilient planning.

Resilience generally is defined as the capacity of a system to absorb disturbance, recover quickly, and reorganize to retain functionality [18,19]. The resilience concept is frequently explored in urban studies [20–22], in climate adaptation [23,24], or infrastructure systems [25,26]. Especially for infrastructure, there have been several systematic reviews, such as the one by Mottahedi et al. [27] that aimed to consolidate how resilience is defined and analyzed in the context of critical infrastructure systems. Sathurshan et al. [28] also examined how resilience in critical infrastructure has been assessed and measured since the Sendai Framework in 2015 [29]. These systematic reviews offer a useful foundation for resilience studies on critical infrastructures. However, a review on resilience that accounts for the temporality and resource-constrained nature of refugee and IDP settlements is missing in the literature.

Within the context of refugee and IDP settlements, a resilient planning approach embraces planning mechanisms that support rapid recovery, adaptation and upgrading as the settlement evolves [15,30]. However, achieving this ambition in practice is challenged by unique contextual constraints such short-term planning cycles, high planning uncertainty and resource limitation. Infrastructural systems are the focus of this review, as they are the foundations on which the basic necessities depend, such as food [31,32] and water [33]; their absence or failure compromises health, sanitation [34] and supply chains [35]. It remains unclear how resilience is conceptualized in infrastructure systems in refugee and IDP settlements. This gap motivates the systematic literature review.

To address this research gap, we conduct a systematic literature review using a conceptual framework to identify patterns and key limitations in the body of literature. This approach helps to inform both future research directions and policy-relevant insights for resilience-oriented infrastructure planning and is guided by three research questions:

- (1) Which sectors are represented in the infrastructure planning literature for refugees and IDPs?
- (2) How is resilience conceptualized in the planning of infrastructures in refugee and IDP settlements?
- (3) What are the main constraints to enhancing resilience in the planning and management of infrastructures in refugee and IDP settlements?

This paper begins with a conceptual of framework (Section 2), which informs the review's methodology (Section 3). We then describe our study results (Section 4), characterizing the corpus by publication trend and spatial distribution (Section 4.1), infrastructure sector and planning scope (Section 4.2), and planning approach (Section 4.3). This is followed by the conceptualization of resilience in theory and in practice (Section 4.4), across sectors (Section 4.5), and finally, the constraints to enhancing resilience in the planning and management of infrastructures

in refugee and IDP settlements (Section 4.6). We conclude with a discussion of the results and future research directions and policy implications (Section 5).

## 2. Conceptual framework

Resilience in refugee and IDP settlements draws from multiple, overlapping strands. One stream focuses on humanitarian infrastructure and supply chain resilience, emphasizing continuity of operations and service delivery under disruption in disaster areas [36] and resilience of spatial structures in refugee and IDP context [37]. A second strand, rooted in humanitarian governance, highlights the role of institutions, power relations, and local actors in shaping resilience outcomes [38]. A third, from a development-oriented perspective frames resilience in terms of longer-term system transformation and integration into broader socio-economic systems [39]. This review brings these theoretical perspectives together, contextualizing them specifically to the context of refugee and IDP settlements. For instance, in shelter planning, resilience is operationalized through modular designs that enable incremental upgrades (adaptability) and support the transition from isolated settlements to more integrated systems within host communities over time (transformability). Additional operational examples of resilience are provided in Appendix A.

Infrastructure resilience is not solely a technical matter. Rather, we recognize infrastructures as socio-technical systems [40,41]. That is, resilient infrastructures reduce societal disruption, while strong social systems, facilitated through governance, cooperation, community engagement, and institutional capacity, are essential to maintaining and recovering infrastructure functionality during and after shocks [42,43]. In practice, the social dimension interacts through planning and implementation processes: host government policies and regulatory frameworks shape land-use decisions and standards; coordination mechanisms among governments, humanitarian agencies, and NGOs influence infrastructure provision; and community engagement affects how services are used and maintained.

Resilient planning of infrastructures within refugee and IDP settlements differs from other contexts in that it is centered on rapidly deployable and often temporary infrastructure solutions. Humanitarian actors need to prioritize basic infrastructure services in resource-constrained and unstable contexts [44]. Hence, in this context resilience is the ability of displaced communities and infrastructure systems to maintain access to services/resources, under conditions of shocks, prolonged displacement, institutional uncertainty, and severe resource constraints [45].

Based on the literature, we developed a conceptual framework to analyze the articles (Fig. 1). Reflecting the spatial-temporal nature of resilience, the framework classifies studies by geographical location, planning scope, planning approach, and study design. It further organizes the literature around the research questions: infrastructure sectors, resilience dimensions, and constraints to resilience enhancement. More details on the conceptual framework are provided in Section 3.4.

Resilience is conceptualized through various dimensions, notably, preparedness, robustness, recovery, adaptability, and transformability [46]. This framework builds on the resilience framework in the analysis conducted by Mottahedi et al. [27] and resilience theory by Folke et al. [18]. Their work identify core capacities of a resilient system to be: (i) the capacity to imagine what to expect (preparedness), (ii) the capacity to protect against and resist disruptions (robustness), (iii) the capacity to restore normal levels of performance following disruption (recovery), (iv) the capacity to adapt to new conditions generated by disruptions (adaptability), and (v) the capacity of a system to enable a fundamental shift in its infrastructure systems, governance structures, planning horizons or social conditions in order to respond to a shock or a challenge (transformability).

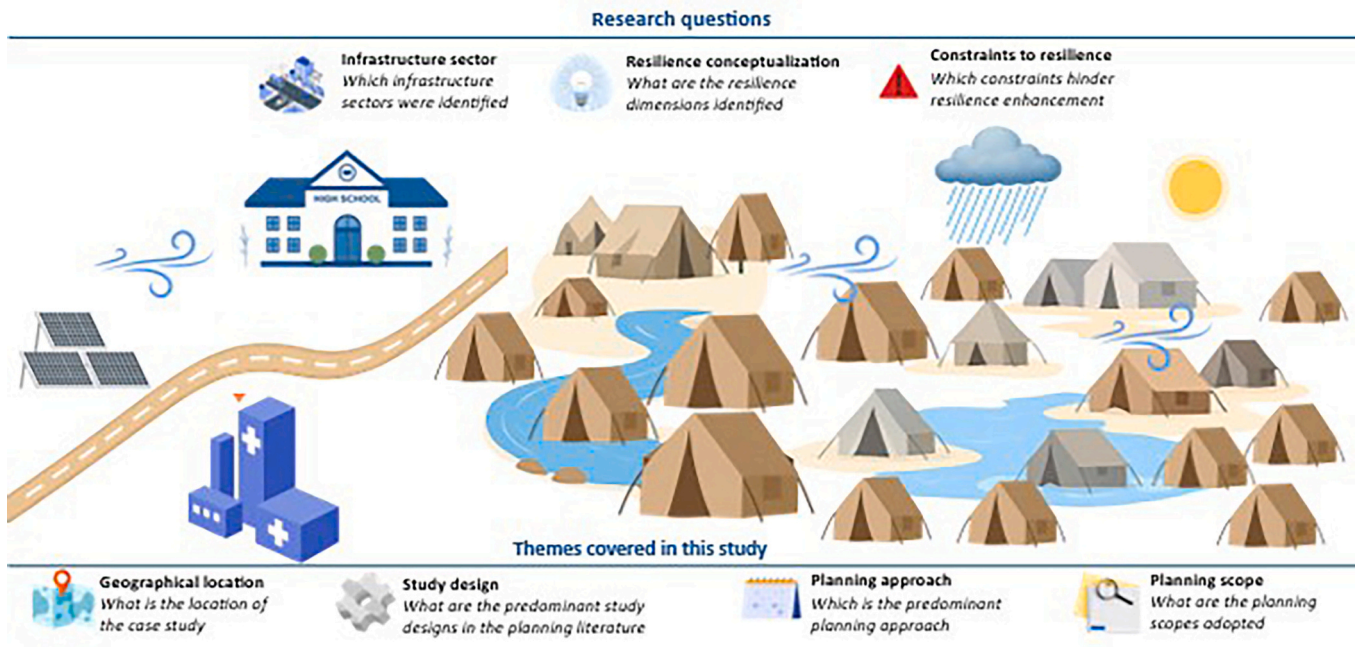


Fig. 1. The conceptual framework evaluating studies related to infrastructure planning. *Infrastructure sector, resilience conceptualization, constraints to resilience enhancement, geographical location, planning approach, planning scope, and study design.*

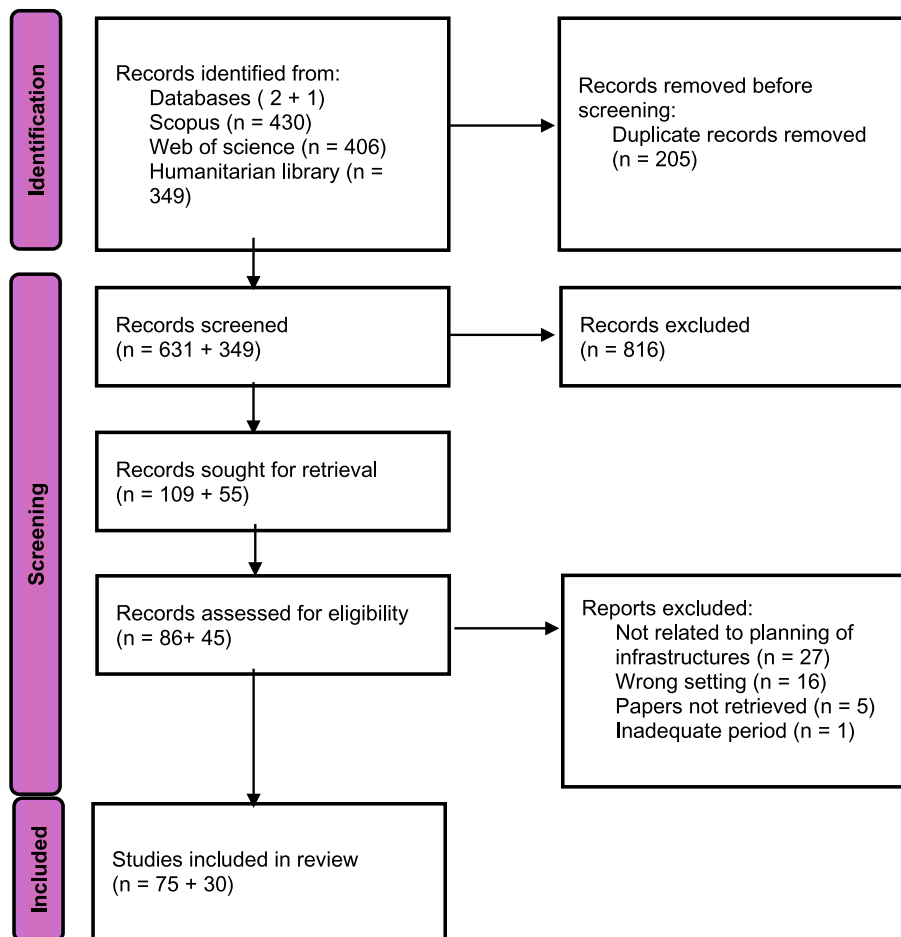


Fig. 2. Filtering of systematic literature review generated using PRISMA. *On the left hand side, the first number indicated on the PRISMA captures the scholarly literature, while the second number indicates the -grey literature.*

### 3. Methodology

The systematic literature review followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) approach [47], a step-wise approach including identification, title and abstract screening, full-text screening, and data abstraction. To manage this process efficiently and collaboratively, we used the software package Covidence (Covidence - Better systematic review management), a web-based platform designed to streamline systematic review articles. Covidence allows for easy handling of uploaded journal references and supports team-based screening [48]. Fig. 2 summarizes the PRISMA approach followed.

#### 3.1. Identification

Alongside the academic literature, governments, development banks, and UN organizations also publish relevant reports in the form of planning frameworks, guidelines, and action plans. To understand current practice, and contrast it with academic articles, we include both scholarly and non-scholarly articles. For the scholarly articles, our search covered the Web of Science and Scopus databases, due to their comprehensive coverage and because they are among the largest abstract and citation databases for peer-reviewed literature [49]. The non-scholarly articles were compiled from the database, Humanitarian Library (<https://www.humanitarianlibrary.org/>). This is a key resource for humanitarian information, providing comprehensive access to diverse grey literature sectors, especially handbooks, reports, toolkits and standards [50].

Our search string captured papers that focus on the planning of infrastructures within refugee and IDP settlements, starting with the population (“refugee\*” OR “internally displaced person” OR “internally displaced people” OR “IDP”), habitat (“camp” OR “settlement” OR “shelter” OR “facilit\*”), infrastructure (“infrastructure” OR “transport” OR “road” OR “energy” OR “electricity” OR “water” OR “health facilit\*” OR “WASH” OR “Water sanitation and hygiene” OR “logistic\*” OR “ICT” OR “information communication technology”), and finally the analytical approach (“plan\*” OR “manag\*” OR “operat\*” OR optimi\*). This search strategy was adopted as it fits both scholarly and non-scholarly articles databases.

We searched only sources written in English, capturing a broad range of publication formats such as peer-reviewed articles, book chapters, conference proceedings, organization reports and guidance notes. This review may potentially overlook important academic and grey literature written in languages other than English, such as French or Spanish. Only studies published between the years 2000 and the first quarter of 2026 were included. This time range reflects a period of significant shifts in global humanitarian priorities, particularly with the publication of the first edition of the SPHERE standards, a global humanitarian standard-setting framework [51]. The combined results of the search engines resulted in 1185 articles.

#### 3.2. Screening

The articles were screened based on their title and abstract. The articles had to explicitly mention the population (refugee, internally displaced people) and at least one infrastructure type (water, energy, healthcare center or facility, transport, etc.) to be selected at this phase. Additionally, the article had to capture infrastructures in displaced settings, such as refugee and IDP settlements. We excluded studies on standard urban or national infrastructure systems, which operate under different conditions. This initial screening process yielded 109 (scholarly) and 55 (grey literature) articles for full-text review.

#### 3.3. Eligibility

In the full text review, the articles were examined based on the extent of discussion of the population, habitat, infrastructure, and the analytical approach. We limited the search to studies focusing on refugee and IDPs residing in settlements. Studies on refugees and IDPs conducted outside of settlement contexts were excluded to ensure relevance for refugee and IDP settlement-based research. Regarding the infrastructural aspect, we excluded studies that did not focus on physical infrastructures, but on ethnography, mental well-being of refugees, toxicology, pharmaceuticals, and nursing with no link to infrastructure. At the end of this phase, 105 studies were eligible for inclusion in the analysis.

#### 3.4. Analysis

The articles were analyzed based on the conceptual framework provided in Section 2. Each research question is linked to a specific dimension of the framework. The first research question, which examines infrastructure sector coverage, is addressed by categorizing the literature across key infrastructure sectors to identify patterns of representation and gaps. The second research question, focusing on the conceptualization of resilience, is analyzed through the classification of the included paper across the resilience dimensions, enabling a comparative assessment of how resilience is framed across sectors. The third research question, which investigates constraints to resilience enhancement in infrastructure planning, is addressed by identifying and synthesizing the constraints reported in the literature. The conceptual framework consist of the following assessment dimensions.

##### 3.4.1. Infrastructure sector

Based on the identified papers, the sectors were grouped into shelter, energy, WASH, transport & logistics, healthcare, and education. Papers that examined two or more infrastructure sectors were separated and counted under each relevant sector individually.

##### 3.4.2. Geographical location

There was no restriction on the location of the settlements analyzed. The countries reported in the analysis correspond to the locations of the case studies examined in each publication. For studies that analyzed multiple case studies across different countries, each country was recorded individually and mapped to the corresponding case study (or paper).

To analyze the geographical distribution of publications, we constructed a research coverage index. The index was calculated as the ratio between the number of articles identified for a given region and the total number of refugees and IDPs reported in that region. Data on refugee and IDP populations were obtained from the World Development Indicators (WDI) database ([https://data360.worldbank.org/en/indicator/WB\\_WDI\\_SM\\_POP\\_FDIP](https://data360.worldbank.org/en/indicator/WB_WDI_SM_POP_FDIP)). This index was used as an indicative measure to assess the relative level of research attention across regions in relation to the scale of forced displacement. However, the index should be interpreted cautiously, as research production is influenced by additional factors such as funding availability, research capacity, and institutional presence.

##### 3.4.3. Planning scope

Papers that analyzed refugee and IDP settlements as an isolated settlement without a link to the hosting country were classified as following a camp-specific planning scope (Table 1). Papers that planned or recommended the potential integration of refugee and IDP settlements into urban or rural planning strategies were classified as following a regional planning scope. Similarly, papers that suggested collaboration among actors involved in planning, such as the government of the host

**Table 1**  
Planning dimensions and their definition.

Planning scope	
Regional planning	This pertains to approaches that consider refugee and IDP settlement planning as part of the development plan of the region hosting the refugee and IDP settlement, e.g., <i>the collaboration of humanitarian and government or development actors to plan infrastructures in refugee and IDP camps, resulting in shared infrastructure among refugees and IDPs and the local community.</i>
Camp-specific planning	This refers to the planning of settlements as an isolated unit within the host community, e.g., refugee camps designed as self-contained settlements with dedicated infrastructure and services that operate independently of the <i>host community systems.</i>
Planning approach	
Adaptive planning	This reflects a design approach where the settlement is expected to evolve over time, with planning mechanisms that support adaptation and upgrading as the settlement evolves.
Static planning	This refers to a design approach where settlements are planned as fixed and not expected to evolve after initial setup, as the settlements are supposed to be temporary.
Periodic update	These are plans that incorporate regular assessments or monitoring processes aimed at evaluating infrastructure performance and service outcomes, and subsequently informing improvements, e.g., <i>a recurrent survey of refugees and IDPs and healthcare personnel on WASH practices or infrastructure functionality in camps.</i>
Study design	
Single case study	This is a research approach that involves an in-depth examination of one case study.
Comparative study	These are papers that analyzed two or more cases to identify similarities, differences, or patterns between them.

country, humanitarian actors, and development actors, were classified as following a regional planning scope.

### 3.4.4. Planning approach

In this category, the papers were categorized into static, periodic, and adaptive planning approach, highlighting the different planning objectives in humanitarian contexts (Table 1).

The categorization of planning approaches and planning scopes presented in Table 1 is informed by the temporal and spatial dimensions of the framework proposed by Jahre et al. [15]. In this study, planning approaches are categorized according to their temporal dimension, distinguishing between static and adaptive planning, which takes place at the establishment phase of the settlement. In addition, we introduce periodic planning as a separate category, as it is conceptually distinct from both static and adaptive approaches, and is mentioned in the literature as well [7]. The planning scope is derived from the spatial dimension and is used to classify the reviewed studies into regional-level and camp-specific planning categories.

### 3.4.5. Study design

We examined the scope of each paper. Studies that focused on a single geographical setting (e.g., a single settlement) were coded as single case studies. Those that contrasted two or more settings were coded as comparative studies.

### 3.4.6. Resilience dimensions

Resilience indicators were identified in the literature, drawing on earlier work by Petrović et al. [52] and Mottahedi et al. [27]. These indicators were mapped to the corresponding resilience dimensions: preparedness, robustness, adaptability, recovery, and transformability (see Appendix A). For instance, indicators relating to anticipation or contingency planning were coded under *preparedness*; those describing redundancy, durability or the capacity to withstand disruption were

coded to *robustness*; indicators referring to flexibility, hybridization were assigned to *adaptability*; indicators concerning restoration of services or system rehabilitation were mapped to *recovery*; and those involving a fundamental system shift or systemic redesign were coded under *transformability*. Resilience dimensions were absent from certain studies, while others addressed two or more dimensions and were consequently mapped to multiple dimensions.

### 3.4.7. Constraints to resilience enhancement

Enhancing resilience in the planning and management of infrastructures in refugee and IDP settlements is constrained by various organizational, implementation, and operational barriers [53]. To identify these constraints, all papers that reported any constraints to resilience enhancement of infrastructures or to adaptive planning were captured. The constraints mentioned in the papers were categorized by type (Table 2).

Lahn and Grafham [54], documented constraints to sustainability within specific infrastructure sectors, particularly energy systems. This study focuses on the resilience framework and extends beyond sector-specific analyses by developing a classification of constraints that cuts across infrastructure sectors.

## 4. Results

### 4.1. Publication trends and their spatial distribution

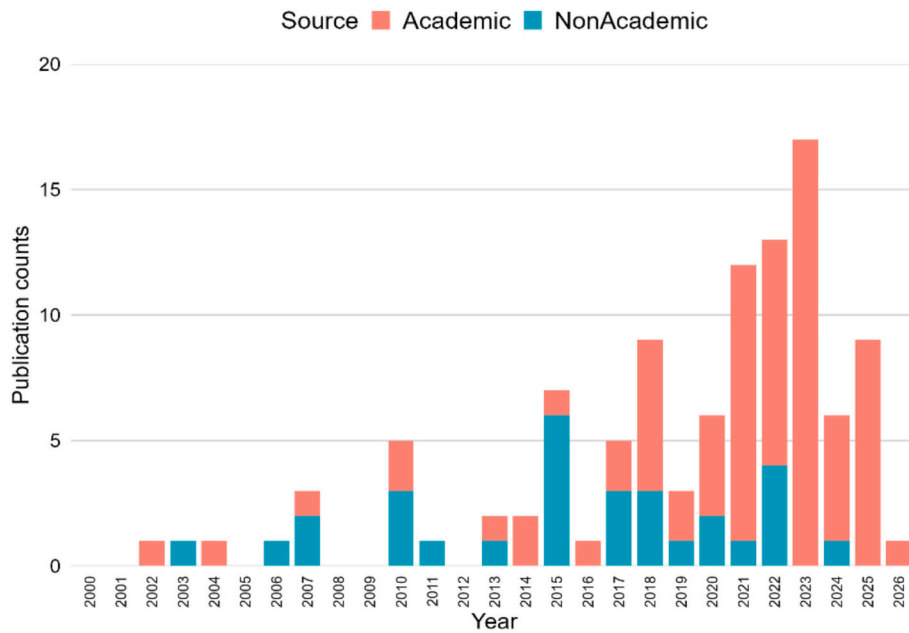
Since 2000, interest in infrastructure planning within refugee and IDP settlements has steadily increased across the academic and non-academic sources (Fig. 3). Publication activity was low in the early years, with sporadic outputs from both sources. The corpus increased consistently, peaking in 2023 with 17 out of the 105 identified articles.

The non-academic outputs dominate earlier periods, driven by

**Table 2**

Definition of constraints that hinder resilience enhancement in the planning and management of infrastructures in refugee and IDP settlements.

Challenges	Description/example of indicators
Institutional/political	This refers to constraints related to politics and legal frameworks that hinder effective settlement planning and management, e.g., <i>policies against the integration of refugees into host countries</i>
Administration and control	This refers to constraints related to the operation and supervision of the settlements, as well as stakeholder responsibilities in the management, e.g., <i>a lack of good control measures in refugee and IDP settlements, leading to unplanned settlement growth and overcrowding</i>
Coordination	This constraint captures the fragmented or lack of collaboration between the various actors involved in refugee and IDP settlement planning and service delivery, often leading to duplication of efforts and inefficient services, e.g., <i>funding of the same projects or initiatives by different humanitarian actors simultaneously or humanitarian actors operating with differing agendas</i>
Resource limitations	The category of limited resources refers to the lack of technical skills, data, funding, and human resources that hinder effective refugee and IDP settlement planning, implementation, and management, e.g., <i>Shortage of skilled staff on site for the operation and maintenance of advanced energy systems, lack of long-term funding, and irregular or unpredictable funding flows</i>
Logistical constraint	This category is about studies that highlighted how operational bottlenecks like delivery disruptions impact access to essential resources, such as healthcare, e.g., <i>a sudden increase in demand due to an unpredicted influx of refugee and IDPs occurring in the context of constrained resources</i>
Land ownership	This refers to constraints related to legal entitlement to land, which grants an individual, a community, or an institution the right to possess, use, and control that land, e.g., <i>pressure to restore land after a predefined period of encampment</i>

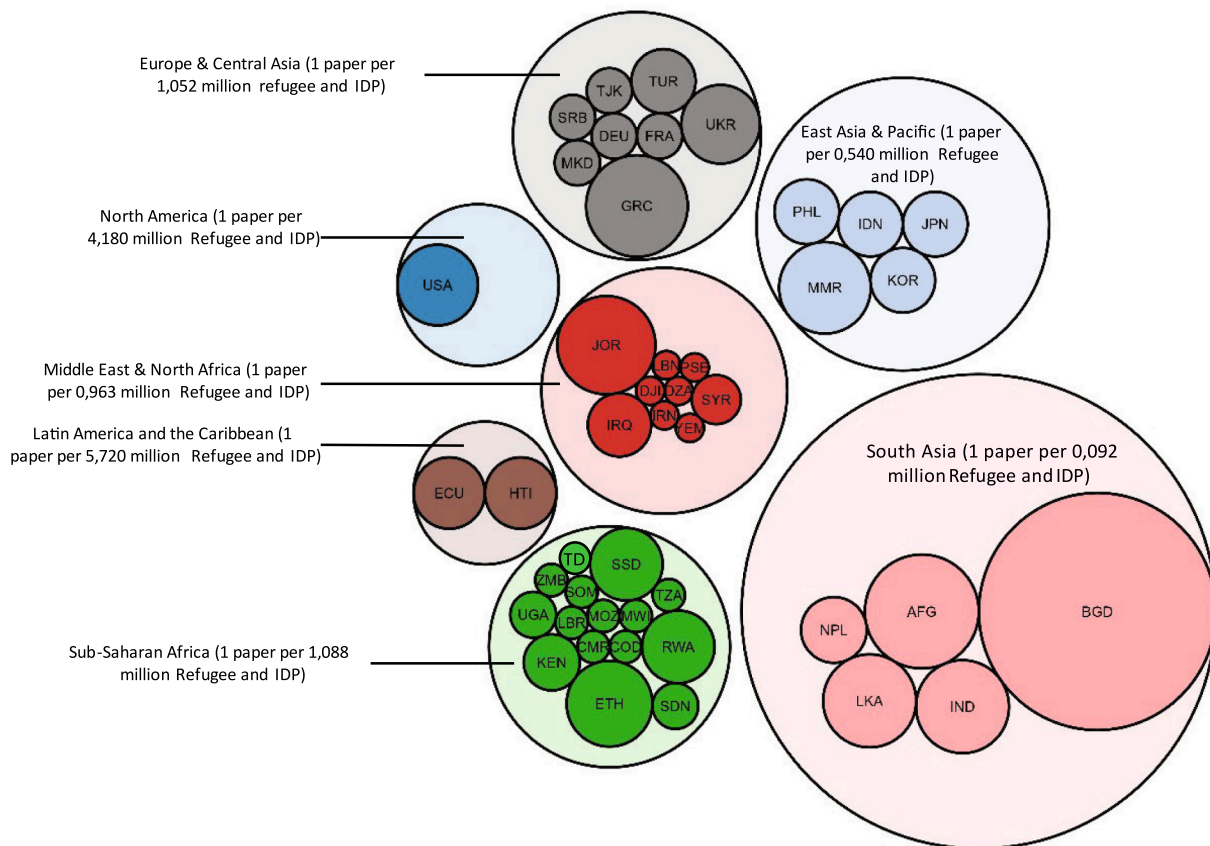


**Fig. 3.** Frequency of publications. The bar graph illustrates an overall increase in publications about infrastructure planning in refugee and IDP settlements from 2000 to the first quarter of 2026.

operational needs, standards and norms for crisis response, and coordination mechanisms led by organization handbooks [55–58]. The non-academic publications remain few and sparsely distributed over time.

From 2017 onward, academic publications increased sharply; this surge reflects a shift from late 20th-century and early 2000s studies that

focused mainly on infrastructure standards & norms, and technical assessments toward multidimensional and analytical approaches that integrate social, cultural, political, economic, and environmental considerations [59]. In addition, the increase in research since 2017 is also likely driven by the global sustainable development agenda, including



**Fig. 4.** Spatial distribution of case studies. The hierarchical circle packing displays the spatial distribution of case studies in the regions. The size of the regions (circles) indicates the magnitude of the research coverage of that region. The full meanings of the country abbreviations can be found in Appendix C.

the Sustainable Development Goals (SDGs) and the UNHCR Global Strategy for Settlement and Shelter. Overall, academic publications have dominated the latter years.

The corpus spans 45 countries (Fig. 4), reflecting the global distribution of refugee and IDP settlements. Refugee and IDP settlements in Sub-Saharan Africa are the most frequently analyzed (28% of the studies) (Appendix B). This includes research into refugee and IDP settlements in Ethiopia ( $n = 8$ ), Rwanda ( $n = 6$ ), South Sudan ( $n = 4$ ), and Kenya ( $n = 3$ ). The Middle East & North Africa region also receives considerable attention, accounting for 25% of all studies, represented by countries such as Jordan ( $n = 15$ ) and Iraq ( $n = 5$ ). Bangladesh in South Asia (19%) accounts for 58% of the studies and stands out as the most researched country in the region, home to one of the world's largest refugee settlements (Cox's Bazar).

North America (1%), East Asia & the Pacific (6%), Latin America and the Caribbean (2%), and Europe & Central Asia (14%) are the least studied regions. This is likely due to the fact that most refugee and IDPs in these regions are not housed in settlements (camps). For example, refugee and IDPs in North America are often housed in urban housing (municipal and social) once they receive asylum in the host countries [60]. This is less often the case in regions like Sub-Saharan Africa, where a high percentage of refugee and IDPs live in settlements [61]. Lastly, 6% of the papers focused on reports designed for global/international use and not case-specific. These are reports and toolkits designed to set standards, such as the UNHCR handbook for emergency [9] and the Green Recovery and Reconstruction Toolkit (GRRT) [62].

The research coverage index shows that although regions such as Sub-Saharan Africa, the Middle East & North Africa and Europe & Central Asia account for a high number of publications, the number of studies remains low relative to the large number of refugees and IDPs they host (one paper per 1088 million refugee and IDP, one paper per 0,963 million refugee and IDP, and one paper per 0,092 million refugee and IDP respectively) (Annex B). In contrast, South Asia, which contributes only 19% of the publications, displays the highest research coverage when adjusted for the relatively smaller number of refugee and IDPs in the region (one paper per 0,092 million refugee and IDP).

#### 4.2. Sectors identified and their planning scope

Regarding the infrastructure sectors studied (Fig. 5), most publications focus on the shelter sector, accounting for 38% of all papers ( $n = 49$ ), followed by WASH (32%,  $n = 40$ ) and energy (17%,  $n = 22$ ). The remaining sectors (healthcare, education, transport & logistics), constitute only 13% of the papers analyzed ( $n = 17$ ). The papers that considered more than one sector (e.g., WASH and healthcare) in the scholarly ( $n = 4$ ) and in the non-scholarly literature ( $n = 15$ ) were

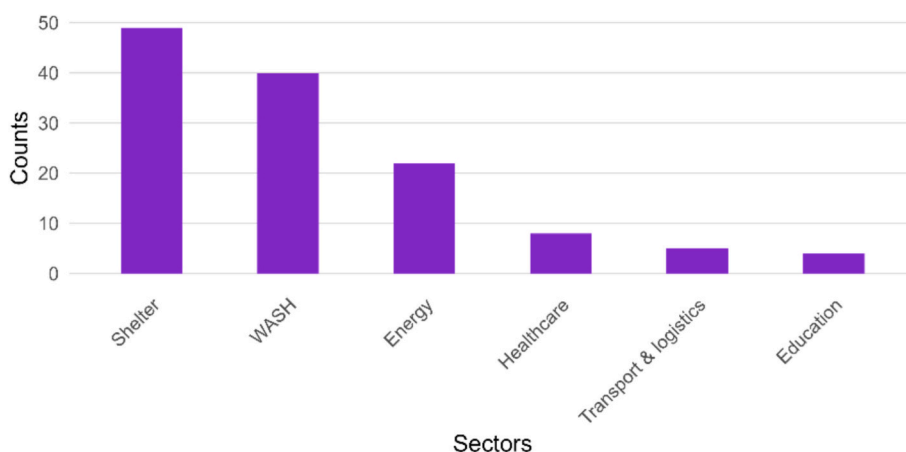
counted as one to the corresponding sectors. For example, two papers considered energy and healthcare sectors simultaneously [63,64] and one paper considered WASH and healthcare simultaneously [65]. Chowdhury et al. [63] analyzed the resilience of a solar PV battery system used to power healthcare centers in the Rohingya refugee settlements, highlighting the critical link between energy infrastructure and health service continuity. Similarly, Kabir et al. [65] jointly assessed infrastructures related to WASH and healthcare management within health facilities in refugee and IDP settlements, aiming to strengthen healthcare delivery.

Concerning the planning scope, most studies consider a camp-specific approach in infrastructure planning (Table 3). Only 12% of the papers ( $n = 13$ ) consider a regional planning approach, encompassing examples ranging from regional shelter planning by Aldeek et al. [66], regional energy planning by Baldi et al. [67], to regional health facility planning by Komakech et al. [68]. These regional studies consider planning scopes that link refugee and IDP settlements to the host community infrastructures. For instance, in the regional planning approach by Schweitzer et al. [69], the authors showed that delivering water services separately to refugees and host communities can lead to entrenched inequality and inefficiency. They recommend adopting regional-based approaches in which infrastructure and financing mechanisms are integrated into national systems, as this represents an opportunity for having resilient infrastructures. Similarly, the study by Alawneh & Rashid [37] considers a regional planning scope to prevent isolating the refugee and IDP settlements as the city develops.

Regarding the study design, we observe a strong focus on single-case study analysis rather than comparative analysis (Table 3). Only 17% of papers ( $n = 18$ ) adopted a comparative analysis of refugee and IDP settlements. These include, for instance the study conducted by Haggag et al. [70] whose aim was to evaluate and rank different emergency settlement design approaches using the Analytical Hierarchy Process (focusing on settlements in South Sudan, Ethiopia, and Southern Bangladesh). The objective was to identify which model best supports

**Table 3**  
Descriptive statistics of planning dimensions.

Dimensions	Paper percentages (n = counts)
Planning scope	
Regional planning	12% (n = 13)
Camp-specific planning	88% (n = 92)
Study design	
Comparative analysis	17% (n = 18)
Case studies	83% (n = 87)



**Fig. 5.** Number of publications per sector. The sectors Shelter, WASH and Energy are more often represented in the literature as compared to the sectors Healthcare, Transport & logistics and Education.

effective and efficient disaster response planning. Similarly, the study by Trabattoni & Esmaeili [71] examined how different types of refugee settlements across Europe, the Middle East, and Africa vary in their spatial organization, management systems, and sustainability challenges, highlighting the need for context-specific and more sustainable planning approaches.

#### 4.3. Planning approach

In the scholarly literature, a static planning approach was considered in 9% of the papers ( $n = 7$ ) (Table 4). Reference to periodic updates was observed in 16% of the papers studied ( $n = 12$ ). These periodic updates evaluate the functionality of existing infrastructures and identify opportunities for improvement. This approach was particularly prominent in the WASH sector, where tools such as the WASH FIT (Water and Sanitation for Health Facility Improvement Tool) and Lot Quality Assurance Sampling (LQAS) surveys were used to monitor service quality and guide infrastructure enhancement [65,72]. Also, 32% of the papers ( $n = 24$ ) considered the adaptive planning approach, advocating or encouraging shifts toward adaptive strategies. The remaining portion of papers (43%,  $n = 33$ ) did not specify any of the above-stated planning approaches, revealing a critical gap in the literature.

The dominance of the adaptive planning perspective as a critical recommendation suggests a growing acknowledgment of the protracted nature of displacement and the necessity for resilient infrastructures [15,73,74]. Moreover, adopting an adaptive planning approach enables refugee and IDP settlements to be more organized. This can be illustrated by the evolution of the Zaatari and Azraq settlements in Jordan. Zaatari initially operated under a static emergency model, while Azraq adopted an adaptive planning framework (with emphasis on long-term vision) from the outset. Both eventually developed into adaptive settlements, with Azraq demonstrating a more organized layout [75,76].

In the non-scholarly literature, 33% papers ( $n = 10$  out of 30) consider a static planning. In most design standards and toolkits, settlements are considered transitory, serving as a justification for the static planning approach [58,77]. The adaptive planning approach was considered in 20% of papers ( $n = 6$ ), referencing the fact that temporary refugee and IDP settlements can be adapted in the long run when conditions allow [77–79].

#### 4.4. Resilience conceptualization in theory and in practice

A total of 65% of the reviewed articles ( $n = 49$ ) addressed at least one resilience dimension, with most focusing on robustness, adaptability, and transformability (Fig. 6a). Adaptability was the most frequently examined dimension (33%,  $n = 16$ ), followed by transformability (18%,  $n = 9$ ) and robustness (12%,  $n = 6$ ). However, only 37% of studies ( $n = 18$ ) adopted a cross-dimensional approach, integrating multiple resilience dimensions ([15,63]; [80]; [81]). Where such integration occurred, studies showed that combining these dimensions enables systems to maintain services, adapt to changing conditions, and support longer-term transitions across sectors. For instance, Yasmin et al. [82]

**Table 4**  
Planning approaches in scholarly and non-scholarly articles.

Planning approaches in scholarly articles	
Adaptive planning	32% ( $n = 24$ )
Static planning	9% ( $n = 7$ )
Not mentioned	43% ( $n = 33$ )
Periodic update	16% ( $n = 12$ )
Planning approaches in non-scholarly articles	
Adaptive planning	20% ( $n = 6$ )
Static planning	33% ( $n = 10$ )
Not mentioned	44% ( $n = 13$ )
Periodic update	3% ( $n = 1$ )

illustrate this in WASH through the consideration of environmental shocks in the design, monitoring and feedback mechanisms, and systems planning, while Nixon & Gaura [83] demonstrate it in energy through resilient PV systems, flexible demand management, and a shift toward smart energy technologies.

In contrast, 97% of the non-scholarly literature ( $n = 29$ ) incorporates resilience in infrastructure planning for refugee and IDP settlements, with a broader focus that includes preparedness (14%,  $n = 4$ ) and recovery (21%,  $n = 6$ ) compared to the scholarly literature (Fig. 6b). Cross-dimensional approaches are similarly present (38%,  $n = 11$ ), typically combining system durability with flexibility in design and operation [84].

Unlike scholarly literature, non-scholarly sources operationalize resilience in terms of preparedness and recovery. Preparedness is addressed through planning guidelines and pre-shock measures that enable timely and effective response, including settlement planning standards, contingency strategies, climate risk mitigation, and capacity building [77,85–89]. Recovery is framed in terms of both community and housing restoration, which manifest through support for rebuilding housing and assets, as well as interventions that promote psychosocial recovery and income generation [55,78,90–93].

#### 4.5. Resilience conceptualization across infrastructure sectors

As illustrated in the heatmap (Fig. 7), there is a distinctly uneven landscape in the conceptualization of resilience across infrastructure sectors. Sectors prioritize different resilience dimensions. Even when sectors prioritize the same dimensions, the objectives within these dimensions differ. For example, the shelter ( $n = 14$  out of 59) and transport & logistics ( $n = 3$  out of 8) sectors prioritize the transformability dimension. However, within the shelter sector, this encompasses a shift toward integrating refugee and IDP settlements within the host communities. Meanwhile in the transport & logistics sector, transformability means building operational buffers into the humanitarian supply chain operation to cope with uncertainties ([56]; [80]).

Across the literature, adaptability emerges as the most consistently emphasized dimension, though operationalized differently depending on context. It ranges from spatial flexibility in the shelter sector [37,94], to technical load optimization and management of the energy system to minimize cost and GHG emissions in the energy sector [81,95–100] and iterative planning updates and climate-responsive measures in the WASH sector [69,101–108]. This variation highlights that adaptability is not a uniform concept but is shaped by sector-specific functions and risks. While all sectors prioritize this dimension, it is predominantly framed in terms of optimizing system performance under changing conditions. This shows that across all sectors, there is an increasing awareness of the multiple shocks to which these settlements are exposed.

The shelter sector shows the broadest engagement across the different resilience dimensions, reflecting its central role at the intersection of humanitarian response and development ([37,94]; [109]; [77]; [110]; [71,74,111]). This likely reflects the prioritization of the shelter sector among infrastructure systems, given its fundamental role in providing immediate protection, safety, and habitability. This inherently multi-functional role of shelters necessitates engagement with multiple resilience dimensions, positioning shelter as a key entry point for more holistic resilience approaches.

Lastly, the energy sector stands out for prioritizing robustness at levels comparable to adaptability, with the two dimensions often addressed in tandem. This reflects the sector's need to balance structural reliability with operational flexibility under conditions of uncertainty. While robustness ensures system stability and redundancy to withstand shocks [97,112], adaptability enables adjustment to fluctuating demand, resource variability, and climatic conditions. Together, this combined emphasis suggests a more integrated approach to resilience, where maintaining system functionality during disruptions is as critical

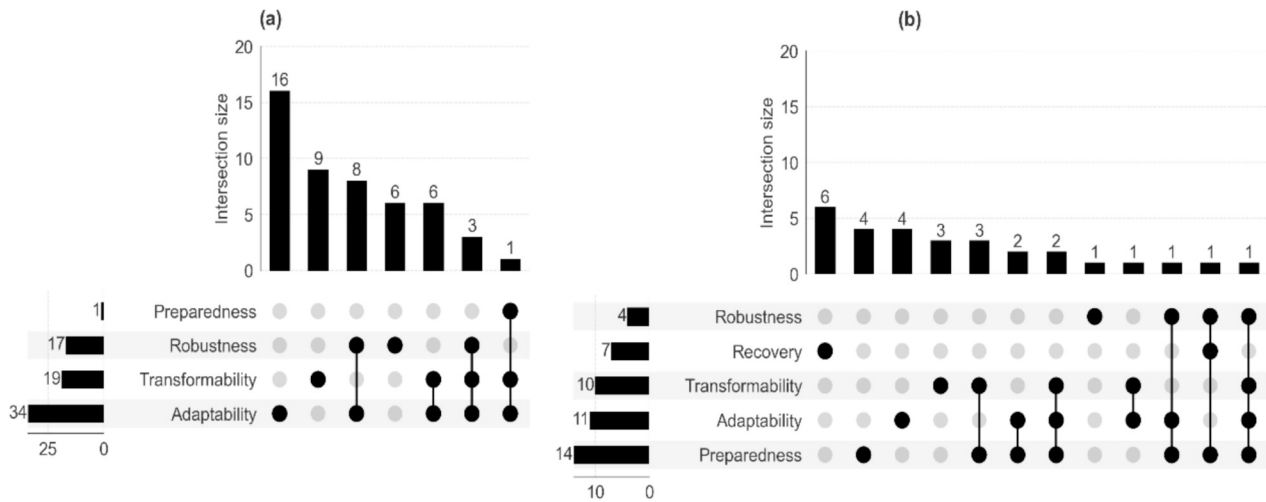


Fig. 6. Resilience dimensions. (a) shows the frequency of resilience dimensions identified in the scholarly literature meanwhile (b) shows the frequency of resilience dimensions identified in the non-scholarly literature.

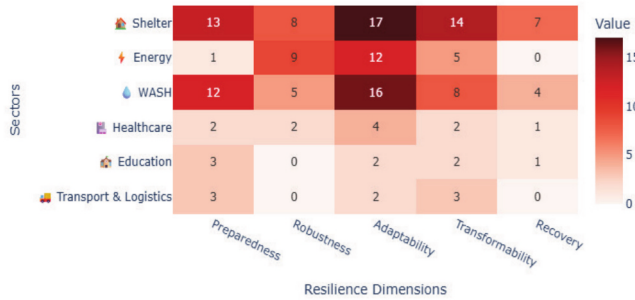


Fig. 7. Resilience dimension across sectors. The rows indicate the sectors considering resilience during the planning of infrastructures in refugee and IDP settlements, meanwhile the columns show the frequency of the resilience dimensions identified per sector in the literature.

as adapting to changing conditions.

#### 4.6. Constraints to enhancing resilience in the planning and management of infrastructures in refugee and IDP settlements

A total of 71% ( $n = 53$  out of 75) of the scholarly articles identified constraints to enhancing resilience in the planning and management of infrastructures in refugee and IDP settlements. These constraints were discussed individually ( $n = 21$ ) or in combination with other constraints ( $n = 32$ ). Similarly, 63% ( $n = 19$  out of 30) of the non-scholarly articles identified resilience constraints, with 68% of them ( $n = 13$ ) identifying a combination. Fig. 8 illustrates the frequency of the constraints encountered across the sectors. Constraints across scholarly and non-scholarly literature are broadly similar. However, constraints linked to land ownership were mentioned in the non-scholarly literature, but not in the scholarly literature.

##### 4.6.1. Resource constraints

Resource constraints were the most frequently mentioned constraints both across the scholarly literature ( $n = 40$ ) and the non-scholarly literature ( $n = 31$ ), predominantly emphasized across the energy and WASH sectors (Fig. 8). This constraint groups four interconnected sub-categories. First, personnel shortages [68], second, unreliable, outdated or inaccessible data [67] [76,83,95,113], then third, lack of technical expertise needed to plan and manage complex infrastructure [67,114]. Fourth, limited and unstable funding cycles, which makes it

difficult to plan for more adaptable infrastructures.

A key pattern is the misalignment between the long-term benefits of resilience investments and short-term funding and operational cycles. For instance, although solutions such as hybrid solar systems offer long-term cost-effectiveness and resilience benefits, their high upfront costs and delayed returns often exceed humanitarian budgets and planning horizons [114]. As a result, resource constraints do not only limit capacity but actively shape decision-making, reinforcing a preference for low-risk, short-term interventions over more resilient, long-term solutions.

##### 4.6.2. Administrative constraints

Administrative constraints reflect governance gaps that limit effective settlement planning and management. Weak administrative oversight often leads to unplanned settlement growth and overcrowding, often resulting in excessive pressure on service systems, as emphasized across the scholarly literature ( $n = 19$ ) [112] and the non-scholarly literature ( $n = 7$ ) (Fig. 8) [84]. This constraint manifests in cases when new settlements are integrated into already strained national infrastructure, worsening the state of infrastructures if not effectively managed [82]. In other cases, it manifests through operational inefficiencies, including a lack of training, weak monitoring systems, and the absence of context-specific management strategies [73,94,111,115]. Administrative constraints hinder the ability to sustain resilience interventions over time, as governance gaps limit continuity.

##### 4.6.3. Institutional/political constraints

A major consequence of institutional constraints is the limited involvement of refugees and IDPs in planning processes, compounded by restrictive legal and policy frameworks that prevent integration into the local community [82,95,116]. This is mentioned both in the scholarly literature ( $n = 15$ ) and the non-scholarly literature ( $n = 8$ ) (Fig. 8). These constraints shape how interventions are designed and implemented, often favoring low-risk, short-term approaches over more transformative solutions [102]. They also create barriers to broader system change by discouraging private sector engagement, as policy uncertainty, perceived financial risks, and the absence of regulatory incentives reduces the private sectors; willingness to invest in resilient infrastructure [100].

##### 4.6.4. Coordination constraints

Coordination constraints were mentioned across all sectors, both in the scholarly literature ( $n = 15$ ) and the non-scholarly literature ( $n = 16$ ) (Fig. 8), particularly due to fragmented or misaligned roles among

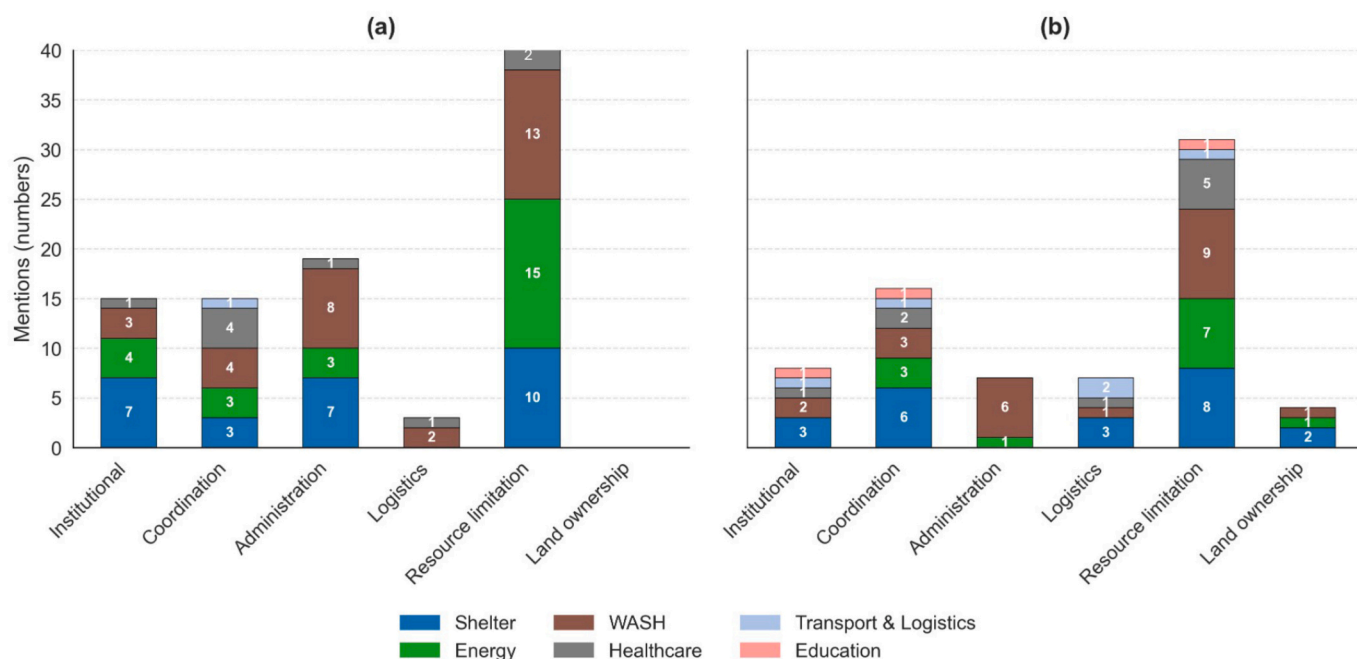


Fig. 8. Constraints to enhancing resilience in infrastructure planning and management. The stacked bars show the number of papers identified under each constraint category. (a) represents papers in the scholarly literature, meanwhile (b) represents papers in the non-scholarly literature.

actors. These actors, including governments, humanitarian agencies, NGOs, and local stakeholders, frequently face the challenge of overlapping roles, duplicated efforts, and agenda misalignment [65,68]. This fragmentation is reinforced by the absence of a unified planning frameworks, often resulting in disjointed development strategies and therefore misaligned priorities and fragmented development strategies. As Drakaki et al. [117] and Seifert et al. [76] argue, robust collaborative platforms and integrated governance models are essential to facilitate participatory engagement and synchronize actions across sectors. Also, without collaborations, the focus of humanitarian actors alone on speed, cost-efficiency, and immediate outcomes will result in the systematic sidelining of adaptive or resilient planning strategies [15].

#### 4.6.5. Land ownership constraints

This constraint was present only in the non-scholarly literature ( $n = 4$ ) (Fig. 8). Land ownership remains a major constraint to the planning and management of infrastructures in refugee and IDP settlements. Across the literature, insecure or unclear land tenure limits investment and reinforces short-term, static interventions, as uncertainty over land rights and limited cooperation from landowners constrain longer term or adaptive planning processes [79,85]. These challenges are further exacerbated by the time-sensitive nature of humanitarian responses, where the lengthy processes required to resolve land ownership issues are often incompatible with urgent planning needs [15].

#### 4.6.6. Logistical constraints

Logistical constraints, though less frequently cited, reveal a pattern of supply chain fragility that directly affects service continuity and timely upgrade of camp capacity. Across the literature, disruptions such as stockouts of essential goods and bottlenecks in water supply systems highlight the vulnerability of infrastructure to demand surges and limited resource access [68,104]. These constraints show how inadequate logistics capacity can compromise critical services, particularly during emergencies, emphasizing the importance of robust and responsive supply chain management [69].

## 5. Discussion

Despite growing attention for refugee and IDP settlements in the planning literature, there remains a gap in our understanding how infrastructure sectors conceptualize resilience in refugee and IDP settlements, and the key constraints that hinder the enhancement of resilience in infrastructure planning. This systematic literature review addresses this gap. Drawing on 75 scholarly articles and 30 non-scholarly sources, this review reveals patterns and gaps in the resilient planning of infrastructure across refugee and IDP settlements. We outline six pathways for future research to address.

### 5.1. Future research avenues and policy implications

#### 5.1.1. Develop comparative studies that make local insights generalizable

The steady rise in publications over the past two decades, especially the sharp increase after 2017, highlights growing global attention to infrastructure planning in refugee and IDP settlements. This attention is not uniformly distributed. Sub-Saharan Africa, Europe & Central Asia, the Middle East & North Africa, and Latin America and the Caribbean, which host more refugees and IDPs, have published relatively less research in proportion to the number of refugees and IDPs they host. This suggests that current knowledge production may be shaped by specific regional challenges, which limit the generalizability of research findings to other regions. Blanchet et al. [118] show that evidence generated in one context cannot be readily generalized to other humanitarian settings due to substantial differences in contextual characteristics.

Our review further showcases that comparative analyses which help to understand local specificities and to derive broader conclusions are scarce in the literature. Heavily relying on case studies impedes the generalizability and transferability of findings [119]. Therefore, comparative analyses are needed, especially in the underrepresented regions (e.g., Sub-Saharan Africa) to reduce over-reliance on findings from a limited set of environments. Specifically, an indicator-based

cross-case comparative approach can be adopted, in which a standardized set of indicators is determined and aggregated and then applied across multiple case studies to enable systematic comparison [120]. This approach facilitates comparisons across regions by ensuring a common assessment framework and consistent evaluation criteria. From a policy perspective, this highlights the need to support cross-context data collection and comparative research to inform scalable and context-sensitive resilience strategies. This aligns directly with the priorities of the Sendai Framework for Disaster Risk Reduction, such as risk-informed decision-making and the sharing of knowledge across contexts to strengthen disaster resilience. In this sense, comparative analysis provides the empirical basis needed to support these objectives and enhance the resilience of infrastructure systems [121].

#### 5.1.2. Analyze refugee and IDP settlements as embedded in their host communities and countries

This review shows that the literature treats refugee and IDP settlements as isolated entities, disconnected from national or regional development agendas, which restricts opportunities for resilient planning [37]. There is limited adoption of regional planning perspectives, with only 12% of studies in our systematic review framing infrastructure planning in refugee and IDP settlements within broader territorial systems.

Future research should focus on determining how the planning model for refugee and IDP settlements can be integrated into the broader urban and rural development planning frameworks of host countries. As many humanitarian settlements eventually serve as the footprint for new towns, the implications of poor initial decisions regarding settlement planning and development can be significant in the long run [122]. Therefore, planning should ensure that refugee and IDP settlements comply with national and local land-use regulations and minimum emergency response standards. In practice, this requires multi-scalar coordination: national authorities set regulatory frameworks, regional planners align settlements with infrastructure and development plans, and local actors guide site design and implementation. Participatory planning constitutes an effective approach for engaging host communities, displaced populations, and local authorities to improve infrastructure planning. This operationalizes resilience planning framework by emphasizing cross-scale coordination, integrated governance, and stakeholder inclusion [123,124].

#### 5.1.3. Integrate the many facets of resilience into refugee and IDP settlement planning

Resilience is especially important in refugee and IDP settlements, given the multiple and frequent shocks to which these settlements are exposed. This is coupled with the uncertainty about how settlements evolve, and the associated operability of their services. However, resilience was identified in only 65% of the scholarly articles.

Beyond the need to embed resilience into refugee and IDP infrastructure planning, our review revealed that only 37% of scholarly articles and 38% of non-scholarly articles adopted a cross-dimensional approach to resilient infrastructure planning, with several resilience dimensions being underemphasized. For example, the preparedness and recovery dimensions of resilience are particularly underrepresented in the academic literature.

Infrastructure systems that lack preparedness and recovery capacities are more likely to fail during disruptions, leading to prolonged service interruptions [125,126]. Evidence shows that higher levels of disaster preparedness significantly improve response capacity and reduce recovery time [126]. On the other hand, recovery is a core dimension of resilience, embedded in how it is measured through the restoration of functionality over time, a system without recovery remains degraded [127]. Resilience planning should therefore explicitly incorporate preparedness and recovery measures into infrastructure design and management. This includes contingency planning, backup systems (e.g., energy and water supply), and predefined recovery

protocols to ensure rapid service restoration. Embedding these capacities into planning processes can reduce system disruptions and reduce down time [128].

#### 5.1.4. Ensure research balance across infrastructure sectors

The systematic literature review, as presented in Section 4.2, reveals an uneven distribution of published papers across infrastructure sectors. This could be due to the underrepresentation or the absence of some infrastructures in refugee and IDP settlements in practice, or even disparity in infrastructure access within these settlements [129]. Resilience begins with the provision of infrastructure, followed by the ability of people to benefit from it [130]. This shows access functions as the pathway through which infrastructure contributes to refugee and IDP settlement resilience.

This imbalance also has implications for resilience planning. Resilience frameworks highlight that infrastructure systems operate as interconnected networks that collectively sustain essential services [131,132]. When research focuses primarily on a limited number of sectors such as shelter, energy, and WASH while giving little attention to others (health facilities, transport & logistics, education facilities, and ICT), this may lead to a lack of complete understanding of the infrastructure system within refugee and IDP settlements. As a result, important gaps in service provision may remain unidentified, leading to the development of planning strategies that strengthen some infrastructures while neglecting others that are equally critical for the functioning of the settlement.

In this sense, there is a need to understand the reasons for the unequal distribution of research papers across the infrastructure sectors. Little attention has been given so far to which infrastructures are available in refugee and IDP settlements in practice and in what quantity relative to the number of refugee and IDPs in the settlements. To address this gap, future research should focus on evaluating how infrastructure access varies across different refugee and IDP settlements, enabling the visualization of trends and providing targeted interventions.

#### 5.1.5. Develop cross-sectoral approaches to infrastructure planning to enhance resilience

Resilience in settlements can be better achieved by accounting for the interdependencies between infrastructure sectors [133]. The review reveals that most studies remain siloed, lacking a cross-sectoral approach to infrastructure planning, even though infrastructures are interdependent. We identified only four cross-sectoral studies in the scholarly literature and 15 cross-sectoral studies in the non-scholarly literature (Section 4.2).

The limited number of cross-sectoral studies in the scholarly literature highlights the need for more cross-sectoral research and collaboration. To address this gap, future research should adopt integrated approaches, such as systems-of-systems frameworks, which explicitly analyze interdependencies across infrastructure sectors [134]. Methodologically, this can be achieved through integrated network modeling of infrastructure systems, in which infrastructure interdependencies (e.g., electricity for WASH and transportation) are explicitly captured [135]. Such approaches are particularly relevant across both the emergency phase which is characterized by rapid, sector-specific interventions and the protracted phase, where planning shifts toward longer-term, system-level integration.

From a policy perspective, there is a need to institutionalize cross-sector coordination mechanisms, align planning frameworks across sectors and governance levels, and prioritize investments that focus on infrastructure systems rather than isolated components. These approaches are consistent with resilience planning frameworks that emphasize coordination across interconnected systems to ensure the continuity of essential services during and after shocks [121,136].

### 5.1.6. Understand interlinked constraints to resilient infrastructure planning and management

The most emphasized constraint in both scholarly and non-scholarly literature is resource limitation. Infrastructure resilience outcomes are constrained by the availability of resources; when resource capacity is limited, recovery tasks are delayed, leading to slower restoration of infrastructure performance and lower resilience levels [125]. This implies that limited resources lower resilience outcomes. However, all constraints are deeply interconnected across the sectors; therefore, solution strategies targeting only one of them will not be effective. Even with the available resources, the lack of coordination and collaboration among actors involving the local community and government could exacerbate administrative constraints within the hosting community. These constraints reveal that enhancing the resilience of refugee and IDP settlements is a multifaceted challenge involving political, technical, cultural, and institutional dimensions [123,137]. Addressing a single constraint in isolation is therefore unlikely to produce significant resilience outcomes, as other interacting constraints may continue to hinder the effective functioning of infrastructure systems.

From a policy perspective, there is a need to integrate refugee and IDP settlement planning into host community planning frameworks, in collaboration with local government and communities, to alleviate institutional and funding constraints, this could help to ensure adequate resource allocation for infrastructure development for refugee and IDP settlements. Strengthening these foundational conditions can help reduce the severity of related constraints, including land ownership, administrative, and logistical challenges. To further inform the prioritization of interventions, future research should adopt diagnostic frameworks such as systems mapping to identify how constraints interact and reinforce one another [138]. These analyses can be complemented by scenario-based assessments to evaluate how targeted interventions in one domain influence other constraints relevant to resilience enhancement.

### 5.2. Limitations of the study

We acknowledge that, there are some limitations to consider during the interpretation of the findings. First, the inclusion of only English-language publications may have introduced a regional bias in the evidence base, potentially underrepresenting studies conducted in regions where research is more commonly published in other languages. Second, the literature search was limited to selected academic databases and grey literature sources, which may have excluded relevant studies published in other repositories. Third, the review draws partly on grey literature, including guidance documents and reports produced by humanitarian organizations such as UNHCR. While these sources provide valuable practical insights and policy perspectives, they may also reflect institutional priorities and operational frameworks that differ from those typically emphasized in peer-reviewed academic research. Fourth, the study relies on descriptive and comparative synthesis without assessing causal inferential relationships. The small sample size of the studies, diversity of study designs, contexts, and reported outcomes limited the feasibility of statistical aggregation. Consequently, while patterns can be identified, their statistical significance cannot be formally evaluated.

## 6. Conclusion

By contrasting academic literature and articles from practice, this study explored the infrastructure sector coverage in refugee and IDP

settlement planning, the conceptualization of resilience in this context, and identified constraints that hinder resilient planning approaches.

The findings reveal that infrastructure planning in this setting remains fragmented across sectors, with a strong focus on shelter, energy, and WASH, while other critical sectors such as transport, healthcare, logistics, ICT and education are underrepresented. From a policy perspective, this requires adopting integrated, cross-sector planning frameworks that mandate the inclusion of missing infrastructure systems in the planning process and prioritize investment in planning that integrates critical infrastructures as a system.

Resilience is predominantly framed through robustness, adaptability, and transformability, with limited attention to preparedness and recovery, and little integration across these dimensions. This calls for policy measures that embed preparedness and recovery into infrastructure planning standards, including requirements such as contingency planning, early warning systems, backup service provision, and predefined recovery protocols within planning and regulatory frameworks.

Constraints to enhancing resilience in infrastructure planning are multidimensional and interconnected, spanning technical, institutional, social, cultural, and political factors. From a policy perspective, addressing these challenges requires prioritizing foundational constraints, particularly institutional constraints and resource limitations, which underpin many of the observed constraints. A critical first step is to integrate refugee and IDP settlement planning into host country regional planning frameworks, enabling more coordinated governance, access to resources, and alignment with existing infrastructure systems. Strengthening these foundational conditions can help reduce other constraints, including land ownership, administrative, and coordination constraints.

### CRedit authorship contribution statement

**Josue Godwe Gnowa:** Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Jasper Verschuur:** Writing – review & editing, Validation, Supervision, Conceptualization. **Tina Comes:** Writing – review & editing, Validation, Supervision, Project administration, Conceptualization.

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### 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.

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**Appendix A. Resilience indicators and dimensions used for categorizing papers under the resilience framework**

Indicators	Resilience dimensions	Description/example of indicators
Contingency planning	Preparedness	It involves creating strategic and scenario-based plans to anticipate risks and manage uncertainties, e.g., <i>this includes outlining specific actions and legal frameworks that ensure systems can respond effectively to future disruptions</i>
Planning guidelines	Preparedness	This refers to structured principles and standards that guide the design/ implementation of infrastructures in refugee and IDP settlements, and also the collaboration of actors in this sector e.g. <i>planning standards like handbooks, and collaboration strategies among humanitarian actors and other actors</i>
Capacity building	Preparedness	This refers to strengthening the knowledge and skills of individuals, communities, and organizations involved in planning and management of infrastructure in refugee and IDP settlements e.g. <i>trainings on the usage of early warning or energy systems</i>
Redundancy of supply systems	Robustness	This refers to the use of multiple infrastructure systems to ensure service continuity e.g. <i>the use of diverse water supply sources such as boreholes and dams, and energy networks to act as backup options in case of disruptions</i>
System durability	Robustness	The ability of systems or structures to withstand prolonged exposure to adverse conditions without significant degradation in performance e.g. <i>the use of local building materials for the design of shelters and the use of tempohomes</i>
System optimization	Robustness	This refers to the process of improving how efficiently a system operates e.g. <i>the efficient sizing of energy systems, water supply networks, and outsourcing of activities to achieve the best possible outcomes under given constraints</i>
Risk-informed planning	Robustness	This involves the risk assessment performed before infrastructure implementation to reduce the impact of shocks when they occur e.g. <i>conducting a flood risk mapping before settling or elevating shelters</i>
Resistance	Robustness	It is about how well a system can stand firm when hit by a shock, minimizing damage e.g. <i>the consideration of technical parameters such as the health of the battery bank, its maximum depth of discharge, and its capacity to maintain service during peak loads or disruptions</i>
Rebuilding/ Rehabilitation	Recovery	This involves repairing, reconstructing, or upgrading physical infrastructure that has been damaged or destroyed, with the goal of restoring full functionality e.g. <i>reconstruction of damaged houses and infrastructures</i>
Access to recovery support	Recovery	This refers to the availability of financial, technical, social, or institutional assistance/programs that enables communities and local actors to recover effectively from disruptions e.g. <i>households receiving cash assistance or moral support to help in the recovery process</i>
Hybridization of systems	Adaptability	This involves combining two or more technologies into a unified system designed to lower operational costs or reduce emissions, and enhance reliability e.g. <i>this approach is common in energy sectors, where multiple systems such as PV, generators, and batteries work together to improve efficiency</i>
Flexibility	Adaptability	This pertains to the system's ability to adjust to changing conditions without losing function e.g. <i>the use of sensors to detect fluctuations in demand or malfunction, then adjust accordingly in the energy supply mechanism</i>
Scalability	Adaptability	It refers to the ability of a system to accommodate increased demand or workload effectively without compromising performance e.g. <i>the ability to modify shelter configurations to accommodate refugee and IDP influx in a settlement</i>
Performance monitoring	Adaptability	The is the ongoing assessment of infrastructure system performance after implementation to identify failures, emerging risks, and changing needs, and to ensure systems remain effective over time, e.g. <i>assessment of WASH system performance using methods such as WASH FIT and FIETS</i>
Transition to dynamic systems	Transformability	It reflects a move to a new system dynamic or advocacy for a paradigm shift in refugee and IDP settlements planning e.g. <i>this includes shift from static, emergency setups to adaptive or system approach in planning refugee and IDP settlements</i>
Integrative planning	Transformability	This refers to a shift that facilitates the integration of refugees e.g. <i>the sharing of infrastructures such as health facilities with host communities and developing policies for their integration into host countries</i>
Proactive planning	Transformability	A shift from reactive or standardized planning approaches toward data-informed strategies that draw on lessons from comparable contexts, enabling a transition toward more forward-looking planning approaches, e.g. <i>the planning of Azraq camp based on data from Zaatar camp, hence showing better end performance and anticipating the weaknesses encountered in Zaatar camp</i>

**Appendix B. Research coverage index**

Regions	Number of publication counts	Publication share (%)	Number of forcibly displaced people	Research coverage index
Sub-Saharan Africa	39	28	42,44 millions	1 paper per 1088 million refugee and IDP
Middle East and North Africa	35	25	33,71 millions	1 paper per 0,963 million refugee and IDP
South Asia	26	19	2,39 millions	1 paper per 0,092 million refugee and IDP
Europe and Central Asia	18	13	18,94 millions	1 paper per 1052 million refugee and IDP
East Asia and Pacific	8	6	4,32 millions	1 paper per 0,540 million refugee and IDP
Latin America and Caribbean	3	2	17,16 millions	1 paper per 5720 million refugee and IDP
North America	1	1	4.18 millions	1 paper per 4,18 million refugee and IDP
Global	8	6	123,15 millions	1 paper per 15,394 million refugee and IDP

**Appendix C. List of countries and their ISO 3 codes**

United States: USA, Haiti: HTI, India: IND, Bangladesh: BGD, Japan: JPN, Ethiopia: ETH, Iran: IRN, Turkey: TUR, Germany: DEU, France: FRA, Myanmar: MMR, Kenya: KEN, South Korea: KOR, Uganda: UGA, Sudan: SDN, Algeria: DZA, Ukraine: UKR, Iraq: IRQ, Afghanistan: AFG, Cameroon: CMR, Chad: TD, Palestine: PSE, Sri Lanka: LKA, Syria: SYR, Zambia: ZMB, Somalia: SOM, Rwanda: RWA, Jordan: JOR, South Sudan: SSD, Greece: GRC, Lebanon: LBN, Macedonia: MKD, Djibouti: DJI, DR Congo: COD, Ecuador: ECU, Indonesia: IDN, Liberia: LBR, Malawi: MWI, Mozambique: MOZ, Nepal: NPL, Philippines: PHL, Serbia: SRB, Tajikistan: TJK, Tanzania: TZA, Yemen – YEM.

## Data availability

Data will be made available upon request.

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