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Role of Environmental Determinants in Community Resilience in Flood: A Systematic Review

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Abstract

Background: The role of environmental determinants in the community's resilience in flood, as a predominant hydrological disaster, has not been investigated.
Objectives: This systematic review aimed to discuss the role of environmental determinants on communities' resilience in floods using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol.
Methods: A total of 50 relevant papers were extracted, including those on the subject of water resource planning (n=32), soil-plant systems (n=8), and air and climatic factors (n=10).
Results: The results revealed that although most studies have investigated climatic factors, biological effects, surface water flooding, and groundwater contamination, the researchers did not have a comprehensive approach to environmental determinants. This study highlighted the role of water, soil, and air, as the main environmental determinants. In addition, the related subdeterminants should simultaneously be considered in flood risk management and community resilience.
Conclusion: Eventually, a conceptual model is presented for analyzing the effects of environmental factors on the communities' resilience against floods.

Keywords: Community, Environmental determinants, Flood, Resilience

1. Background

Natural hazards are among the most important health concerns worldwide and are related to social development processes, the increase in the human population, and the perception of risk governance. According to the complexity, diversity, and quantity of development and its multidimensional impacts, this process is considered an important parameter for the realization of sustainable development goals (SDGs) and sustainability of health in communities (1). Based on the United Nations Office for Disaster Risk Reduction (UNDRR), hundreds of millions of people are exposed to several inherent risks, including climate change, floods, land sliding, drought, and earthquakes, which their intensity and consequences depend on the perception of disaster risk governance and environmental perturbations. These conditions imply the critical role of the environment in communities' development, maturation, and health loss. Therefore, the environmental determinants might affect disaster management phases decisively, especially in the reduction and prevention phases, which in turn, can help realize community resilience as the most critical strategy in terms of vulnerability, reduction, and elevation. According to the Federal Emergency Management Agency (FEMA), the elimination of natural or man-made disasters' effects on human health is the main goal of disaster management. In some cases, social development on national or local scales included road and dam construction without land using patterns, comprehensive environmental risk assessment, and disaster risk perception, which can lead to biosystems' buffer destabilization, thunderstorms floods, and health consequences (2).

Several studies have revealed inattention to environmental determinants and chronic and acute health consequences. Horrible accidents have led to the death of more than 2000 people in Vaionet city of Italy (3). The occurrence of the Nepal flood after vegetation cover destruction between the years 1983 and 1998 led to 18,000 deaths, implying the role of environmental determinants in disaster risk management (4).

Resilient communities are less vulnerable to disasters; therefore, the responsible organizations and international documents including Hyogo Framework for Action (HFA) have focused on resilience elevation (5),(6). Based on the above-mentioned documents, although, environmental components are crucial in the disaster management cycle, such as flooding, this issue has often been ignored.

2. Objectives

Therefore, this study has focused on the role of the environmental parameters in community resilience promotion in floods.

3. Methods

3.1. Review question

Based on the PICO model (Patient/Problem, Intervention, Comparison, and Outcome), the research question was: Which environmental determinants have an impact on the community resilience in flood?

3.2. Search Strategy

Search, selection, analysis, evaluation, and summarization of the articles were performed based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol. All available full text published articles were included in the study. Some reports and working papers were not reliable for this systematic review. The selected and evaluated articles included all those published in English and Persian languages up to August 2021 which were indexed in international databases including Google Scholar (Google Inc., Mountain View, CA), EBSCO, ISI Web of Science (Thomson Reuters, New York, NY), Science Direct (Elsevier, Amsterdam, Netherlands), PubMed (National Library of Medicine, Bethesda, MD), Springer, Scopus (Elsevier), Ovid (New York, NY), ProQuest (Ann Arbor, MI), CINHAL and Wiley (Hoboken, NJ), as well as international official sites, such as the WHO, EPA, and UNISDR. A comprehensive literature search was also carried out on Springer Online Journals (http://link.springer.com/). The articles were searched based on the PICO search strategy using such keywords as "Environmental", "Resiliency", and "Floods" which used headings of medical topics (Mesh) in the PubMed database. Different combinations of keywords were searched using the Boolean operators (AND, OR). Moreover, synonyms of these keywords were considered in the search strategy.

Two authors examined the compatibility of searches independently, and minor discrepancies were resolved in meetings to ensure the search process.

In the second phase, the selected articles were reviewed based on their abstracts and full texts after the title screening. The references of all retrieved original articles were checked for additional relevant items. Eventually, the quality of the extracted articles was evaluated based on PRISMA checklists, and the selected articles which met the inclusion criteria underwent reassessment and final analysis.

3.3. Inclusion criteria

The following eligibility criteria considered for deep search analysis included 1) articles published in the English language, 2) peer-reviewed original articles, case studies, review articles, and editorials, 3) studies in which the environmental determinants have been one of the studied indicators, and 4) publication date up to the year 2000.

3.4. Excluding criteria

Lack of thematic communication, lack of full text, and being repetitive were considered excluding criteria. Due to unavailability, books and conference proceedings papers were excluded. Selection bias might exist in this study in terms of inaccessible publication, especially reports, working papers, and governmental documents.

3.5. Data Extraction

Extracted data included authors, year of publication, aims and objectives, method, study design, and research setting. The results of the selected papers were extracted and gathered in a formatted table. Grey literature such as theses and unpublished papers were also searched manually by referring to the relevant libraries at Tehran, Iran, Yazd, and Baqiyatallah universities of medical sciences.

4. Results

A total of 179 articles were identified from seven databases, and 79, 26, and 24 articles were excluded due to irrelevancy, duplication, lack of full text, and screening of abstracts, respectively. After the full-text review based on the PRISMA checklist and considering the type of articles and quality assessment through peer review, only 50 articles were selected and included in the analysis (Figure 1). These articles were classified based on the importance of the article for community resilience in floods and categorized by type (review, original research, case study, editorial, and comparative). Figure 1 illustrates the screening process of the papers.

A total of 50 relevant papers were extracted, including those on water resource planning (n=32), soil-plant systems (n=8), and air and climatic factors (n=10).

After full reading of the papers, a descriptive analysis was conducted to extract the included papers. Afterward, assessment and data synthesis were performed to obtain the main results (Table 1). However, 50 articles were reviewed and examined in sections of the results and discussions.

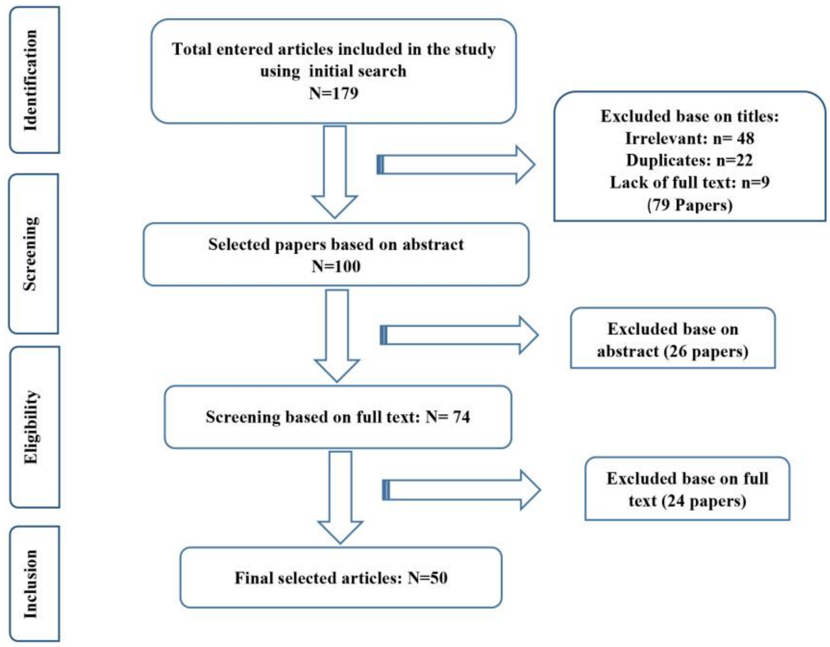

Figure 1. Articles screening and selection process based on PRISMA diagram

Table 1. Role of environmental determinants in flood

Author and year	Study region	Study data period (days)	Study variables	Results	References
Tangdamrongsub et al. 2021	USA	8-32 day	Soil moisture	Soil moisture had a stronger correlation with flood inundations than precipitation, soil moisture, and terrestrial water storage. Soil moisture affects the spatial distribution and timing occurrence of floods (extent/occurrence). Soil moisture could affect flood lead-time.	(7)
Zhu et al. 2021	USA	1990-2018	Precipitation, soil moisture	Soil moisture and catchment hydrograph can lead to high uncertainty in short-term floods. Precipitation was the major source of uncertainty in prolonged floods.	(8)
Zhong et al. 2021	China	return periods of 2, 5, 10, 20, 50, and 100 years	Soil moisture, Rainfall	Raising risk parameter thresholds leads to flash floods possibility. The return periods with bivariate and multivariate joint distribution have different effects. Fixing peak flow and soil moisture is effective on the incidence odds of flash floods.	(9)
Wu et al. 2021	China	2006-2017	Rainfall, Surface water resources, Topography	Urban rainfall disasters have had the greatest impact on surface water resources.	(10)
Wang et al. 2021	China	1985-2018	Geographic characteristics, Rainstorm, Antecedent moisture conditions	Physical geographic characteristics were crucial prominent factors of lag time, flood peak, and runoff coefficient. Rainstorm characteristics influence the extent of unit discharge and runoff depth. Floods were mostly affected by rainstorms and physical geographic characteristics. A delta area might become more destructive with the progressive rainfall extremes and sprawling impervious surfaces in a changing environment.	(11)
Wang et al. 2021	China UK	2001-2019	Water depth, Flood Risk	The negative consequences of water depth on flood risk for vehicles were higher than that for people.	(12)
Mei et al. 2021	China	1960-2017	Climate change, Rainfall, Flood risk	Climate change is effective in flood increase and the spatial and temporal patterns of changing rainfall grading. Changes in rainfall are important in risk assessment and management of floods in urbanized sensitive river deltas.	(13)
Ghimire et al. 2021	USA	2003-2018	Storm movement Catchment, Flood peak response	The peak of the rainstorm with the peak of the width function of the basin is effective on streamflow peak response.	(14)
Osman et al. 2021	Malaysian	2011-2020	Land use, Flood Changing	Land use, channel, and flooding changes conform to hydrological regularities and can provide a technical reference for flood control and disaster reduction.	(15)

Table 1. Continued

Zhong et al. 2020	China	1958- 2013	Precipitation, Digital elevation, Slope, Soil type, Drainage density, Vegetation cover	Soil type, slope degree, and digital elevation were the dominant environmental factors of flash floods. Precipitation is one of the most important factors in severe flash flood hazards occurrence. Instability of sand clay and saturated soil moisture can lead to flash floods occurrence, even with slight rainfall.	(16)
Marsooli and Lin 2020	USA	late twentieth century (1980–2000) to future periods in the mid-and late twenty-first century (2030–2050 and 2080–2100	Sea level rise, Tropical cyclone	Sea-level rise is more effective than tropical cyclones on flood hazards. The effects of climate change are important for low-probability, high-consequence floods.	(17)
Devkota and Bhattarai. 2018	Nepal	1980-2008	Climate change, Floods	Climate change and unusual rainfall lead to flooding with various impacts on agricultural and settlement areas.	(18)
Nied et al. 2017	Central Europe	10 years	Soil moisture	Flood generation processes are effective on flood scale, extent, and consequences. Soil moisture, as well as weather patterns, affected possible flood occurrence, flood processes, and flood characteristics.	(19)
Grillakis et al. 2016	Greece	1976-2005	Soil moisture, Soil type, Flood intensity	The scale and severity of soil moisture affect flood intensity. Soil type has a significant impact on the runoff.	(20)
Zope et al. 2016	India	1966-2009	Land cover, Land use, Flood hazard	Return period is effective on flood inundation risk analysis of floods revealed increasing hazardous area by 22.27%.	(21)
Tarigan et al. 2016	Indonesia	1990-2013	Land cover, Flood frequency	Land cover changing of catchments could lead to intensification of flood frequency.	(22)
Carmen Llasat et al. 2016	Spain	1900-2011	Flash flood, Precipitation	Rainfall quantity is relevant to flash floods.	(23)
Nourali et al. 2016	Iran	1950-2000	Watershed management, Peak discharge, Flood volume	Appropriated watershed management affect discharge and flood volume.	(24)
Liu et al. 2016	Canada USA	1960-2013	Depth of snow, Temperature, Humidity, Wind	Moisture, lightning, and wind with low-pressure systems led to large amounts of rainfall, melting of snow, and flooding of rivers.	(25)
Alfieri et al. 2015	Italy	1970-2100	Temperature, Carbon dioxide, Precipitation, Frequency of river floods	Changes in the frequency of extreme discharges have more substantial impacts on overall flood hazards versus their magnitude. In Europe, the frequency of flood peaks with return periods over 100 years is projected to double within three decades.	(26)
Ouma and Tateishi. 2014	Kenya	2001-2011	Precipitation, Height and slope, Drainage network, Land use, Land cover, Soil type	Soil forest cover had the highest weight in the flood than the other factors.	(27)
Singh and Hadda. 2014	Switzerland	50-days	Soil compaction, Surface runoff, Flood risk	Soil compaction is an important factor. Soil compaction leads to an increase in runoff and flooding.	(28)
Liu et al. 2014	China	1960-1975 and 2000-2010	Air temperature, Outburst floods	Elevation of temperature can lead to glacial lake floods.	(29)
Flesch and Reuter. 2012	Canada	during June 2005	Mountain height, Rainfall, Topography	Mountain elevation is effective on precipitations and foothills floods. Topography has little effect on mountains.	(30)
Zhanqing et al. 2011	USA	10-years	Aerosols, Precipitation, Temperature, Pressure Wind, Humidity	Aerosol concentration is effective in increasing Cloud's height and thickness. Aerosols are effective on precipitation frequency and rain rate. Particles led to changes in cloud microphysics, atmospheric stability, and rainfall.	(31)

Table 1 presents the results of 25 articles, including articles published from 2011 onwards in flooded countries of the world, such as America, China, India, Iran, Indonesia, Nepal, Malaysia, Italy, Greece, Europe Central (Switzerland and ...). Such items as author, publication year, title, research source, methods, a summary of results, and the conclusion were verified in the articles.

Based on published papers, the findings revealed several gaps between environmental determinants and community resilience in the occurrence of disasters. Environmental determinants can play a critical role not only in disaster prevention but also in the elevation of communities' resilience in disasters, such as floods.

Environmental degradation is one of the main reasons for the increase in floods and their damages. In watersheds, flooding has several effective components, including the sloping part, mainly with the rocky cover above the watershed, which are the main factors in runoff creation. Other than this factor, rangelands and forests act as the first barrier against increasing the volume of runoff water and floods. The destruction and overuse of pastures can play a role in increasing runoff. The second flood barrier is coarse-grained porous alluvium at the foot of mountains and at the beginning of plains in watersheds, which absorbs and transfers the runoffs water to groundwater aquifers.

Based on this review, the environmental determinants can be classified into three main categories including water, soil, and air, considering the conceptual model development (Figure 2). Water-related factors include extreme precipitations, melting of glaciers, management of the watershed, and river geomorphology changes. Soil factors included soil moisture, land slope, land cover, topography, soil porosity and permeability, construction of dams, and land-using changes, and air-related factors included climate change, temperature fluctuations, humidity, and air pollution. This model shows that variation in the characteristics of the occurrence (probability and intensity) changes the characteristics of environmental determinants (water, air, and soil) and resilience.

The results revealed that the lack of rivers maintenance programs, comprehensive urban development plan based on local hazards, not dredging up rivers and ravines, the construction of dams without a sustainable development approach, vegetation destruction, deforestation, watershed mismanagement, topography, steep slope, mountainous regions, and geology, and missing the soil properties can lead to flooding and community resilience (Table 1, Figure 2).

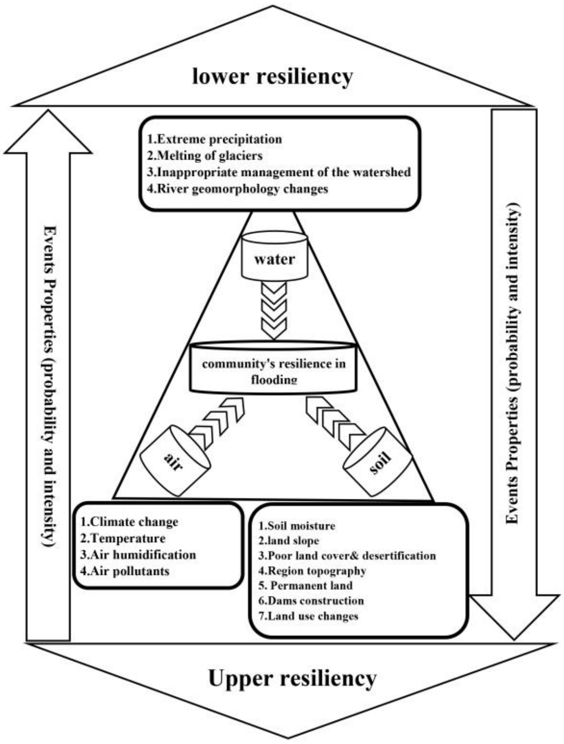

Figure 2. Conceptual model of the environmental determinants' role, on community's resiliency in flood

5. Discussion

Since natural hazards are a real challenge for achieving SDGs (32), reducing vulnerability and resilience improvement are key solutions. Based on this study, the research on community resilience elevation founded on environmental approaches in natural disasters needs maturation with tremendous efforts for the identification of resilience aspects and environmental determinants effects. Based on these findings, surveying the effects of environmental determinants on communities' resilience during the flood, as a recurrent natural disaster, is a new field that requires intensive research. Although extensive research was conducted on the physical and technical dimensions of disasters or elimination of acute consequences and management requirements, the role of environmental determinants was not considered in these studies.

Therefore, such parameters as the perception of the role of environmental determinants, better resource management, and allocation for communities' resilience are required for the improvement of the efforts toward disaster risk reduction versus disaster risk management. Nowadays, resilience analysis in natural disasters is considered to be a necessary concept, and the SDGs and disaster management are realized through the increase of resilience. Although complete disaster control is not possible, sustainable development can be achieved in a safe environment. In this regard, the realization of resilient communities is the best approach for reducing disaster risk based on environmental determinants (33).

Based on the evidence, consideration of environmental determinants plays an important role in social resilience and reducing the consequence of natural disasters. Resilience explanation in disaster threats involves reducing the vulnerability of communities in dealing with hazards caused by natural disasters (34). Bastaminia et al. (2016) introduced various models to determine the urban community's resilience against natural disasters, among which, the combination of Haiti and the ResilUS has been introduced as the best models. Although, several environmental determinants influence flood occurrence, providing a comprehensive model for community resilience that integrates all the environmental determinants is necessary. The presented conceptual model in this study reveals the reciprocal relationship between the environmental determinants and the resilience of communities in floods (Figure 2). This model implies that variation of the environmental determinants (water, air, and soil) can lead to the occurrence of floods and community resilience. Based on this model, the environmental determinants are classified into three groups: water, air, and soil, and their impacts will be discussed below.

5.1. Soil determinants

The results of the previous studies showed the influence of soil moisture and type influence on the increase of runoff water and the magnitude and severity of floods. Grillakis et al. demonstrated that the nonlinear behavior of runoff water in sand soil texture is strongly associated with the fluctuation of soil moisture. In contrast, the shallow and relatively impermeable soils reveal a linear relationship between the flood peak and the initial soil moisture (20). Soil slope is another characteristic that is considered in several studies on flood occurrence. Feysnia et al. (2016) studied the soil slope and its permeability effects on flood occurrence. Based on this study, the soil slope is the second factor influencing the flood (Feysnia S Abdollahian Z, Ebrahimi KH, 2016).

Based on the above-mentioned studies, the effect of the soil characteristics including soil slope, drainage network, land use patterns, vegetation cover and density, soil texture and type need to be identified on the occurrence of floods. Ouma and Tateishi calculated the Urban Flood Risk Index and showed that urban areas are more susceptible to flooding. This phenomenon implies the lower infiltration and permeability of the soil and lack of proper drainage networks, which are intensified in poorly planned and congested regions. Based on this systematic review, it can be recommended that the integration of the Analytic Hierarchy Process (AHP) and Geographic Information System (GIS) techniques are powerful tools for flood hazard mapping and decision making which increase community resilience and decrease vulnerability. Moreover, multi-criteria evaluation for the determination of the effects of different factors is useful in the definition of hazardous areas and prediction of flood occurrence (27). In Indonesia, Tarigan et al. (2016) investigated the impacts of land cover fluctuation on flood frequency and reported that land cover alteration in the Batanghari catchment could lead to flood frequency intensification (22).

Topography is another important parameter in urban development and population planning programs that affect the communities' resilience. Flesch et al. (2012) investigated the effects of topography on two floods and reported that rainfall is affected in the mountainous area and its foothills which are related to orographic lifting (30).

Soil compaction is effective on runoff occurrence. These phenomena lead to the increase of soil density, infiltration decrease, and elevation of surface runoff coefficient. This parameter is substantial in surface runoff in grazed and ungrazed areas. Several studies based on models implied a direct relationship between increasing the compacted area and peak discharge of runoff water. In small catchments, a decrease in infiltration capacity resulting from soil compaction can have a significant effect on flood peaks; however, the evidence is less available in large catchments (36).

Land use alteration not only leads to the increase of syllable risk but also hurts the resilience of surface and ground waters (37). The impact of land-use–land-cover (LULC) and urbanization on floods hydrograph were investigated for different return periods by HEC-GeoHMS and HEC-HMS models in India. The results showed that in the last 43 years, the rise in peak runoff and runoff volume varied marginally by 3.0% and 4.45% for the 100-year return period, and by 10.4% and 12.2% for the two-year return period, respectively (21).

5.2. Water determinants

Alteration of the hydrological regime due to dam construction is one of the most important factors. Dam construction and monitoring of the downstream irrigation networks can lead to the regulation of hydrological regimes and vulnerability reduction. Also, dams have significant impacts on river hydrology through changes in timing, magnitude, and frequency of low and high flows, and the generation of hydrological regimes which are significantly different from the pre-impoundment natural flow regimes. In the United States, the application of the hydrological model for the evaluation of the hydrological changes related to dams indicates that dams have a remarkable impact on hydrological characteristics measured by Indicators of Hydrologic Alteration (IHA). These results revealed that dam construction had modified hydrologic regimes in large and small rivers (38).

Extreme precipitation, intensity, and duration of rainfall have the highest effect on the occurrence of floods. Carmen et al. (2016) reported the effects of rains on flooding and the increase of rains and flash floods (23). Kim et al. (2019) considered the correlation between flood severity and precipitation (39). Numerous research was performed on the floods resulting from melted glaciers and snow. The results have shown that discharge has increased exponentially, and outbursts of floods originating from the glacial lake could be dangerous for the surrounding areas up to hundreds of kilometers. Future floods pose a serious threat to down-valley communities and infrastructure in many mountain ranges (40).

Comprehensive management of watershed basins plays a major role in increasing the resilience of communities. Water basins have been adopted and used in many areas for the management of natural resources, including water, environment, agriculture, and natural disasters. Bulcock et al. (2016) investigated the impact of the small weir on flood risk modeling in the UK. Accordingly, the effects of the weir on morphology, hydraulics, flood risk, and sediment transport have been assessed. Based on the obtained results, weirs significantly modify flow regime and sediment transport which ultimately affect habitats and ecosystems, and the constrained rivers behave differently from the unconstrained channels (41). Rogger et al. (2006) recognized the relationship between flood changes due to alterations in forest management, agricultural practices, and artificial drainage (42).

River geomorphology is one of the most critical factors that play a vital role in community resilience and flood risk management. Arnaud-Fassetta et al. (2009) reported the effects of fluvial geomorphology on flood management. The results showed that the contribution of river geomorphology in flood risk management in France and the Himalayas is high and can lead to the development of an innovative approach for flood risk reduction and river maintenance. Management of soil erosion and floodwaters is a key problem, and management of debris originating from the interaction of erosion processes on the slopes and surface of valleys has vital importance (43). Therefore, it can be concluded that river management is the most important issue which should be considered in flood management and communities' resilience.

5.3. Air determinants

Several studies show that air determinants have a significant impact on the reduction of vulnerability and community resilience in flooding. Analysis of climatic parameters can help mitigate the effects of climate change on flood occurrence. The results showed that the vulnerability effects of climate change with increasing severe rains and unusual features are significant indicators of the climate change effects on communities' resilience (18).

Alfieri et al. evaluated the effects of predicted changes on flooding risk and explored the potential effects of global warming on river floods with a hydrological model. The results showed that changes in the frequency of discharge extremes are more likely to have a considerable impact on the overall adverse consequences of a flood compared to changes in their magnitude. In Europe, flood peaks with return periods above 100 years within three decades are projected to double in frequency (26). Wasko and Sharma showed that in the most extreme cases for smaller catchments, the increase of precipitation at higher temperatures corresponds to increases in streamflow (44). The relationship between temperature and flood occurrence has also been investigated in China. This study concluded that temperature fluctuation is the main factor for floods in the Glacial Lake Outburst Floods. Based on monthly and daily temperature analysis, the study revealed that the outburst of flooding of the glacial lake depends on temperature interaction and cumulative temperature (29). Liu et al. (2016) investigated the effects of air humidity, as a climatic aspect and weather characteristic, on flooding. The results showed that the occurrence of significant events, such as flooding, is related to a combination of different factors. the results of this study also demonstrated that the abundant moisture of the central Great Plains, thunderstorms, and low-pressure winds lead to large amounts of rainfalls which result in snow melting and flooding in rivers downstream (25). The results obtained by Lavers et al. (2012) implied that 40-80 % of the total flooding in the UK is related to the transport of air moisture from tropical areas. This phenomenon indicates a substantial contribution of Atmospheric Rivers (ARs) and winter floods in the UK (45).

Air pollutants and their various effects on communities' resilience should not be ignored. Li et al. examined the long-term impact of aerosols on the vertical development of clouds and rainfall frequencies. The results showed that aerosols concentration influences precipitation frequency and rain rate. The rain precipitation increases with an aerosol concentration in deep clouds that have high liquid-water content and declines in clouds that have a low liquid-water content. This study showed that aerosols alter the density of clouds and atmospheric balance which in turn leads to changes in cloud microphysics and atmospheric stability which either attenuate or augment the formation of clouds and rainfall. The effects of an aerosol depend on meteorological conditions and aerosol properties. Moreover, the results showed that urban and industrial pollution completely stops rainfall in transient and shallow clouds (31). Daniel Rosenfeld's research indicated that the effects of cities' air pollution can be distributed up to hundreds of kilometers along with the wind. The results indicated that air pollution has a direct influence on the increase of drought and floods. Another study approved that pollution affects rainfall and influences the type of clouds that are formed in the same area as well as the moisture content in that area (46). Jirak and William investigated the effects of air pollution on precipitation in the Rocky Mountains. The results revealed that over the past half-century the ratio of upslope precipitation for elevated sites west of Denver and Colorado Springs, Colorado, to upwind urban areas, has decreased by approximately 30% (47). Ghahraman and Taghvaeian showed that from 1970 to 2000, the annual rainfall in 22 cities of Iran had a slight decline and showed a slight rise in eight cities. This slight fluctuation of precipitation can be predicted based on Colorado research (48).

6. Conclusion

Increases and decreases in the characteristics of the environmental determinants (probability, intensity, and magnitude), can affect the flood potential and the community's resilience. Although flooding depends on several factors, environmental factors play an important role in flooding. This systematic review attempted to identify the roles of environmental factors on community resiliency. This study provided a conceptual model in which the role of the environmental determinants was considered. Therefore, consideration of these factors in social development is highly recommended for the improvement of communities' resilience and reducing vulnerability to floods as an important natural hydrological disaster. Therefore, this conceptual model can be useful for the managers of the relevant organizations.

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Footnotes

Conflicts of Interest: The authors declare no conflict of interest.
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