Urmia University

Journal of Geography and Regional Future Studies
Vol. 3, Special Issue, Winter, 2026
Online ISSN: 2981-118X
https://grfs.urmia.ac.ir/

Impacts of Climate Change and Flooding in South Asia: A Systematic Review

Asma Khan Kakar [1] and Zakaria Shah [2]

[1] Department of Geography and Regional Planning, University of Balochistan, Quetta, Pakistan
[2] Department of Geography and Regional Planning, University of Balochistan, Quetta, Pakistan

ARTICLE INFO

Article type:
Research Article

Received:
2026/06/27
Accepted:
2026/08/29
pp:
51-63

Keywords:
Climate Change;
Flood;
Asia;
Southeast Asia;
Monsoon.

ABSTRACT

Background: South Asia is among the regions of the world most vulnerable to the risk of flooding. Millions of people living in shared river basins face imminent dangers to their infrastructure, agricultural output, total economies, and socioeconomic livelihoods due to the rising frequency and severity of catastrophic weather events, which are mostly caused by global climate change.

Objectives: This systematic review's main goal is to evaluate and compile the body of research on the effects of global climate change and floods that occur inside South Asia's borders.

Methodology: A systematic analysis was conducted in accordance with PRISMA guidelines and using computerized databases, searching for terms such as "climate change," "temperature," "global warming," "rainfall," and "humidity." In this approach, 60 full-text papers were evaluated for eligibility after 80 titles and abstracts were examined. In the end, 50 peer-reviewed articles that particularly discussed the effects of floods and climate change in South Asian nations were chosen for this qualitative review.

Results: South Asian countries particularly Pakistan, Bangladesh, and India are witnessing an increase in the frequency, intensity, and geographical extent of severe flood events, while Nepal and Sri Lanka are also facing emerging risks in this regard. Although past floods fell within the normal range of climatic variability, human-induced climate change is fueling intense monsoon cycles, causing severe damage to rice production, infrastructure, and rural livelihoods.

Conclusion: Millions of people's livelihoods and the economies of South Asian nations are negatively impacted by an increase in flood disasters. Since the majority of the South Asian nations share sizable river basins, coordinated formulation, and execution of adaptation strategies are required.

Citation: Kakar, A. K., & Shah, Z. (2026). Impacts of Climate Change and Flooding in South Asia: A Systematic Review. *Journal of Geography and Regional Future Studies*, 3(Special Issue), 51-63.

 Publisher: Urmia University.

DOI: https://doi.org/10.30466/grfs.2026.57320.1255

1. INTRODUCTION

Global circulation of precipitation is an important part of how well the Earth's system works (Dufresne et al., 2013). By moving higher latitudes, we are being heated by tropical heat, which aids in controlling the Earth's temperature (Costello et al., 2009). Nonetheless, this system is susceptible to long-term temperature variations, sometimes known as climate change (S. Reid, Smit, Caldwell, & Belliveau, 2007). The idea that human activity has enhanced the phenomenon of climate change is currently being disputed. To measure climate change and its relationship to other environmental systems, many scientists today have been working (Juhola & Westerhoff, 2011). In Southeast Asia, flooding is a frequent risk that can

[1] **Corresponding author:** Zakaria Shah, **Email:** zakariashah3@gmail.com, **Tell:** +923342368566

seriously harm infrastructure, crops, and people (Luo et al., 2021). Flooding from heavy rains has the potential to cause traffic disruptions, postpone construction projects, and damage or remove the soil and culverts supporting the roadways, tunnels, and bridges. The damage is growing even though there is no clear pattern in the rise in peak flood discharge in Southeast Asia's major rivers (Merz et al., 2021). There were five significant floods in Bangladesh between 1987 and 2007; this demonstrates that the frequency of major floods is also increasing. In Pakistan and India, flooding is also occurring more frequently. Moreover, there is a tendency for flood-prone areas to expand (Kundzewicz et al., 2014). In western India, for instance, where droughts are extremely common, floods are now occurring more frequently (M Monirul Qader Mirza, 2011).

The Southeast Asian monsoon season is undoubtedly one of the most reliable weather systems (J. S. Reid et al., 2013). To measure climate change and its relationship to other environmental systems, many scientists today have been working. Yet, human actions such as burning fossil fuels, excessive greenhouse gas emissions, and urbanization have been directly connected to the global warming of the 20th century (Yoro & Daramola, 2020). The sum of temperature readings taken all across the world is used to calculate global temperatures (Trenberth et al., 2014). One way that rapid urbanization affects climate change is by raising temperatures due to structures and urban activity (Liu, Zou, Xia, Chen, & Wang, 2022). In metropolitan areas, impoverished neighborhoods are typically the sites of the most dangerous and damaging circumstances (Rauh, Landrigan, & Claudio, 2008). Many individuals can be found on river floodplains in urban areas, constructing their homes and raising their food. Some build their homes on treacherous cliff faces, along the shoreline of former mangrove swamps or tidal flats, or in other hazardous locations All nations are at risk from climate change and unpredictable weather patterns, but the poorest nations and the poorest people living there are the most at risk since they are the most exposed and have the fewest resources to adapt (Costello et al., 2009).

The monsoon season is arguably one of those that is most reliant on weather patterns (Loo, Billa, & Singh, 2015). A lot has been studied about how the monsoon seasons interact, but little has been written on how climate change is affecting things like how much rain Southeast Asia gets throughout the monsoon season. An area's unfavorable effects (damages), which include lives lost and interruption of numerous activities that typically produce health, wealth, and well-being, are characterized by the severity, extent, and frequency of catastrophic flooding in an inland or coastal region (Bonanno, Brewin, Kaniasty, & Greca, 2010). Researchers discovered a statistically significant rise in the danger of major floods throughout the twentieth century in basins greater than 200 thousand square kilometers worldwide (Quintero, Mantilla, Anderson, Claman, & Krajewski, 2018). According to many writers, among other things, changes in land use and land cover, as well as climate conditions, have an impact on the frequency and size of significant flows (Owrangi, Lannigan, & Simonovic, 2014). Furthermore, the evaluated flood damages can help determine whether or not it is still successful to occupy and develop a flood-prone zone (Hooijer, Klijn, Pedroli, & Van Os, 2004).

In South Asia, flooding is a frequent risk during the monsoon season. In Nepal, landslides and floods happen virtually annually. Flooding is a major threat in the northeastern region of India, where the Brahmaputra river system flows (Devrani, Srivastava, Kumar, & Kasana, 2022). Uttar Pradesh, West Bengal, and Bihar are the states in the Ganges basin that are all frequently inundated. Flooding is a rare occurrence in Sri Lanka (Jain & Singh, 2022). Yet, the worst floods Sri Lanka had seen in more than 50 years struck the island nation in 2003, leaving a path of devastation and 150 dead. In Pakistan, floods are also acknowledged as significant natural disasters. Even though these occurrences fall within the range of climate variability, experts are worried that South Asia's flood frequency, severity, and extent may rise based on projected future climate conditions (Field, Barros, Stocker, & Dahe, 2012).

According to climate change predictions, most regions of the world would experience the frequency and intensity of extreme precipitation events increasing, which might increase the size of extreme flows (Westra et al., 2014). Despite widespread agreement that rising temperatures have resulted in increased precipitation extremes, some studies have suggested that this has not exacerbated floods, with the exception of small catchments where flashy flows predominate (Eccles, Zhang, & Hamilton, 2019). The lack of papers in a systematic review of research on the impacts of climate change and flooding in southeast Asia led me to choose this topic. This study's goal is to examine research on the impacts of climate change and flooding in Southeast Asia.

2. METHODOLOGY

2.1. Research design

A systematic review was done on how climate change has affected floods in South Asia as per the criteria of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) database. The title, abstract, introduction, methodology, findings, and discussion of this study all meet the criteria listed in the checklist.

2.2. Search strategy

We looked through electronic databases including Web of Science, Science Direct, and the System for Information on Grey Literature in Asia for data on floods and climate change. Using computerized databases and PRISMA principles, a systematic study was carried out, looking for phrases like "climate change," "temperature," "global warming," "rainfall," and "humidity." The wildcard character "climate" as well as the Boolean logic operators "AND" and "OR" were used to search the phrases in the titles and abstracts. There were no language restrictions, even though all search terms were in English.Using this method, 80 titles and abstracts were reviewed before 60 full-text manuscripts were assessed for eligibility. For this qualitative review, 50 peer-reviewed articles that specifically addressed the impact of floods and climate change in South Asian countries were ultimately selected.

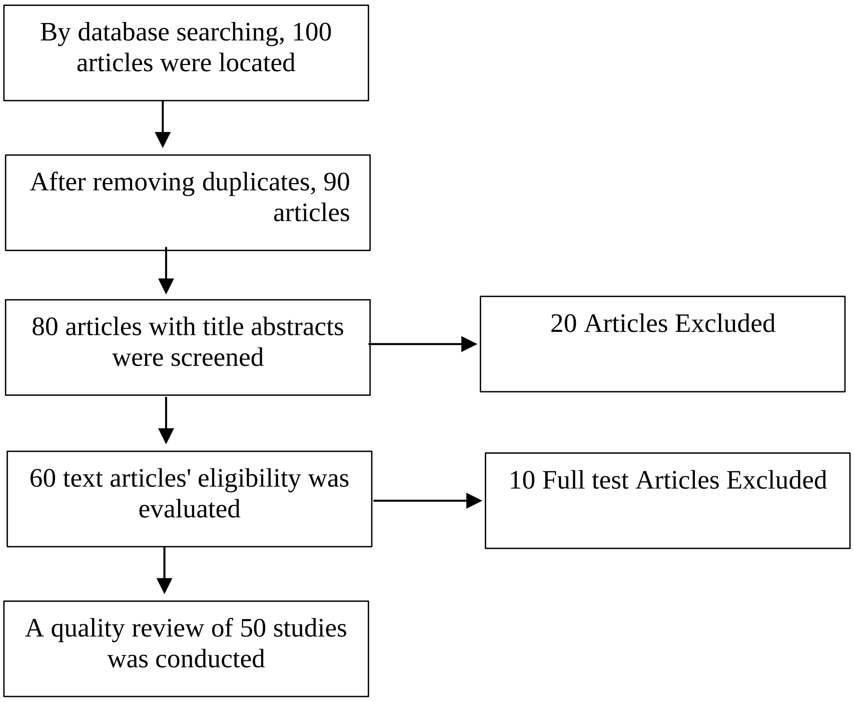

Fig 1. Diagram of the PRISMA study selection process

2.3. Article identification

The study's title and abstract have been checked, and only articles that specifically addressed the impact of flooding and climate change in Asia have been located. Finally, research that did not focus on the aforementioned drought indices was disregarded.

2.4. Eligibility criteria

The geographical scope of this systematic review was tightly restricted to the designated South Asian nations of Afghanistan, Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan, and Sri Lanka in order to ensure strict regional alignment with the study's stated purpose. Countries outside of South Asia, which were first added based on general keywords (such Southeast Asian countries, China, and Iraq), were methodically removed during the screening stage. The eight South Asian nations were chosen because they are all susceptible to hydrological changes brought on by climate change because they share interconnected river basins (like the Indus and the Ganges-Brahmaputra-Meghna systems) and are similarly connected to the extremely unstable South Asian monsoon cycle.

2.5. Data extraction

For the study, fifty publications were reviewed after the screening and eligibility stage. For a systematic review, Robinson and Lowe (2015) suggested including 10–50 papers. With systematic reviews, a few papers are appropriate to wrap up a particular area of investigation. Despite there being a minimal number of papers for the systematic review, the screening and qualifying process found the articles to be sufficient and relevant. The systematic review was carried out using thematic analysis on a qualitative level.

3. RESULTS

3.1. Climate Variability and Change

Climate change is inevitable and unstoppable due to its nature (Mayer & Smith, 2019). However, sociocultural impacts such as the burning of fossil fuels, excessive emissions of greenhouse gases, and urbanization have been directly linked to global warming in the 20th century. The sum of temperature readings taken all across the world is used to calculate global temperatures (Kirschbaum, 1995). In terms of different information, including their average state (such as the standard deviation, form of frequency distribution), climate variability is the capacity of climate elements to alter overall scales of a geographical and temporal organization that extend beyond the scope of a single weather event (Reyer et al., 2013). One of the main factors contributing to floods in South Asian countries, which are greatly impacted by the monsoon weather system, is most likely precipitation (M Monirul Qader Mirza, 2011). The southwestern monsoon, which lasts from June to September, dominates the climate of South Asia. More than 81 percent of the yearly rainfall occurs during the monsoon season (Guofeng et al., 2017). The ENSO phenomena, which is the continental component of the Indian subcontinent, is closely associated with conditions of excessive rainfall and monsoon flooding (Lenka, Devi, Joseph, Gouda, & Climatology, 2022), Global warming may induce a change in the frequency of heavy precipitation due to possible changes in the paths and intensities of storms and depressions as well as possible increases in convective activity (Fowler & Hennessy, 1995).

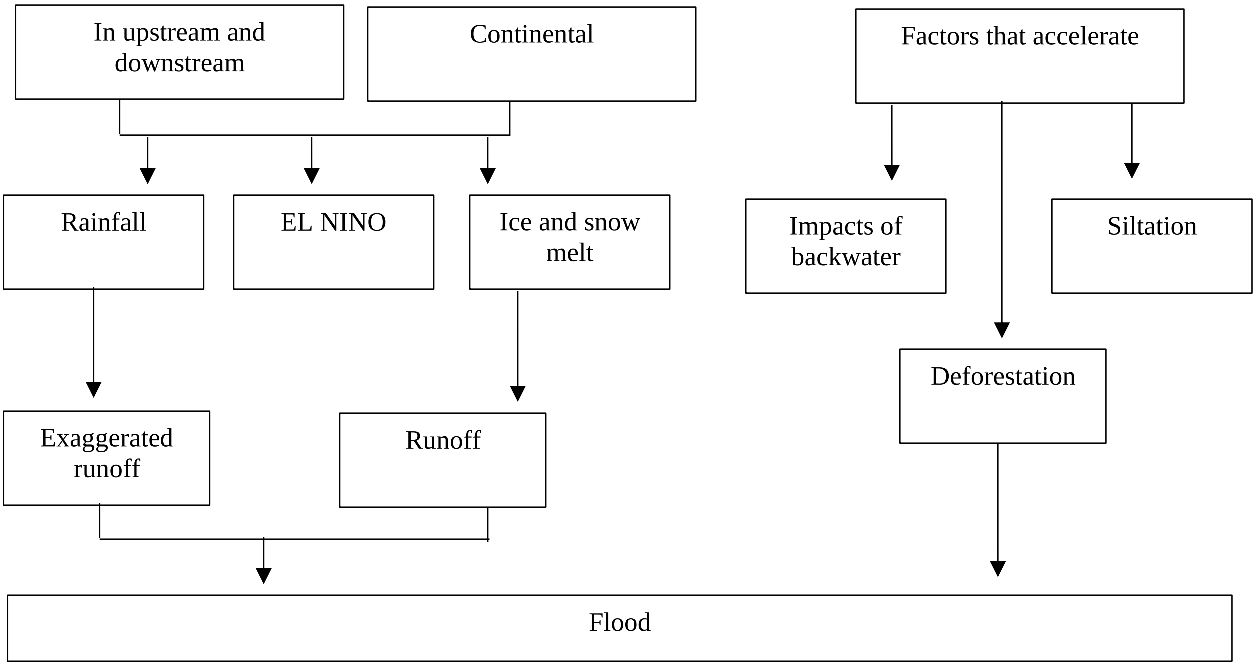

Fig 2. Causes of floods in South Asia

3.2. The south asian monsoon season

The southwest monsoon season, which runs from June to September and accounts for more than 81% of the region's yearly rainfall, is crucial to South Asia's climate. Despite being a large-scale seasonal shift that has historically been linked to the Arabic word "mawsim" the monsoon wind system's behavioral patterns are changing significantly as a result of alterations in the global climate. Rainfall is shown to be the main cause of severe flooding in South Asian nations that are heavily impacted by the monsoon weather system. In the Indian subcontinent, the "El Niño-Southern Oscillation" (ENSO) phenomenon is a major regional element that is strongly correlated with unusual rainfall and destructive monsoon floods (M Monirul Qader Mirza, 2011). The frequency of heavy rainfall occurrences is expected to fluctuate continuously over South Asia due to global warming, causing systematic variations in the severity of storms, active weather systems, and atmospheric disturbances. Extreme daily rainfall occurrences are directly caused by movement connected to monsoon depressions or mid-tropospheric storms (Yadav, 2022).

3.2.1. Flash flood

The fast and quick hydrological reaction of a catchment region to extreme weather events is what distinguishes flash floods as a rapidly developing concern in South Asia. Even when the catchment's soil is comparatively dry, these floods frequently happen. They are brought on by short-lived but incredibly powerful rainstorms, usually of a "convective" kind, in which the runoff mostly flows across the ground surface due to the storm's restricted geographical range. In South Asia, severe floods are more frequent in the summer and the last few months of summer because the warm atmosphere has the energy needed to create these strong, destructive storms (Meer, Mishra, Nagaraju, Das, & Tariq, 2025).

3.2.2. Snowmelt flood

Snowmelt is a major factor in seasonal floods in the catchments of South Asia's high-altitude mountainous regions, especially in the linked river basins supplied by the Hindu Kush-Himalaya region. In contrast to flash floods, snowmelt-related floods happen in pleasant weather and are generally caused by a sharp increase in local air temperatures. High-altitude solar radiation and turbulent heat exchange provide the energy needed for snowmelt in lower-lying regions.Snowmelt often takes place over the course of one or two weeks, soaking the soils, steadily increasing the flows, and eventually producing a flood . Snowmelt floods, which mostly happen in early winter or even in spring depending on the altitude, can only happen in catchments where a significant volume of water is trapped in the snowpack (Martin Beniston, 2012). Also, it's likely that neither the conceptual representation of the range of techniques and processes involved nor the categorization of these process types has clear-cut bounds. Instead of having distinct process boundaries, the distinctions between long and short rain, brief rain and flash floods, rain on snow and snowmelt etc. Most categories in hydrology as well as other Earth sciences that take into account heterogeneity follow this pattern (McDonnell et al., 2007).

3.2.3. Floods caused by accumulated rain and snow

On top of an existing snow cover, rain falls, due to a variety of factors, moderate rainfall depths might result in extremely deep runoff (Boudhar et al., 2009). As opposed to dry periods, considerable long wave radiation but also latent heat inputs during rainfall increase snowmelt. Prior snowmelt may heavily saturate the watershed, allowing for easier overland flow when the rain begins. Large rain-on-snow floods commonly happen in Alpine catchments near the conclusion of the winter season when river flows are considerable from earlier snowmelt (Martin Beniston & Stoffel, 2016). When snowfall, snowmelt, and rain events overlap in the lowlands in early winter, significant rain-on-snow floods can indeed happen (Seybold et al., 2022).

Table 1. Floods Types and climate change impacts on Monsoon Patterns

Flood Types	Climate Change Impacts on Monsoon Patterns	Other Elements Influencing the Frequency of Flooding	References
Flash flood	Greater frequency of heavy rainfall occurrences in cities	A rise in runoff from impermeable surfaces with urbanization.	(Feng, Zhang, & Bourke, 2021) (Hassan, Yassine, & Amin, 2022)
Overflowing riverbank	Increased bank overflow due to longer-lasting rainfall bouts and more severe storm depressions.	Reductions in tree cover on a large scale for urban and agricultural development upstream Schemes for irrigation Dam and embankment structural collapses	(Chapman & Rudra, 2007)
Floods and landslides	Landslides and flash floods are more likely to occur when heavy rainstorms occur more frequently in mountainous terrain.	Changes in hazard hazards as a result of land use	(Debortoli, Camarinha, Marengo, & Rodrigues, 2017) (Cao et al., 2016)
Seasonal flooding of the floodplain	Decreased inland rainfall, which decreased flood heights and duration	Measures for protecting flood plains, withdrawals, and diversion	(Lebel, Foran, Garden, & Manuta, 2012) (Brammer, 2014)
Coastline floods	Coastal flooding risk is more likely as a result of sea level rise.	Groundwater pumping-related land subsidence	(Hoover, Odigie, Swarzenski, & Barnard, 2017) (Shi, Ma, Hu, Huang, & Lin, 2021)

Alterations in flood patterns may also interact with other societal factors that influence risk, such as affluence, resource accessibility, and levels of convertible assets (McLeman, 2009). For specific regions, it is difficult to predict how climate change may affect flood regimes in southeast Asia (Junk et al., 2013).

3.2.4. Southeast Asia's seasonal monsoonal variations and rising temperatures

The population of India would suffer because the summer monsoons account for 74% of the country's annual rainfall. More than two-third thirds of the world's population, or 1.24 billion people, are at risk from floods. This risk is primarily borne by the Southeast Asia region (Bhatia, Ortega, Dash, & Mohamed, 2014). On July 24, 2004, however, things were different since an early monsoon began in northeastern India and Bangladesh, causing maximum flooding that resulted in a death toll of about 1005 people throughout South Asia (Uddin, Matin, & Meyer, 2019). The regional circulations at small scales are more susceptible to changes rain during the monsoon (Loo et al., 2015). As a result, the temporal and spatial distributions cannot be represented by a generic measurement of monsoon system strength (Talchabhadel, Karki, Thapa, Maharjan, & Parajuli, 2018). Despite the fact that ENSO can only be said to have a limited impact on the cyclical nature of the Asian monsoon's rainfall patterns, In India, monsoon rainfall is expected to increase in the next years, it was discovered. Convection from monsoon depressions or mid-tropospheric cyclones is to blame for extreme daily rainfall events (Pattanaik & Rajeevan, 2010).

Table 2. Impacts of floods and the risk of flooding in South Asia

Rank	County	Flood Risk by Population at Risk (%)	Impacts of Flood	References
1	Bangladesh	57.5%	Drowning claims, the lives of 75% of all flood victims. Died from cholera, typhoid, dysentery, and diarrhea.	(Dewan, 2015)
2	Pakistan	31.1%	A significant amount of agricultural land was lost. The nation's food supply has decreased dramatically. livestock that was lost	(Page & Gautier, 2012)
3	Nepal	29.4%	Destroy important infrastructure and restrict access to key public services.	(Badal, 2019) (Chaudhary, Uprety, & Rimal, 2016)
4	India	27.7%	Large agricultural regions in Uttar Pradesh, West Bengal, and Bihar were inundated by rivers spilling their banks in the Brahmaputra and Ganges basins; insufficient drainage systems caused catastrophic flash floods in urban areas.	(Dasgupta et al., 2010) (Dikshit, Dikshit, Dikshit, & Dikshit, 2014)
5	Sri Lanka	~15.0%	Although floods have historically occurred seldom, there are unanticipated flash flood events, such as catastrophic bouts that occur over several decades and cause unexpected fatalities, infrastructure destruction, and local economic shocks.	(Wickramasinghe, Prematilaka, Witharana, Halwatura, & Perera, 2023)
6	Afghanistan, Bhutan, & Maldives	Qualitative Synthesis	**Afghanistan/Bhutan** Flash floods are a result of glaciers melting quickly and snowfall during rainy seasons. **Maldives** Increased storm surge severity as a result of increasing sea levels, saltwater intrusion into freshwater reserves, and the growing possibility of permanently submerging coastal regions.	(Lacombe, Chinnasamy, & Nicol, 2019) (Monioudi et al., 2025)

Large-scale marine and atmospheric phenomena including El Niño, heavy rainfall, and severe snowfall and snowmelt in mountainous areas. significant backwater effects, deforestation, and siltation. Due to impermeable concrete surfaces and the failure or overtopping of agricultural and structural dam systems, rapid urbanization increases runoff (Hanson et al., 2011).

3.2.5. Flood impacts on livelihood

Some academics contend that the area's distinctive geography is the primary cause of the recurrent flood disasters (Hossain, Sohel, & Ryakitimbo, 2020). Southeast Asians appeared to blame floods for their poverty as a whole, and the community assumed that these impoverished individuals would constantly be afflicted by floods (Padawangi, Turpin, Prescott, Lee, & Shepherd, 2016). They also suffered financial losses and asset losses as a result of the frequent flooding, and their ability to deal with the flooding was constrained (Ajibade & McBean, 2014). Several studies have already revealed the wide-ranging effects of floods on people's livelihoods (Bang, Miles, & Gordon, 2018). Flood catastrophes are a constant and terrifying concern, especially to Southeast Asian char village impoverished communities (Renton, 2009). One of the most obvious signs that someone is poor is their occupation and income. The type of occupation determines how much of an impact flooding has (Hardoy & Pandiella, 2009).

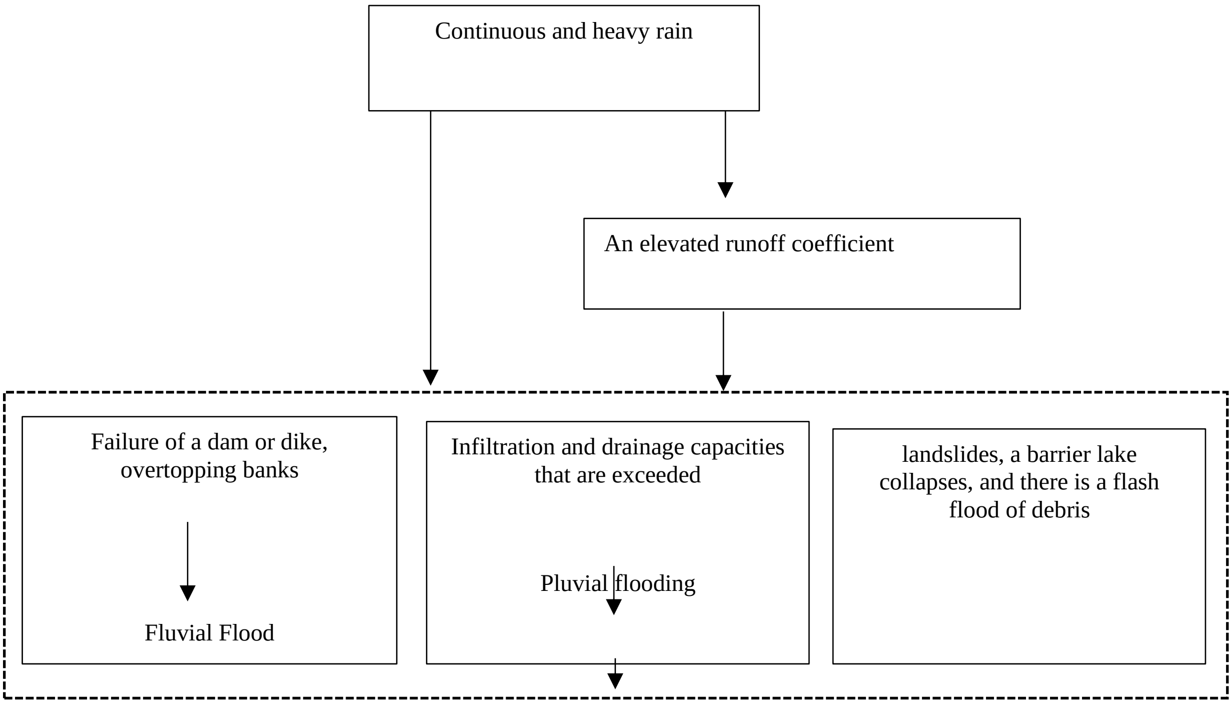

Fig 3. Impacts of flood on livelihood

The soil is getting increasingly barren as a result of siltation following flooding in the study region, and day by day, productivity is decreasing relative to the land that was not damaged by the flood (Hossain et al., 2020). Moreover, one of the biggest threats to the residents of the Char Land is riverbank erosion, which results in enormous annual losses of agricultural land (Majumdar, Das, & Mandal, 2023). Natural disasters like floods compel people to change their occupations and have an unfavorable impact on their income (Bhuiyan, Islam, & Azam, 2017). Due to the lack of opportunities to find work or continue doing previous work even during a flood, the take home pay significantly fell.

3.2.6. Southeast Asia's ineffective climate defense

According to the IPCC assessment, achieving net-zero greenhouse gas emissions by 2050, as defined in the Paris Agreement, is required to keep global warming to 1.5°C and that human activity is "unequivocally" to blame for more severe climate events including heatwaves, floods, and droughts (Le Ravalec, Rambaud, & Blum, 2022). The majority of the countries in the region do not have carbon reduction strategies in place that will effectively lessen the severity of the climate risks outlined in the IPCC report, despite the fact that Southeast Asian countries are predicted to experience some of the harshest effects of climate change (Ebi et al., 2021). Variations in monsoon rainfall can have a greater impact on small scale regional circulations (K. Rajendran, Kitoh, Srinivasan, Mizuta, & Krishnan, 2012). As a result, the temporal and spatial distributions cannot be well represented by a universal measurement of the strength of monsoon systems (Prakash & Gairola, 2011). The patterns of rainfall totals obtained from many sources can be used to understand how the monsoon rainfall changed in Southeast Asian countries (Loo et al., 2015). According to research, India and Bangladesh also experience a big number of these widespread floods that cover a wide area and are brought on by monsoon rainfall (M Monirul Qader Mirza, 2011). Nonetheless, the annual monsoon rains fall during the wet season in northeastern India and Bangladesh (Shahid, 2009).

4. DISCUSSION

A thorough analysis of these 50 key articles reveals a strong link between aberrant local rainfall patterns in South Asia and rising global temperatures. The largest transboundary river basins in South Asia the Indus, Ganges, and Brahmaputra are controlled by a variety of flood causes, including monsoon variability, rapid snowmelt, and rain-on-snow events, in contrast to small catchments that are dominated by spectacular floods. Our findings show that the effects of these flood dynamics are quite varied throughout the region, mostly due to institutional adaptation capacities, population concentration, and vulnerability at the regional level(Ajibade et al., 2014).

According to historical data, low-income agricultural regions bear a disproportionate share of the financial and human costs associated with floods, with Bangladesh and India having the greatest populations at risk. Due to changes in monsoon patterns brought on by the twentieth-century increase in global temperatures, seasonal cycles that were once predictable and regular have become perilous and intensely intense (Krishan & Srivastava, 2026). For example, frequent riverbank erosion harming Bangladesh's char lands and severe flooding in Pakistan's agricultural belts show how climate-driven floods are actively turning past weather variations into long-term socioeconomic challenges. Additionally, the Maldives faces structural hazards from coastal flooding and increasing sea levels, while high-altitude areas like Nepal and Bhutan are particularly vulnerable to flash floods and landslides caused by convective storm systems. This wide range of risk highlights the reality that, despite the common climate dangers that bind South Asia, each nation faces unique tragedies.

A flood or inundation is typically defined as an accumulation of rainwater that is significant enough to completely engulf the ground. In addition to oceans extending inland to engulf low-lying areas, these floods expand out from rivers and lakes. The 20th century's global warming quickly exacerbated the flooding episodes, which the communities reliant on agriculture had previously acknowledged as having a favorable impact (McMichael, 2012). As the mechanisms involved in each type of flood are very distinct, it makes sense that the frequency of the processing steps would alter depending on the size of the occurrence (Sivapalan, 2006). The main factor affecting floods is precipitation (Kunkel, 2003). One would anticipate that the tail of the pattern of the catchments dominated by rain on snow would be shorter than that of the catchments dominated by rainfall as the meltwater discharge is constrained by the energy available (see Table 1) (Merz et al., 2022).

4.1. Consequences of Floods and the Risk of Flooding

The results of the historical event review support earlier findings that the mortality from floods varies geography, economy's state of development, and the magnitude of the event most flood-related fatalities take place in impoverished, inhabited regions, particularly in Southeast Asia having the highest risk (Doocy, Daniels, Murray, & Kirsch, 2013). The flooding disasters in Southeast Asia show that the monsoon rain trend is changing (Loo et al., 2015). There is no denying that recent changes in precipitation patterns have occurred globally. Rising monsoon rainfall intensities in Pakistan, Malaysia and other Southeast Asian nations are not only a cause of significant floods but also the beginning of big landslide events (see Table 2) (Whitmee et al., 2015). The deaths and property damage brought on by Southeast Asia's monsoon flooding have had a significant impact on a lot of people (Chen, Giese, & Chen, 2020). As seen by the 1980 floods and the 2011 monsoon flooding that drowned the majority of southern Thailand, Thailand is regarded as one of the ten countries in the world with the worst flood damage (Phongsathorn, 2011).

According to research, floods are more common in Asian nations, particularly Southeast Asian nations like the Philippines, Indonesia, Bangladesh, Thailand, Vietnam, and Cambodia. Southeast Asia experiences the majority of the world's floods (Torti, 2012). Large-scale flooding brought on by monsoon rains is a typical occurrence in Bangladesh and India as well (Pandey, Kaushik, & Parida, 2022). On the other hand, northeastern India and Bangladesh see their annual monsoon rains from June until the end of September (Dikshit et al., 2014). While flood death rates vary little throughout continents, those in Asia are more deadly and more disruptive because they affect far bigger geographic areas and populations (Guha-Sapir, Hargitt, & Hoyois, 2004).

5. CONCLUSION

In order to illustrate the effects of climate change and flooding throughout South Asia, this systematic review integrated fifty important peer-reviewed publications. The body of research suggests that rising global temperatures accelerate glacier and snowmelt processes in the Hindu Kush-Himalayan region and change the South Asian monsoon's intensity, frequency, and spatial distribution. As a result, nations like Bangladesh, India, Nepal, and Pakistan are experiencing more frequent and unpredictable landslides, floods, and fluvial overtopping, endangering millions of people's livelihoods, interfering with agricultural production (especially rice cultivation), and taxing regional infrastructure. Efforts at the individual and local levels are insufficient since these South Asian nations are intricately linked by transboundary river systems and common weather networks. Strong data-sharing networks, a cohesive, integrated regional approach to disaster management, and the coordinated development and execution of transboundary climate adaption measures are all necessary to mitigate the socioeconomic effects of future floods.

DECLARATIONS

Funding: This research received no external funding.

Authors' Contribution: Authors contributed equally to the conceptualization and writing of the article. All of the authors approved thecontent of the manuscript and agreed on all aspects of the work declaration of competing interest none.

Conflict of Interest: The authors declare that they have no conflicts of interest.

Acknowledgments: The authors would like to thank the manuscript reviewers whose invaluable feedback improved the quality of manusrcipt.

REFERENCES

Afsar, R. (2003). Internal migration and the development nexus: the case of Bangladesh. Paper presented at the Regional conference on migration, development and pro-poor policy choices in Asia.

Ajibade, I., & McBean, G. (2014). Climate extremes and housing rights: A political ecology of impacts, early warning and adaptation constraints in Lagos slum communities. J Geoforum, 55, 76-86. **DOI:** 10.1016/j.geoforum.2014.05.005

Badal, B. P. (2019). Tourism: Visit Nepal 2020. J Research Nepal Journal of Development Studies 2(2), 12-32.

Bang, H., Miles, L., & Gordon, R. (2018). Enhancing local livelihoods resilience and food security in the face of frequent flooding in Africa: A disaster management perspective. J Journal of African Studies Development 10(7), 85-100. **DOI:** 10.5897/JASD2018.0510

Beniston, M. (2012). Impacts of climatic change on water and associated economic activities in the Swiss Alps. J Journal of Hydrology 412, 291-296. **DOI:** 10.1016/j.jhydrol.2010.06.046

Beniston, M., & Stoffel, M. (2016). Rain-on-snow events, floods and climate change in the Alps: Events may increase with warming up to 4 C and decrease thereafter. J Science of the total environment, 571, 228-236. **DOI:** 10.1016/j.scitotenv.2016.07.125

Bhatia, R., Ortega, L., Dash, A., & Mohamed, A. J. (2014). Vector-borne diseases in South-East Asia: burdens and key challenges to be addressed. WHO South-East Asia journal of public health, 3(1), 2-4.

Bhuiyan, M. A. H., Islam, S. D.-U., & Azam, G. (2017). Exploring impacts and livelihood vulnerability of riverbank erosion hazard among rural household along the river Padma of Bangladesh. J Environmental Systems Research, 6, 1-15.

Bonanno, G. A., Brewin, C. R., Kaniasty, K., & Greca, A. M. L. (2010). Weighing the costs of disaster: Consequences, risks, and resilience in individuals, families, and communities. J Psychological science in the public interest 11(1), 1-49.

Boudhar, A., Hanich, L., Boulet, G., Duchemin, B., Berjamy, B., & Chehbouni, A. (2009). Evaluation of the snowmelt runoff model in the Moroccan High Atlas Mountains using two snow-cover estimates. J Hydrological Sciences Journal, 54(6), 1094-1113.

Brammer, H. (2014). Bangladesh's dynamic coastal regions and sea-level rise. J Climate risk management, 1, 51-62.

Cao, C., Xu, P., Wang, Y., Chen, J., Zheng, L., & Niu, C. (2016). Flash flood hazard susceptibility mapping using frequency ratio and statistical index methods in coalmine subsidence areas. J Sustainability, 8(9), 948. DOI: 10.3390/su8090948.

Chapman, G. P., & Rudra, K. (2007). Water as foe, water as friend: Lessons from Bengal's millennium flood. J Journal of South Asian Development, 2(1), 19-49. DOI: 10.1177/097317410600200102

Chaudhary, R. P., Uprety, Y., & Rimal, S. K. (2016). Deforestation in Nepal: Causes, consequences and responses. J Biological environmental hazards, risks, disasters 335-372.

Chen, A., Giese, M., & Chen, D. (2020). Flood impact on Mainland Southeast Asia between 1985 and 2018—The role of tropical cyclones. J Journal of Flood Risk Management, 13(2), e12598. DOI: 10.1111/jfr3.12598

Costello, A., Abbas, M., Allen, A., Ball, S., Bell, S., Bellamy, R., . . . Kett, M. (2009). Managing the health effects of climate change: lancet and University College London Institute for Global Health Commission. J The lancet, 373(9676), 1693-1733. **DOI:** 10.1016/S0140-6736(09)60935-1

Dasgupta, S., Huq, M., Khan, Z. H., Ahmed, M. M. Z., Mukherjee, N., Khan, M., & Pandey, K. D. (2010). Vulnerability of Bangladesh to cyclones in a changing climate: Potential damages and adaptation cost. J World Bank Policy Research Working Paper(5280). **DOI:** 10.1596/1813-9450-5280

Debortoli, N. S., Camarinha, P. I. M., Marengo, J. A., & Rodrigues, R. R. (2017). An index of Brazil's vulnerability to expected increases in natural flash flooding and landslide disasters in the context of climate change. J Natural hazards, 86, 557-582. **DOI:** 10.1007/s11069-016-2705-2

Devrani, R., Srivastava, P., Kumar, R., & Kasana, P. (2022). Characterization and assessment of flood inundated areas of lower Brahmaputra River Basin using multitemporal Synthetic Aperture Radar data: A case study from NE India. J Geological Journal, 57(2), 622-646. **DOI:** 10.1002/gj.4293

Dewan, T. H. (2015). Societal impacts and vulnerability to floods in Bangladesh and Nepal. J Weather Climate Extremes 7, 36-42. **DOI:** 10.1016/j.wace.2014.11.001

Dikshit, K., Dikshit, J. K., Dikshit, K., & Dikshit, J. K. (2014). Weather and climate of north-east India. J North-East India: land, people economy, 149-173.

Doocy, S., Daniels, A., Murray, S., & Kirsch, T. D. (2013). The human impact of floods: a historical review of events 1980-2009 and systematic literature review. J PLoS currents, 5. **DOI:** 10.1371/currents.dis.26ae92e7129f95dce30094189ab27d3d

Dufresne, J.-L., Foujols, M.-A., Denvil, S., Caubel, A., Marti, O., Aumont, O., . . . Benshila, R. (2013). Climate change projections using the IPSL-CM5 Earth System Model: from CMIP3 to CMIP5. J Climate dynamics, 40, 2123-2165. **DOI:** 10.1007/s00382-011-1228-1

Ebi, K. L., Vanos, J., Baldwin, J. W., Bell, J. E., Hondula, D. M., Errett, N. A., . . . Spector, J. (2021). Extreme weather and climate change: population health and health system implications. J Annual review of public 42(1), 293-315. **DOI:** 10.1146/annurev-publhealth-012420-105026

Eccles, R., Zhang, H., & Hamilton, D. (2019). A review of the effects of climate change on riverine flooding in subtropical and tropical regions. J Journal of Water Climate Change 10(4), 687-707. **DOI:** 10.2166/wcc.2018.175

Feng, B., Zhang, Y., & Bourke, R. (2021). Urbanization impacts on flood risks based on urban growth data and coupled flood models. Natural Hazards, 106, 613-627. **DOI:** 10.1007/s11069-020-04409-5

Field, C. B., Barros, V., Stocker, T. F., & Dahe, Q. (2012). Managing the risks of extreme events and disasters to advance climate change adaptation: special report of the intergovernmental panel on climate change: Cambridge University Press.

Fowler, A., & Hennessy, K. (1995). Potential impacts of global warming on the frequency and magnitude of heavy precipitation. J Natural hazards, 11, 283-303. DOI: 10.1007/BF00613411

Guha-Sapir, D., Hargitt, D., & Hoyois, P. (2004). Thirty years of natural disasters 1974-2003: The numbers: Presses univ. de Louvain.

Guofeng, Z., Dahe, Q., Yuanfeng, L., Fenli, C., Pengfei, H., Dongdong, C., . . . Climatology, a. (2017). Accuracy of TRMM precipitation data in the southwest monsoon region of China. 129, 353-362. **DOI:** 10.1007/s00704-016-1791-1

Hanson, S., Nicholls, R., Ranger, N., Hallegatte, S., Corfee-Morlot, J., Herweijer, C., & Chateau, J. (2011). A global ranking of port cities with high exposure to climate extremes. J Climatic change, 104, 89-111. **DOI:** 10.1007/s10584-010-9926-y

Hardoy, J., & Pandiella, G. (2009). Urban poverty and vulnerability to climate change in Latin America. J Environment urbanization 21(1), 203-224. **DOI:** 10.1177/0956247809103019

Hassan, B. T., Yassine, M., & Amin, D. (2022). Comparison of urbanization, climate change, and drainage design impacts on urban flashfloods in an arid region: case study, New Cairo, Egypt. Water, 14(15), 2430. **DOI:** 10.3390/w14152430

Hooijer, A., Klijn, F., Pedroli, G. B. M., & Van Os, A. G. (2004). Towards sustainable flood risk management in the Rhine and Meuse river basins: synopsis of the findings of IRMA-SPONGE. J River research applications 20(3), 343-357. **DOI:** 10.1002/rra.781

Hoover, D. J., Odigie, K. O., Swarzenski, P. W., & Barnard, P. J. (2017). Sea-level rise and coastal groundwater inundation and shoaling at select sites in California, USA. J Journal of Hydrology: Regional Studies, 11, 234-249. **DOI:** 10.1016/j.ejrh.2016.12.085

Hossain, B., Sohel, M. S., & Ryakitimbo, C. M. (2020). Climate change induced extreme flood disaster in Bangladesh: Implications on people's livelihoods in the Char Village and their coping mechanisms. J Progress in Disaster Science, 6, 100079. **DOI:** 10.1016/j.pdisas.2020.100079

Jain, S. K., & Singh, V. P. (2022). Strategies for flood risk reduction in India. J ISH Journal of Hydraulic Engineering, 1-10. **DOI:** 10.1080/09715010.2021.2023530

Juhola, S., & Westerhoff, L. (2011). Challenges of adaptation to climate change across multiple scales: a case study of network governance in two European countries. J Environmental science policy, 14(3), 239-247. **DOI:** 10.1016/j.envsci.2010.12.006

Junk, W. J., An, S., Finlayson, C., Gopal, B., Květ, J., Mitchell, S. A., . . . Robarts, R. D. (2013). Current state of knowledge regarding the world’s wetlands and their future under global climate change: a synthesis. J Aquatic sciences, 75, 151-167. **DOI:** 10.1007/s00027-012-0278-z

Kirschbaum, M. U. (1995). The temperature dependence of soil organic matter decomposition, and the effect of global warming on soil organic C storage. J Soil Biology biochemistry 27(6), 753-760. **DOI:** 10.1016/0038-0717(94)00242-S

Krishan, A., & Srivastava, A. (2026). Assessing Climate Change Impacts on Water Resources: Modeling Tools, Regional Case Studies, and Adaptation Strategies. J. Mater. Environ. Sci., 17 (1), 1, 19. **DOI:** 10.30955/jmes.2026.01.019

Kundzewicz, Z. W., Kanae, S., Seneviratne, S. I., Handmer, J., Nicholls, N., Peduzzi, P., . . . Mach, K. (2014). Flood risk and climate change: global and regional perspectives. J Hydrological Sciences

Journal, 59(1), 1-28. **DOI:** 10.1080/02626667.2013.857411

Lacombe, G., Chinnasamy, P., & Nicol, A. (2019). Review of climate change science, knowledge and impacts on water resources in South Asia: International Water Management Institute (IWMI).

Lal, M. (2004). Implications of climate change in small Island developing countries of the South Pacific. A Journal of Contemporary Fiji, 2(1), 15-35.

Le Ravalec, M., Rambaud, A., & Blum, V. (2022). Taking climate change seriously: Time to credibly communicate on corporate climate performance. J Ecological Economics, 200, 107542. **DOI:** 10.1016/j.ecolecon.2022.107542

Lebel, L., Foran, T., Garden, P., & Manuta, J. B. (2012). Adaptation to climate change and social justice: challenges for flood and disaster management in Thailand Climate change adaptation in the water sector (pp. 147-164): Routledge. **DOI:** 10.4324/9780203152140-14

Lenka, S., Devi, R., Joseph, C. M., Gouda, K. C. J. T., & Climatology, A. (2022). Effect of large-scale oceanic and atmospheric processes on the Indian summer monsoon. 147(3-4), 1561-1576. **DOI:** 10.1007/s00704-021-03881-2

Liu, H., Zou, L., Xia, J., Chen, T., & Wang, F. (2022). Impact assessment of climate change and urbanization on the nonstationarity of extreme precipitation: a case study in an urban agglomeration in the middle reaches of the Yangtze river. J Sustainable Cities Society 85, 104038. **DOI:** 10.1016/j.scs.2022.104038

Loo, Y. Y., Billa, L., & Singh, A. (2015). Effect of climate change on seasonal monsoon in Asia and its impact on the variability of monsoon rainfall in Southeast Asia. J Geoscience Frontiers, 6(6), 817-823. **DOI:** 10.1016/j.gsf.2014.04.011

Luo, P., Mu, Y., Wang, S., Zhu, W., Mishra, B. K., Huo, A., . . . Duan, W. (2021). Exploring sustainable solutions for the water environment in Chinese and Southeast Asian cities. J Ambio, 1-20. **DOI:** 10.1007/s13280-020-01452-4

Majumdar, S., Das, A., & Mandal, S. (2023). River bank erosion and livelihood vulnerability of the local population at Manikchak block in West Bengal, India. J Environment, Development Sustainability 25(1), 138-175. **DOI:** 10.1007/s10668-021-02096-7

Mayer, A., & Smith, E. K. (2019). Unstoppable climate change? The influence of fatalistic beliefs about climate change on behavioural change and willingness to pay cross-nationally. J Climate Policy, 19(4), 511-523. **DOI:** 10.1080/14693062.2018.1532872

McDonnell, J., Sivapalan, M., Vaché, K., Dunn, S., Grant, G., Haggerty, R., . . . Roderick, M. (2007). Moving beyond heterogeneity and process complexity: A new vision for watershed hydrology. J Water resources research, 43(7). **DOI:** 10.1002/2006WR005467

McLeman, R. A. (2009). On the origins of environmental migration. J Fordham Envtl. L. Rev., 20, 403.

McMichael, A. J. (2012). Insights from past millennia into climatic impacts on human health and survival. J Proceedings of the National Academy of Sciences, 109(13), 4730-4737.

Meer, M. S., Mishra, A. K., Nagaraju, V., Das, J., & Tariq, A. (2025). Satellite-based assessment of extreme rainfall during the 2019 Indian monsoon: climatic linkages to IOD and ENSO. Modeling Earth Systems and Environment, 11(4), 305. **DOI:** 10.1007/s40808-024-02104-z

Merz, B., Basso, S., Fischer, S., Lun, D., Blöschl, G., Merz, R., . . . Macdonald, E. (2022). Understanding heavy tails of flood peak distributions. J Water resources research, 58(6), e2021WR030506. **DOI:** 10.1002/2021WR030506

Merz, B., Blöschl, G., Vorogushyn, S., Dottori, F., Aerts, J. C., Bates, P., . . . Lall, U. (2021). Causes, impacts and patterns of disastrous river floods. J Nature Reviews Earth Environment 2(9), 592-609.

Mirza, M. M. Q. (2011). Climate change, flooding in South Asia and implications. J Regional environmental change, 11(Suppl 1), 95-107. **DOI:** 10.1007/s10113-010-0184-7

Monioudi, I. N., Vousdoukas, M. I., Giardino, A., Stocchino, A., Mentaschi, L., & Feyen, L. (2025). Impacts of sea level rise and adaptation across Asia and the Pacific. Scientific Reports, 15(1), 35742.

Owrangi, A. M., Lannigan, R., & Simonovic, S. P. (2014). Interaction between land-use change, flooding and human health in Metro Vancouver, Canada. J Natural hazards, 72, 1219-1230. **DOI:** 10.1007/s11069-013-0975-2

Padawangi, R., Turpin, E., Prescott, M. F., Lee, I., & Shepherd, A. (2016). Mapping an alternative community river: The case of the Ciliwung. J Sustainable Cities Society 20, 147-157. **DOI:** 10.1016/j.scs.2015.11.006

Page, S., & Gautier, P. (2012). Use of antimicrobial agents in livestock. J Revue Scientifique et Technique-OIE, 31(1), 145.

Pandey, A. C., Kaushik, K., & Parida, B. R. (2022). Google Earth Engine for large-scale flood mapping using SAR data and impact assessment on agriculture and population of Ganga-Brahmaputra basin. J Sustainability, 14(7), 4210. **DOI:** 10.3390/su14074210

Pattanaik, D., & Rajeevan, M. (2010). Variability of extreme rainfall events over India during southwest monsoon season. J Meteorological Applications: A journal of forecasting, practical applications, training techniques modelling, 17(1), 88-104. **DOI:** 10.1002/met.164

Phongsathorn, P. (2011). Environment and migration: The 2011 floods in Thailand. J Gemenne, F., Brückner, P.Ionesco D.. The State of Environmental Migration

Prakash, S., & Gairola, R. M. J. (2011). Large-scale precipitation estimation using Kalpana-1 IR measurements and its validation using GPCP and GPCC data. J Theoretical applied climatology, 106, 283-293. **DOI:** 10.1007/s00704-011-0429-x

Quintero, F., Mantilla, R., Anderson, C., Claman, D., & Krajewski, W. (2018). Assessment of changes in flood frequency due to the effects of climate change: Implications for engineering design. J Hydrology, 5(1), 19. **DOI:** 10.3390/hydrology5010019

Rajendran, C. P., & Rajendran, K. (2001). Characteristics of deformation and past seismicity associated with the 1819 Kutch earthquake, northwestern India. J Bulletin of the Seismological Society of America, 91(3), 407-426. **DOI:** 10.1785/0119990150

Rajendran, K., Kitoh, A., Srinivasan, J., Mizuta, R., & Krishnan, R. (2012). Monsoon circulation interaction with Western Ghats orography under changing climate: projection by a 20-km mesh AGCM. J Theoretical Applied Climatology 110, 555-571. **DOI:** 10.1007/s00704-012-0690-7

Rauh, V. A., Landrigan, P. J., & Claudio, L. (2008). Housing and health: intersection of poverty and environmental exposures. J Annals of the New York Academy of Sciences, 1136(1), 276-288. **DOI:** 10.1196/annals.1425.032

Reid, J. S., Hyer, E. J., Johnson, R. S., Holben, B. N., Yokelson, R. J., Zhang, J., . . . Giglio, L. (2013). Observing and understanding the Southeast Asian aerosol system by remote sensing: An initial review and analysis for the Seven Southeast Asian Studies (7SEAS) program. J Atmospheric Research, 122, 403-468. **DOI:** 10.1016/j.atmosres.2012.06.005

Reid, S., Smit, B., Caldwell, W., & Belliveau, S. (2007). Vulnerability and adaptation to climate risks in Ontario agriculture. J Mitigation Adaptation Strategies for Global Change 12, 609-637. **DOI:** 10.1007/s11027-006-9051-x

Renton, A. (2009). Suffering the Science: Climate change, people, and poverty (Vol. 130): Oxfam.

Reyer, C. P., Leuzinger, S., Rammig, A., Wolf, A., Bartholomeus, R. P., Bonfante, A., . . . Abou Jaoudé, R. (2013). A plant's perspective of extremes: terrestrial plant responses to changing climatic variability. J Global change biology, 19(1), 75-89. **DOI:** 10.1111/gcb.12023

Seybold, E. C., Dwivedi, R., Musselman, K. N., Kincaid, D. W., Schroth, A. W., Classen, A. T., . . . Adair, E. C. (2022). Winter runoff events pose an unquantified continental-scale risk of high wintertime nutrient export. J Environmental Research Letters, 17(10), 104044. DOI: 10.1088/1748-9326/ac91d3

Shahid, S. (2009). Spatio-temporal variability of rainfall over Bangladesh during the time period 1969-2003. J Asia-Pacific Journal of Atmospheric Science, 45(3), 375-389. **DOI:** 10.1007/s13143-009-0026-z

Shi, G., Ma, P., Hu, X., Huang, B., & Lin, H. (2021). Surface response and subsurface features during the restriction of groundwater exploitation in Suzhou (China) inferred from decadal SAR interferometry. J Remote Sensing of Environment, 256, 112327. **DOI:** 10.1016/j.rse.2021.112327

Sivapalan, M. (2006). Pattern, process and function: elements of a unified theory of hydrology at the catchment scale. J Encyclopedia of hydrological sciences.

Talchabhadel, R., Karki, R., Thapa, B. R., Maharjan, M., & Parajuli, B. (2018). Spatio-temporal variability of extreme precipitation in Nepal. J International Journal of Climatology, 38(11), 4296-4313. **DOI:** 10.1002/joc.5669

Torti, J. (2012). Floods in Southeast Asia: A health priority. J Journal of global health, 2(2). **DOI:** 10.5287/jogh.02.020304

Trenberth, K. E., Dai, A., Van Der Schrier, G., Jones, P. D., Barichivich, J., Briffa, K. R., & Sheffield, J. (2014). Global warming and changes in drought. J Nature Climate Change, 4(1), 17-22.

Uddin, K., Matin, M. A., & Meyer, F. J. (2019). Operational flood mapping using multi-temporal Sentinel-1 SAR images: A case study from Bangladesh. J Remote Sensing, 11(13), 1581. **DOI:** 10.3390/rs11131581

Westra, S., Fowler, H. J., Evans, J. P., Alexander, L. V., Berg, P., Johnson, F., . . . Roberts, N. (2014). Future changes to the intensity and frequency of short-duration extreme rainfall. J Reviews of Geophysics, 52(3), 522-555. **DOI:** 10.1002/2014RG000464

Whitmee, S., Haines, A., Beyrer, C., Boltz, F., Capon, A. G., de Souza Dias, B. F., . . . Head, P. (2015). The Rockefeller Foundation–Lancet Commission on planetary health. Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation–Lancet Commission on planetary health. J Lancet, 386(10007), 1973-2028.

Wickramasinghe, D., Prematilaka, L., Witharana, A., Halwatura, D., & Perera, T. (2023). Cities and climate change: Responding to the impacts of water-related disasters in Sri Lanka. International handbook of disaster research, 2331-2353. **DOI:** 10.1007/978-981-16-6088-7_98

Yadav, M. (2022). South Asian monsoon extremes and climate change Extremes in atmospheric processes and phenomenon: Assessment, impacts and mitigation (pp. 59-86): Springer.

Yoro, K. O., & Daramola, M. O. (2020). CO2 emission sources, greenhouse gases, and the global warming effect Advances in carbon capture (pp. 3-28): Elsevier. **DOI:** 10.1016/B978-0-12-819657-1.00001-3

Younger, P. L., Banwart, S. A., Hedin, R. S., Younger, P. L., Banwart, S. A., & Hedin, R. S. (2002). Mine water hydrology: Springer.