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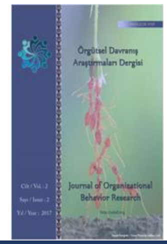

Geomorphological Hazards in Urban Development

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ABSTRACT

Various geomorphological processes are significant natural factors affecting urban development. Ideally, settlements should be safeguarded against floods, landslides, earthquakes, avalanches and other destructive natural processes. However, in some areas, these processes create challenges for certain urban functions, consistently or suddenly prompting specific engineering interventions that increase construction costs, make facility maintenance expensive, and reduce building lifespans. Severe and recurrent phenomena, such as landslides occurring at irregular intervals, force residents to evacuate all or part of their settlements. Moreover, long-term, irregularly occurring events, like earthquakes, floods, and volcanic eruptions, escalate construction costs, as urban inhabitants have settled in potentially hazardous areas. Therefore, the zoning of geomorphological hazards in urban areas, which is one of the most critical tasks of geomorphology experts, becomes indispensable. Consequently, studying geomorphological processes and preparing precise spatial distribution maps of these processes hold great significance in urban planning and construction.

Keywords: *Urban Development, Geomorphological Hazards, Natural Disasters, Unplanned Construction*

INTRODUCTION

Environmental problems and hazards, as a part of the human environment, arise from human activities, encroachment into hazardous areas, and neglect of natural boundaries. They lead to human and economic crises and restrict sustainable urban development (Najafi et al., 2016). What is now referred to as environmental hazards is often the result of improper practices and unbalanced human-nature interactions. The identification and analysis of these hazards fall within the scope of geographical studies in two ways: first, the relationship between humans and the environment is a fundamental subject of geographical research. Second, hazards occur in specific locations, and location is a geographical domain. Therefore, the human-environment relationship has a spatial nature (Alijani, 2014). Consequently, the relationship between human activities and their environment should be positively (i.e., human utilization of natural resources) and negatively (i.e., natural hazards and disasters) considered (Ghanbari and Zolfi, 2014). Natural hazards have received significant attention among researchers in various scientific disciplines, aiming to analyze these phenomena and their impacts on the Earth's surface, as they are recognized as one of the major hindrances to regional development (Jafari and Shahzeydi, 2018).

Geomorphology is one of the most dynamic fields of applied geographical studies, revealing the connection between environmental factors and Earth's landforms (Jafari and Shahzeydi, 2018). Since cities are composed of various topographic and geomorphological units, any action related to urban development and construction intersects with this dynamism and, consequently, with geomorphological phenomena (Khorshiddoust, et al., 2011). As cities expand, their encounters with diverse topographic and geomorphological units and associated issues intensify (Hosseinzadeh and Panahi, 2015). Predicting future geomorphological changes resulting from urban development requires an understanding of the past, a grasp of the present, and the ability to foresee the future (Moghimi, 2012).

In various fields, such as Earth sciences, biology, mineral resource exploration, and rural development, geomorphology can serve as a platform for intervention. The utilization of geomorphology can be classified into four major areas, each with a specific focus. Geomorphology can be used concerning the human impact, where humans significantly affect the Earth's shape. Additionally, geomorphology can be a goal in the investigation of issues related to human permanence on Earth. Furthermore, geomorphology can serve as a goal and an idea in the examination of urban planning issues. Lastly, geomorphology functions as knowledge and technique in environmental engineering and construction (Toulabi, 2010).

The continuous growth of cities, influenced by population growth and migration, has led to unplanned construction and significant alterations in the urban spatial structure, especially the physical development of the city in unfavorable natural locations. Natural hazards, especially geomorphological hazards, entail both human and economic losses, making it essential to identify hazard-prone areas to mitigate risks, prevent financial and human losses, and initiate priority protective, preventive, and remedial measures.

Vulnerability:

In engineering definitions, vulnerability refers to the capacity to measure the damage that may occur as a result of exposure to a set of risk factors. In other words, vulnerability represents the likelihood of a hazard or a successful attack on a particular entity. In different definitions, it pertains to an adversary's use of a weakness to gain unauthorized access to infrastructure, with the intention of causing destruction or theft (Abdollahpour, 2017). Vulnerability is a term used to indicate the extent and potential damage resulting from natural disasters to communities, buildings, and geographical areas (Yousefi, 2017). The concept of vulnerability signifies the amount of risk, combined with the level of economic and social capacity, with which a system can confront an event arising from a hazard (Smith, as cited in Moghimi and Goodarzi-nejad, 2015). Vulnerability is about potential harm or loss. Vulnerability is a fundamental concept in the field of research on natural hazards and disasters. To describe potential damage or destruction in a physical system (such as coastal erosion, glacier melting), the term "fragility of the constructed environment" is used, as well as vulnerability in social and economic systems. Vulnerability can be examined on an individual level (Bobrowsky, 2013).

Vulnerability assessment is a process for evaluating the risk resulting from vulnerability across a wide range of computers, programs, and devices throughout an organization (Haber and

Hibbert, 2018). Vulnerability assessment can be considered as an effective tool for determining the sensitivity of a system, providing the necessary information for prioritizing management and protection plans, and its outputs can provide solutions for reducing vulnerability by decreasing threats and offering technical remedies (Gharachaei, 2018). Evident linkages exist between physical system interaction with social conditions to create vulnerability to hazards. Many of these stressors are individually examined, such as drought or earthquakes and tsunamis, but assessing vulnerability to multiple stressors, although more challenging, is gradually becoming apparent. In any case, assessments begin with an understanding of the interrelationships between physical systems, human systems, and the built environment, although the spatial exposure of individuals and places to natural hazards differs. Evaluating vulnerability to natural hazards is an emerging field in the hazards and natural disasters community. Recent progress in conceptual understanding and measurement is rapidly unfolding. The need for such critical information is essential, as localities and nations cannot develop disaster risk reduction strategies without knowing who and what are the most vulnerable (Bobrowsky, 2013).

Risk Analysis:

Risk analysis typically involves utilizing available information to assess the risk to populations, assets, resources, and more. This analysis encompasses two primary areas: delineating the extent of the exposed area at risk (zonation) and identifying the type and degree of the hazard while estimating its impact. The goal of risk analysis is to assess and demonstrate the possibility of an event's occurrence and its impact in terms of physical and socio-economic consequences within a given environment (Jafari, 2015).

To discuss the risk of hazard or harm, it is essential to estimate the probability of the occurrence of an event or hazard with specific dimensions in a given location, as well as the degree of vulnerability of the threatened factors and phenomena (Naghshbandi, 2017). The probability of occurrence of a hazardous event is another important aspect that must be considered when dealing with risk in the context of natural hazards. The probability of occurrence of a hazard (hazard occurrence) is often estimated using the frequency of similar past events or using the Event-tree method. However, if the event tree cannot be formulated, estimating the probability of rare events may be difficult. Accurately identifying the frequency of tsunamis is still a challenge, especially in areas where they occur very rarely. Similarly, irreversible triggering natural hazards and changes, given climate change, such as sea level rise, as well as human-made hazards, such as terrorist attacks, make the traditional frequency-hazard probability relationship problematic. Also, the cascading hazard in March 2011 in Japan, which was caused by an earthquake followed by a tsunami and an accident at the Fukushima nuclear power plant, shows that new approaches are needed that go beyond a single hazard probability function. Therefore, irreversible changes may have different characteristics. Some probability functions also focus on damage and loss, in other words, the probability of human life loss. These calculations must be done carefully when dealing with low frequency and very specific hazard phenomena (for example, cascading hazards) (Bobrowsky, 2013).

Geomorphology:

Geomorphology is a fundamental and applied science that focuses on understanding the processes of the Earth's surface, systemic responses, and landscape evolution (Keller et al., 2019).

From Mahmoudi's perspective, geomorphology is a branch of natural geography that investigates how various natural landforms are created on the Earth's surface and tracks the changes resulting from both internal and external factors that affect these landforms. Its aim is to describe their behavior systematically and predict their future. The core objective of this field is the study of the primary components constituting landforms, employing scientific descriptions of geomorphic phenomena, which include the identification of various landform features, the relationships between them, and their systematic classification.

Urban geomorphology is a subset of geomorphology, focusing on the transformation and modification of the Earth's surface due to uncontrolled urban development and the associated issues and hazards that affect urban inhabitants. Rapid and uncoordinated urban expansion directly alters the landscapes within a very short period, leading to potential impacts on geological processes and natural conditions. Sometimes, artificial changes can influence natural geological processes (Khorsandi-Aghaei and Abdali, 2007). Thus, the fundamental studies in habitat planning involve the identification and representation of geomorphological phenomena on maps. The geomorphic and topographic characteristics of a geographical location significantly impact human activities, not only in terms of distribution and human activities but ultimately influencing the physical spatial structure of an area (Marhamat, 2017). Urban geomorphology investigates problems related to selecting suitable locations for building cities, the placement of structures within cities, the effects of urban development on landforms, and surrounding lands, among other related subjects (Roustaei and Jabbari, 2012). The significance of urban geomorphology becomes evident when the damages incurred are substantial and beyond human tolerance thresholds. Whereas in the past, a flood might have damaged simple and temporary human shelters and basic possessions, today, due to the extensive development of urban areas and the complexity of modern life and urban infrastructure, the damages can be more significant and far-reaching (Karimi-Soltani, 2013). The goal of urban geomorphology is to understand the mutual effects of urban processes and geomorphology, ultimately serving the people and their well-being. Advertisement and standardization for cities are also among its other objectives (Moghimi, 2012).

Geomorphological hazards refer to a collection of natural threats, including hillslope hazards, floods, earthquakes, and more, that present challenges to human resources due to the instability of Earth's surface forms. Researchers define geomorphological hazards as the potential occurrence of destructive phenomena in a specific period of time and within a particular region, resulting from the stability or instability of surface landforms (Naghshbandi, 2017). According to Gares (1994), geomorphological hazards encompass events that pose threats to human resources due to the instability of surface landforms. These threats arise from the responses of landforms to surface processes. Geomorphological hazards are those that arise from exogenic processes, which are processes initiated by natural agents like water, wind, ice, and gravity on or near the Earth's surface. They differ from geohazards that form deep within the Earth, such as volcanic eruptions or earthquakes. The distinction between the two primary categories of geographical hazards is not always clear. For example, volcanic eruptions and earthquakes can result in slope failures, tsunamis, and floods. Moreover, it is not always straightforward to differentiate geomorphological hazards from other major hazard groups, such as meteorological, hydrological, biological, technological, and social hazards. For instance, while floods are typically classified as hydrological hazards, changes in river channels can be considered geomorphological hazards (Marston et al., 2017).

Based on the driving forces, geomorphological hazards can be categorized into three groups. Neotectonics and volcanic activities fall into the category of endogenic processes, whereas landslides, snow avalanches, floods, alluvial erosion, karst subsidence, coastal erosion, and others are grouped under exogenic processes. Hazards resulting from climate change and land-use changes, such as desertification, soil erosion, soil salinization, land degradation, land destruction, glacial outbursts, and more, are classified as erosional processes (Naghshbandi, 2017).

Urban Development:

Urban development, within the framework of urban planning, has a long history as a premeditated endeavor to address the needs of human settlements (Zarei, 2015). Urban development encompasses meeting human needs, forward-thinking for future urban developments, making decisions to minimize urban problems, and, ultimately, preserving a rational relationship between humans and their environment (Mirzaei, 2012). Urban development involves social, economic, and practical mobilization to enhance the quality of the urban environment and establish equilibrium in both the quantity and quality of urban life. It leads to an increase in education, services, hygiene, and, ultimately, the enhancement of human culture within cities (Aghajani, 2009). Urban development, in its precise and scientific sense, carries two distinct meanings: quantitative or spatial development and qualitative development. Quantitative development is concerned with physical and structural expansion, whereas qualitative development primarily focuses on improving the quality, functionality, and efficiency of urban services to enhance the quality of urban life. Qualitative urban development can be achieved through policies for rehabilitation, renewal, the use of new technologies, and improving standards and does not necessarily require quantitative expansion (Mirzaei, 2012). In urban matters, "urban growth" and "urban development" should not be used interchangeably. Urban growth primarily considers the practical aspects of a city, while urban development encompasses all aspects of urban life. In urban planning, an increase in spatial capacity, expansion, and growth are considered forms of urban development. The physical development of a city, by itself, cannot be inherently good or bad, nor can it be perfect. It is impossible to prevent the development of cities because, like living organisms, cities come into existence, grow, and expand (Aghajani, 2009).

Natural Hazards and Urban Environments:

Many major cities, especially those that have experienced rapid growth in recent years, are characterized by continuous construction, inadequate infrastructure, unhygienic environments, and insufficient administrative and medical services, all of which have negative effects on their vulnerability and capacity. Despite these limitations, they are relatively balanced. In addition to their relatively high ability to mobilize resources for responding to disasters and reconstruction, their status as superior cities lead to a concentration of knowledge, expertise, and relatively better science regarding hazards and risks. Furthermore, they provide early warning to the public, a faster response to an event (whether through national resources or international assistance), and, in essence, are equipped for empowering people in reducing vulnerability and disaster preparedness. Developing more effective disaster risk management strategies that involve all the integrated political, administrative, and social elements of a city is facilitated by the significant focus of these elements in major cities (Babrowski, 2013).

Geomorphology and Cities

In urban planning, due consideration must be given to the sensitivity of geomorphology and its relevance to planning at various scales, the phenomena that impact planning, process thresholds, and their categorization. "Geomorphic contributions to planning vary in terms of type and significance. Typically, the most important tasks involve collecting existing data, obtaining new data, and analyzing them" (Moghimi, 2012). Neglecting adequate geomorphological assessments during the establishment of a new city may still lead to a chain of potential environmental irregularities affecting higher-level planning decisions. At the city's overall scale, the common challenge in managing a natural unit, such as a watershed, is divided into multiple segments for better study and monitoring, and a specific organization manages each section (e.g., dividing the municipality into various zones). Identifying environmental issues in each section and combining them and creating a map of geomorphological hazards will prepare the necessary readiness for dealing with these risks in responsible organizations and city managers.

However, it is essential to note that ignoring other influential factors in urban development and non-development will be one-dimensional, which complicates proper planning with numerous challenges and necessitates a comprehensive review of urban planning studies (Roustaei and Jabbari, 2012). Planning for hazards, especially geomorphological hazards, requires a systematic approach because the type of hazardous event, secondary hazards, and the geographical environment are interrelated. Therefore, a systematic understanding of the concept of geomorphology in planning that focuses on these interactions is essential (Mo'tamedi Nia and Moghimi, 2008).

Geomorphic units and topographic elements are predominantly associated with the dynamics and variability of the natural environment. Therefore, any actions towards the development and construction of cities confront the phenomena and forms of geomorphology, and consequently, with the dynamics and these forms (Asghari and Zeynali, 2015). Various geomorphological processes, such as floods, landslides, and earthquakes, may impose difficulties on some urban functions, whether continuously or suddenly. Implementing specific engineering measures that increase construction costs, high maintenance costs, and reduce the lifespan of structures. A severe and intermittent process such as landslides that occur at irregular intervals compels residents to leave some or all of their settlements. Still, if the process operates at long and irregular intervals, such as earthquakes, floods, and volcanoes, the construction costs increase since the city's population is located in potentially dangerous areas. For this reason, zoning for geomorphological hazards in urban areas is essential.

Thus, the study of geomorphological processes and the preparation of accurate maps of their spatial distribution and density are of great importance for urban design and construction (Roustaei and Jabbari, 2012).

Natural Disaster Management

Undoubtedly, the management of any crisis, rooted in environmental hazards, necessitates actions before, during, and after the event (Kaviyanirad, 2014). Following the occurrence of natural hazards, a portion of national resources, both human and physical, are lost in a dream-like vision of these phenomena. One of the major problems that often exacerbates the adverse consequences of natural hazards is the absence of predefined plans regarding the responsibilities of executive agencies and the coordination of their activities.

The identification and analysis of hazards are the first necessary steps for reducing the potential impacts of hazards and preparing for emergency situations. Although addressing all potential hazards in an area is challenging, assessing risks can prioritize them so that initially, the highest probability and most hazardous conditions are addressed. Subsequently, events that occur less frequently and pose a lower probability of significant problems can be examined later. Hazards should be prioritized based on their location, frequency, and magnitude. Major hazards in an area can be identified through geological records of historical events, analysis of recent events, current scientific knowledge, and the assessment of environmental changes such as changes in transportation, industrial and urban development, and population density. After collecting data for various hazards, ranking or weighting methods can be used for prioritizing different risks. Subsequently, a qualitative or quantitative approach can be employed to determine the spatial distribution of a selected hazard. The results assist decision-makers in designing and introducing risk reduction methods or emergency preparedness measures. In the beginning, hazards that are likely to occur frequently and cause significant harm to people and properties should be investigated. Hazards that have a lower probability or result in less damage need to be addressed after identifying more serious hazards. The assessment requires identifying vulnerable populations, infrastructure, critical facilities, and natural resources to estimate fatalities, injuries, property damage, and economic losses. Such information can be used with geographic information systems and computer models to integrate hazard assessment and vulnerability assessment for risk assessment. Risk assessment is essential for rational decision-making regarding investments in hazard reduction, emergency preparedness, and warning systems (Bobrowsky, 2013).

Research Background

Geographical research on natural hazards has a long history, beginning with a focus on physical processes and evolving to consider the interaction of the physical and human environments (Yamani & Moradipour, 2013). The United Nations designated the final decade of the twentieth century as the International Decade for Natural Disaster Reduction. Initial research on natural hazards was pioneered by Gilbert F. White and some of his students. White's early work led to the discovery that despite spending over five billion dollars to control floods through activities like dam construction, levees, and channelization, flood damages increased between 1942 and 1958 (Gares, et al., 1994).

Alcantara-Ayala & Goudie (2010) in their book "Geomorphic Hazards and Natural Disaster Prevention" state that human activities, through industrialization and land-use changes, have a significant impact on the environment and landscapes, resulting in climatic changes, deforestation, desertification, land degradation, and air and water pollution. These effects are strongly related to the occurrence of geomorphic hazards such as floods, landslides, earthquakes, soil erosion, etc. David Higgitt (2010) in an article titled "Geomorphic Hazards and Sustainable

Development" suggests there should be a tangible connection between environmental risk discussions and sustainability. Planning for the sustainable environmental future undoubtedly requires the identification, assessment, and management of risks and vulnerabilities. Human vulnerability to a wide range of environmental hazards affects community sustainability. His aim in this article is to investigate some aspects of the interdisciplinary debate about the interaction of hazard, risk, and sustainability, which can help assess the potential of geomorphology in addressing this intersection. Mount et al. (2011) demonstrated in their results that natural hazards play a significant role in shaping urban and environmental planners' strategies and, in some cases, exacerbate due to improper human activities. For example, the destruction of vegetation cover intensifies erosion processes and inappropriate land use accelerates landslides in urban areas (Monte et al. cited in Marhamat, 2017).

In their 2012 paper, Faccini et al. examined geomorphic hazards resulting from intense rainfall in the Recco River basin in Italy in July 2007. The research findings revealed that various types of landslides, particularly debris flows, occurred as a result of this rainfall, causing significant damages and casualties. In this study, a hazard map for the region was generated. Prokos et al. (2016) investigated the influential geomorphic hazards on the city of Tetouan, Morocco. This city is one of the primary urban centers in northern Morocco. It is situated between two mountain ranges and faces serious challenges due to torrential rains and the construction of residential areas on unstable hills. The authors of this paper aimed to create a comprehensive document to inform the public about these hazards and raise awareness about the environmental vulnerability they live in. Based on the findings of Keiler and Fuchs (2016), geomorphological processes and society are interconnected through a diverse set of relationships and feedback mechanisms. One of the most significant connections pertains to the impact of hazardous geomorphic processes on society, leading to both economic and human losses. Lu et al. (2016) conducted a study on earthquake prediction utilizing geological, geophysical, geomorphological, and seismological data. They concluded that the tectonic seismotectonic characteristics align more closely with reality.

Paliaga et al. (2019) presented their research on the Parco Casazza landslide dam in the city of Genoa, Italy. The study aimed to explore the interaction between slope instability processes and structural interventions in reducing risks in a densely populated area. They emphasized that discontinuities in human interactions within a geomorphic system, especially following primary hazard reduction, can lead to increased threats associated with urban expansion. The research also highlighted the need for continuous assessment of geomorphic evolution and active processes to determine specific actions and interventions to ensure the stability of landslide dams. Edwards et al. (2019) in their article titled "Applications in Geomorphology" depicted geomorphology as an applied science with the purpose of addressing societal needs. They underscored that geomorphologists are addressing issues related to surface process rates, landscape evolution, and practical applications in areas that have garnered societal attention, such as natural hazards (floods, landslides, earthquakes), land-use planning, risk assessment and mitigation, among others. They view responses to potential hazards, the increase in risk due to vulnerability, and the improvement of preparedness and response as equally important as the medical sciences in social sciences.

Norouzi and colleagues (2013) conducted an analysis and assessment of multi-hazard risks (floods and earthquakes) for buildings in Zone 20 of Tehran city. Considering a useful lifespan of 50 years, they evaluated the structures at different levels based on these hazards and their associated probabilities. Negaresh and Yari (2013) delved into a research study analyzing environmental and natural disaster risk management in Lorestan province using the SWOT technique. The results of this study revealed that risks in the form of weaknesses and threats exist in the province. However, by proper planning and effective crisis risk management, these threats arising from hazards can be reduced. Najafi and Rahnama (2014) stated in their article that geomorphological features and the risks associated with them not only affect the distribution or concentration of human activities but also play a significant role in shaping the structure and appearance of cities, influencing their physical development. In this study, a descriptive-analytical approach was used, involving library research and field observations, an examination of topographic and geological maps of the study area, and the use of Google Earth imagery. The research focused on investigating the most significant geomorphological constraints and risks in the development of the city of Ilam. The results showed that the physical expansion of the city has encroached into the surrounding floodplains and is moving towards the mountains. The development of Ilam city, along with the establishment of residential units in these areas, has led to increased construction costs and the emergence of geomorphological hazards such as slope movements and floods.

Abedini and colleagues (2015) found that the physical expansion of Kosar (Givi) city occurred without consideration of natural constraints and associated geomorphological risks. Their goal in this article was to determine suitable locations for the future development of Kosar city. To achieve this, they used Geographic Information System (GIS) to collect and analyze data, including slope, lithology, faults, landslides, and elevation layers, with expert opinions assigned weights. The results indicated that the city's expansion towards the south, east, and northeast was highly unsuitable and posed serious geomorphological challenges. Therefore, according to the zoning of physical development in Kosar city, it is reasonable to limit expansion to the northwest, as this direction can mitigate the city's threatening problems and hazards. Habibi and Gharibreza (2015) assessed the flood risk potential in the Genaveh Shoor river basin using the TOPSIS model. Their aim was to identify at-risk settlements. The results, combined with field observations and documentary evidence, showed that 30 settlements in the northern and downstream part of the river basin are located in tectonic depressions and slope failure zones, with two levels of risk: very high-risk and high-risk.

Afrakhteh (2015) demonstrated through a research study using the Q-method that four interrelated factors, including speculative real estate activities, land and housing commodification, urban space management, and control of natural resources, have led to a weak productive economy. As a result, urban and peri-urban construction has transformed into a profitable and attractive profession. Builders are seeking profits by converting various land uses, such as parks, green spaces, natural resources, riverbanks, and mountains, into quasi-legal construction spaces, thus creating an environment conducive to heightened environmental risks. Najafi and colleagues (2016) in their article titled "Environmental Challenges and Constraints on Sustainable Urban Development (Case Study: Tehran Megalopolis)" investigated the environmental risks and geomorphological constraints of Tehran city. They concluded that due to the presence of faults and tectonic activities in the study area, the city is susceptible to earthquakes. Additionally, the possibility of floods and waterlogging exists due to the location of river basins within the city and topographic factors. Instability of slopes, particularly in the mountainous regions of the city, and subsidence in southern areas are among other environmental risks in the region.

Abbasi and colleagues (2017) conducted research to classify and identify high-risk geomorphological zones in urban areas of Lorestan province. In this study, influential factors related to earthquake, flood, landslides, and erosion were considered. These factors were combined to create a geomorphological risk map using spatial analysis in GIS and analytic hierarchy process (AHP) models. The results indicated that most cities in Lorestan province are at risk of flooding due to major rivers passing through urban areas. Furthermore, it was found that cities in the western part of the province are susceptible to flooding, while cities in the eastern part are at risk of earthquakes and geomorphological events caused by earthquakes, such as landslides and erosion. Karami (2015) examined the geomorphological hazards along the Esfarayen-Bojnourd corridor in his thesis. Using fuzzy models and AHP, the study evaluated the risk of landslides and floods in the study area. The final results showed that the central part of the region had the highest risk of landslides, while the lowest landslide risk was associated with the northern and southern parts. The flood hazard zoning map revealed that the highest flood risk was concentrated in the northern and northwestern regions, while the lowest flood risk was found in central areas.

Khodadadi and colleagues (2019) conducted a study on geomorphological hazards (landslides and floods) in Alborz province. In this research, a combined VIKOR-AHP model was used to prepare a landslide hazard zonation map, and a relative frequency ratio (FR) model was employed to prepare a flood hazard zonation map. A composite hazard map for the province was then created using a Fuzzy model. The final results indicated that each of these hazards covers a significant portion of the province's area. Specifically, 33.09% of the province's surface is categorized as high landslide risk, and 21.21% falls under the medium flood risk zone. The identification and zonation of areas with the potential for these hazards are of great importance for risk management and disaster preparedness.

Conclusion

No part of this planet is immune to hazards, especially natural hazards like floods and earthquakes. Hazards are an inherent part of life, and they can disrupt the normal course of society, hindering the community's ability to cope with their consequences. Alexander emphasized the most significant characteristic of urban hazards as the abrupt and severe disruption of the natural course of life, resulting in adverse human impacts, including death, physical and mental injuries, diseases, and significant damage to social, economic, and infrastructural structures. When natural hazards affect cities, they can have catastrophic consequences. Recent examples include the displacement of tens of thousands of Americans during Hurricane Katrina on August 29, 2005, in New Orleans, with the extensive destruction of 80% of schools, hospitals, and factories. Additionally, the massive destruction and loss of life due to the earthquake on May 12, 2008, in Sichuan, China, and the tragic loss of around a quarter of Haiti's population in the city of Port-au-Prince due to the earthquake on January 12, 2010. Natural hazards in urban environments can be physical, climatic, biological, or chemical in nature, and often they occur in combination with human-induced hazards. For instance, extreme weather conditions, such as heatwaves, exacerbate the negative impacts of urban air pollution. The destruction of the urban environment by flooding is another example in which natural hazards lead to increased pollution of surface and groundwater from sewage and surface runoff. Therefore, when considering natural hazards in urban environments, it is essential to take into account the additional effects of the interaction between human activities and natural forces.

Due to human activities in the past, both small and large cities have been built. However, the number of these cities and humanity's ability to alter the natural landscape are continually increasing. Urban expansion and development provide opportunities for geomorphological influences on urban affairs. Moreover, as the population grows and, in turn, the available land and space become scarcer, the pressure on the remaining space intensifies. Looking towards the future, it becomes increasingly evident that if we do not take calculated action and continue on our current trajectory, there may be detrimental environmental and economic consequences in urban environments. This complex set of factors, coupled with greater insight and understanding of the land and space, has led to increased awareness and interest in urban environmental issues. The way we interact with urban land is still highly diverse, with most discussions revolving around economic and architectural topics, as well as the demand for land. Nevertheless, incorporating geomorphological values into land use and project assessment is becoming increasingly essential. Some believe that cities play a role in geomorphological phenomena and argue that one of the fundamental aspects of urban studies is paying attention to geomorphological issues. Furthermore, some argue that one of the fundamental tasks of geomorphology is to address urban issues and that the scope of geomorphological studies is also dedicated to human processes. In general, geomorphologists should collaborate and engage with government and non-governmental entities, companies, and institutions that have decision-making authority in urban affairs and may impact the landscape, topography, materials, and processes that encompass it.

On the other hand, it is essential to implement comprehensive management in order to safeguard critical assets against natural disasters. Comprehensive management refers to taking measures and carrying out activities aimed at prevention, control, and recovery of damages caused by natural disasters. The presence of a unified management system for planning related activities, assigning responsibilities and duties to various central, regional, and local organizations and entities is crucial for effective natural disaster management. Furthermore, proper management in each case can lead to a reduction in losses and damages. Natural hazard management, such as earthquake, flood, and landslides, can significantly mitigate the adverse effects of these events, resulting in tangible benefits.

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