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LINKING THE SOCIAL ECOLOGICAL SYSTEMS FRAMEWORK IN ADVANCING HUMAN SECURITY AND RESILIENCE TO FLOOD HAZARDS IN PAKISTAN

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Abstract
For the past couple of decades, flood hazards in Pakistan have been increasing in intensity, frequency, scale, and impact, predominantly driven by climate change induced Monsoon rainfall and glacial melt fed Indus River. Furthermore, persistent governance deficits and grave environmental degradation exacerbate flood vulnerabilities in the country. The floods impact human security across all dimensions: personal, economic, food, health, community, political, and environmental. This study contends that flood susceptibility in the country is a compounding product of mutually reinforcing social and environmental systems failure, and should be addressed by integrating both systems as a unified system. Treating the flooding events in the country not as isolated hydrological/natural disasters but as the manifestation of the intersection of global climatic extremes and social and environmental system failure, the study employs the Social Ecological Systems (SES) Framework. Through the SES vision, this study aims to assess how social systems- anthropogenic attributes and governance structure in Pakistan interact with ecological systems and environmental systems to increase or decrease flood threats. To this end, the study has employed a qualitative research approach and descriptive analytical methods. The critical analysis has framed how social and governance breakdown and weak institutional response have produced a split in resilience based flood management in the country. The study argues that social and environmental systems in the country should be absorptive and strengthened enough to withstand such disasters while overcoming all the disturbances without compromising the previous status. The study critiques anthropogenic adverse tendencies along with the governance shortcomings, and calls for a resilience based flood management in Pakistan to protect human security. The research has provided thoughtful insights for a broader understanding of flood disaster reconceptualization with the SES framework's principles of absorptive, adaptive, and transformative.

***Keywords*:** Social-Ecological System, Flood Hazards, Human Security, Resilience, Environmental Degradation, Global Climate Change

Introduction

From the primaeval traces of human existence on Earth, social and ecological systems have evolved as intertwined, interrelated, interinfluencing, and interdependent systems. The coupled systems exhibit incalculable interlinked dynamics and dimensions of human life. The SES framework posits that the kin linkages between humans and environmental systems can be leveraged to address the challenges that threaten both (Ostrom, 2009), such as climate change-driven flood hazards. However, an underexplored conceptual gap remains among existing scholarship in integrating the SES paradigm and resilience theory to secure human security against flood hazards in Pakistan.

The lexical proximity of the words 'ecological' and 'environmental' denotes inherent intertwining and often overlaps. In a deeper vision, the ecological system is part of broader environmental systems. For the sake of this study, the 'Social-Ecological Systems' (SES) has been expanded to 'Social-Environmental Systems' (SES). The ecological system basically reflects only the relational dynamics among environmental elements. The environmental system encompasses a broader spectrum, including all conditions, impact pathways, cyclic processes, and governance of all environmental elements.

Anthropogenic climate volatility, rising temperatures, monsoonal variability, and rapid glacial retreat are unequivocally posing high flood risks to lowland plains such as Pakistan. The country, being situated in the lower Indus Basin, is highly susceptible to climate linked monsoonal floods (Hamidi, Ford, Novo, Paavola, & Malik, 2026). The monsoon dynamics are mostly responsible for catastrophic floods in Pakistan (Otto, et al., 2022). The country is not

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only ranked among the most climate vulnerable globally but is also considered the least prepared for such disasters.

Since its inception, the country has survived 30 super floods, while the floods of 2010 and 2022 have been recorded as the most disastrous floods (FFC-Pakistan, 2025). Due to the 2022 floods, the country was ranked as highly susceptible and the most climate vulnerable globally (GermanWatch, 2025). Rising temperatures accelerate glacial melting and amplify monsoonal extremes, leaving millions exposed to floods (IPCC, 2021). Generally, the excessive flow of river water, with additional water generated by the monsoonal regimes, triggers floods in South Punjab, Baluchistan, Khyber Pakhtunkhwa (KP), and Sindh provinces. (Ali, 2019; NDMA, 2024).

The floods impact human security in multiple ways. The floods of 2022, reinforcing Pakistan's position among the countries most gravely and repeatedly impacted by floods globally, affected 33 million people, resulted in around 1700 fatalities, and caused economic loss of USD 30 to 40 billion (FFC, 2023; NASA, 2022). Millions of acres of agricultural land (mostly cash crops such as rice and cotton) were destroyed, roughly 4.8 million acres in Sindh and 2.7 million acres in Punjab, producing food insecurity and raising inflation, which immediately exceeded 28.3%, the highest in the last 49 years (FAO, 2023).

Approximately 9.1 million people were immediately pushed below the poverty line, the national poverty ratio increased by 3.7 to 4.0 %, and around 8 million people were displaced (MPDSI-Pakistan, 2022; WBG, 2024). Loss of basic income support and livelihood, due to loss of agricultural lands and livestock, crucially impacted economic security (Gallup, 2022). The population got trapped in vicious cyclical vulnerability traps, such as displaced individuals and slum dwellers having no adequate shelter from the government, who settled on the outskirts of cities, which are often built on river catchments or other flood-prone areas.

The devastation caused by the 2022 floods led to food and clean water insecurity across the country. Around 8,453,800 people were identified in the crisis phase of food insecurity, and around 2,067,400 in the emergency phase (IPC, 2023). Approximately 20.6 million people in Pakistan, including 9.6 million children, were found in critical need of food and other humanitarian assistance after the devastating 2022 floods. It was estimated that around 542,842 children were identified with acute malnutrition (240,008 boys and 302,834 girls) (UNCEF-Pakistan, 2023).

The floods cause loss of infrastructure, homes, workplaces, education systems, and health facilitating systems across the country. The 2022 floods destroyed 27,000 schools (UNICEF-Pakistan, 2022). The schools that survived the floods were transformed into relief camps; thus, for months, millions of children were left without education. The floods in the country produced acute health insecurity; as in the 2010 floods, more than 37 million medical consultations were reported within one year after the floods, for malaria, acute diarrhea, acute respiratory infection, and skin and eye diseases (Ministry of Health, 2012). The marginalized segments of society, like women and children without health facilities, particularly the women who need maternity health care, suffered most (Chakor, 2022; MPDSI-Pakistan, 2022).

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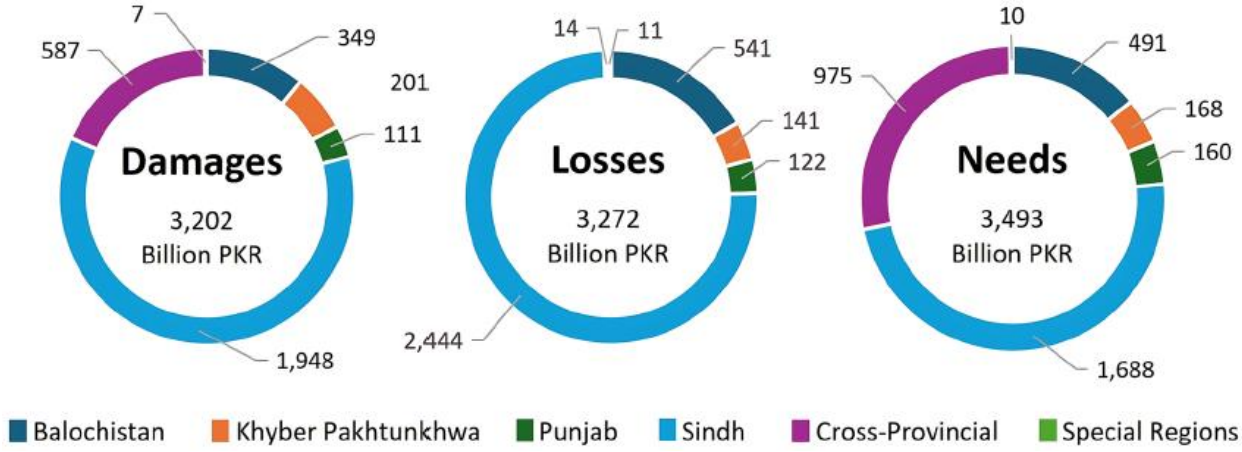


Figure 1. Damages, loss, and Needs Assessment of 2022 Floods.

Note. Adopted from 'Rethinking flood resilience: systemic risk, governance failures, and the social production of vulnerability in the Himalayan–Indus region' by (Hamidi, Ford, Novo, Paavola, & Malik, 2026)

As Figure 1 shows, the country sustained cumulative damages of PKR 3,202 billion and needed PKR 3,493 billion for recovery from the 2022 floods. The country's disaster risk management failed to prevent flood vulnerabilities due to insufficient hydrological measures (dams, barrages, floodwalls, embankments), social system lapses (governance failure and institutional neglect, deep rooted inequality), and environmental degradation (rampant deforestation and rapidly expanding urbanization). In the present study, the system diagnosis is based on the SES model as presented by Ostrom (Ostrom, 2009).

Theoretical Approach

In the present study, which integrates social and environmental perspectives, it is not a matter of preferring one lens over the other. It requires a compact blend of both. In this regard, resilience theory has been carefully applied with SES framework to investigate the socio-governance and environmental systems shortfalls behind floods driven human security challenges in Pakistan. Human security is a bidirectional approach, while resilience is a system-oriented approach.

Table 1. The Essential Elements of Human Security

Serial No.	The Concepts	The Orientations of Concepts
1.	The Safeguards	Human Security provides safeguards by: 1. Identification (of critical pervasive threats), 2. Prevention (so that the risks do not occur), 3. Mitigation (so that if risks occur, the damage is limited), 4. Response (so that victims or chronic poor survive with dignity and maintain their livelihoods) 5. By predictable side-effects that threaten human security.
2.	The Vital Core	Human security is: 1. A rudimentary but multidimensional set of human freedoms and human rights that are based in practical reason. 2. To ensure the freedom from fear and the freedom from want.

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		3. To be specified by appropriate procedures in the relevant context.
3.	Protect all human Lives from	Human Security approach is "People-centered"- that mainly focuses on individuals and their communities. It is universal and non-discriminatory approach.
4.	Critical and Pervasive threats	1. Pervasive threats include large-scale, recurrent dangers and threats such as floods, famine, earthquakes, genocide, and civil war. 2. The threats cause indirect loss, such as financial collapse.
5.	Long Term Human Fulfilment	Human Security is sufficient for human fulfilment. Human security-based processes should be long term, consistent and should remain ongoing with participation and development.

Note. Adopted from 'A Conceptual Framework for Human Security' by Sabina Alkire (Alkire, 2003).

Table 1. Shows the basic traits of the human security approach. The Human Development Report (HDR) has guided through pivotal security concerns (UN-HDR, 1994). As for 'Economic Security ', the HDR has suggested that every human being should be economically secure and must have an assured basic income, which they may generate from any productive or remunerative work. Food Security requires sufficient food for every human being so they can access it, not only economically but also physically, at all times. The domain of health security demands the availability of adequate healthcare facilities and the protection of people from poor nutrition. Due to floods, the affected population suffers from waterborne diseases (Typhoid, Cholera, Diarrhea, and Hepatitis A & E), vector-borne diseases (Dengue and Malaria), encephalitis, Tetanus, Acute Flaccid Paralysis, Viral Hemorrhagic Fever, and Diphtheria (Shabir, 2010).

Environmental security goals of human security laud about 'Healthy Physical Environment' for every human being. Personal security necessitates security for every person in their daily life. It is about having freedom from fear and freedom from want, and to live in dignity. Community security presupposes that an individual derives security from family, group, community, and organization. Community security emphasizes the strength, security, and protection of its members in all situations. UNDP has associated political security with human rights.

The inauguration of resilience theory is the contribution of 'Crawford Stanley Holling', a US-Canadian ecologist, in the field of ecology, originally applied to couple human and environmental systems (Berkes, 2007). Resilience talks about the level of persistence of a system along with its capacity to withstand and absorb sudden change or disturbance while maintaining the same status and functions (Holling C. S., 1973). Since its emergence, the resilience approach has been used to manifest 'elasticity' in the sense of how a rubber band bounces back to its original shape after being stretched. Resilience theory emphasizes the capacity of a system (human-environment) to absorb a shock or the magnitude of disturbance a system can absorb, right before a system loses and changes its previous structure (Holling C. S., 1995).

Integration of Social and Environmental System (SES) Framework

The SES Model, though it originated in the discipline of ecology, has been widely used among various disciplines due to its basic argument that social (humans) and ecological (environmental) systems are inextricably interlocked, thus should not be treated separately and cannot be delineated (Berkes & Folke, 1998; Holling C. S., 1973; Walker, Holling, & Carpenter, 2004) . The non-linear SES approach asserts that both systems also share reciprocal feedback (Berkes, colding, & Folke, 2003). The anthropogenic adverse infiltrations into the

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environment, global climate change, and consequential hazards have made it obvious that environmental disaster can no longer be assessed without broader dynamic approaches like the SES Framework (Liu, Dhugar, S., Bhandari, D., Keating, A., & Mechler, R., 2015) .

A significant number of studies have operationalized the SES model to explain climate-induced disasters, as well as the adaptation and resilience of governance systems, risk reduction policies, and policy implementation (Hutagalung, Yulianto, & Rosalia, 2025). A recent study, by introducing the 'Ecological Resilience Index', investigated the resilience capacity of the Gulf of Oman and the Persian Gulf by investigating indicators such as social, ecological, economic, climatic, geological, hydrological, and maritime (Ghulami, Frazier, Hydari, Danekar, & Kamari, 2026).

Whereas earlier the SES approach was confined to theory development and policy making. The Resilience Alliance workshops (2003/2004), through analysis of 15 case studies, concluded that human social, economic, and cultural systems share reciprocal impacts on environmental systems. Whereas the impacted ecological system, in response, impacts humans (Brian H. Walker, 2006). However, less attention is devoted to utilizing the SES model as an analytical tool to investigate the social attributes and environmental factors to enhance flood resilience in Pakistan.

The approach of human security demands security of individuals in their daily lives, i.e., in their homes, at their jobs, in their communities, as well as within the environment. In fact, the novel approach reoriented the security perspective from state oriented security to people centric security (UN-HDR, 1994). By promoting the agenda of prevention from disaster, disease, and hunger, the approach urges securing humans in economic, personal, food, health, community, political and environmental like cross sectional domains((CRED), 2025; GEF, 1991; Shahrbanou Tadjbakhsh, 2007; Swati Tyagi, 2014; UN-HDR, 1994).

The seminal contribution of Mr. Mahbub-ul-Haq (Haq, 1995) , through HDR, soon received global acceptance (Baru, 1998). Some pragmatic scholars have directly utilized the human security to assess climate induced disasters like floods (Mumtaz, Zahid, & Hatim, 2025; Abdur Rahim Hamidi, 2022; Altaf, 2020; Christopher Hobson, 2014; UNTFHS, 2016; Muhammad Ibrahim, 2024).

Resilience is about the measurement of the persistence of systems and their ability to absorb a shock or disturbance while maintaining the basic structure (Holling C. S., 1973). The resilience approach emerged to address climate induced disasters (Borquez, Aldunce, & Adler, 2017). In a recent study, by combining the knowledge and analysis from 2396 climate change related publications, 1228 disaster risk reduction publications, and 989 climate-induced disaster risk publications, a consensus was developed which claims that through adaptive governance systems and nature based transformations of social and ecological systems, climate change resilience can be developed (Qi, Leng, & Yuan, 2025). The SES analytical model has potential attributes to describe scientific perspectives of environmental studies, as well as the social dimensions of social systems (Ostrom, 2009). Three pivotal attributes of SES-absorptivity, adaptability, and transformability by Holling have been deployed to delve deeper into the inquiry (Walker, Hooling, & Carpenter, 2004).

The Absorptive rule of SES has been operationalized to assess the strengths and weaknesses of social systems by investigating the attributes of flood exposed populations and shortcoming in governance systems. The Absorptive rule helped evaluate the social system to what extent and how social and environmental systems absorb shocks like floods and keep functioning, without compromising the essential functions.

The 'Adaptability' principle is concerned with the role of actors, i.e., the humans who interact with the environment in both ways, auspiciously or adversely. The 'Transformability' principle of SES is about establishing new systems when previous social and environmental

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systems fail to absorb and adapt to disturbances, by introducing new mechanisms and measures in existing systems.

In pursuit of investigating the social and environmental factors behind flood hazards in Pakistan, the application of the 'Social-Environmental System' (SES) is indispensable. Thus, the SES model, along with resilience theory, has converged on addressing hazards such as floods.

Towards the System Diagnosis

By applying the 'absorptive' principle, it has been assessed that social and environmental systems in the country repeatedly fail to absorb shocks like floods and hardly bounce back to their earlier functions. Despite experiencing frequent and acute flooding and looming human insecurities, the country is unable to introduce and implement adaptive management measures, as the 'adaptive' rule says that after becoming aware of a system failure, the system should have some adaptive management, like policies should be transformed after learning shock impacts (Holling C. S., 1978). It is about 'Self-Regulation' of a system after experiencing a disturbance and learning adaptability. Adaptability is about the capability of actors of social, governance, and environmental systems to influence and manage the resilience of social and environmental systems. While aligning with the SES approach's adaptability rule, the present study has focused on the following strategies to cope with flood disasters (Walker, Holling, & Carpenter, 2004).

1. Actors (governmental structures and communities) can move away from disturbances (e.g., floods) and thresholds by moving closer to the system's current state (by altering the system).
2. In another way, the actors can move the current state of the system closer to a threshold.
3. The actors can make the threshold easier or more difficult to be reached by the system
4. Finally, the actors can organize and manage the cross-scale interactions impacting the system to avoid loss of resilience, at mostly social catastrophic scales.

In Pakistan, the actors are neither equipped nor prepared to move the social and environmental systems away from flood shocks, and also fail to make thresholds easy and tolerable with the help of an early warning system and early evacuation of people. Finally, they are also helpless to prevent the intersection of multi-scalar flood impacts. For example, loss of a home initiates the vulnerability trap, as displacement leads to inadequate shelter, physical insecurity, food insecurity, health insecurity, and political insecurity. After failure of systems in absorptive and adaptive capacities, the solution is transformation of existing systems with new mechanisms and ways forward. The basic components such as latitude, resistance, precariousness, and Panarchy assist the employment of transformability as follows (Walker, Hooling, & Carpenter, 2004).

1. The latitude and elasticity of a system emphasize the extent to what degree/level the system can be changed before losing its foundational structure. As due to floods, the system breaks down; mostly, the country looks for foreign aid and assistance, having no immediate technology, machinery and funds. Thus, it proves that the systems are weak and have no elasticity. If an impacted/changed system crosses the threshold, its recovery and return to basic structure will be difficult or even impossible.
2. The 'Resistance' capability refers to the degree of ease or difficulty the system endures while changing after a disturbance. The floods of 2022 impacted 33 million people and inundated one-third of the country, shows that the systems in the country are failing to resist flood shocks.
3. The 'Precariousness' capability talks about the distance and margin the system endured before crossing a threshold or tipping point. If the early warning dissemination is on time, the community having minimal early disaster preparedness.

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4. The rule of 'Panarchy' says that because of multi-scalar interactions, a system remains influenced and impacted by a governmental system and other relevant domains at multiple scales.

An examination of the country's flood disaster trajectory through the principles of absorptive, adaptive, and transformative, has revealed a disquieting pattern of escalating intensity, wherein each successive flood hazard compounds, rather than merely repeats, the multidimensional erosion of human security.



Figure 2. The Factors Impeding the Absorptive Capacity of SES in Pakistan
Note. Compiled by the Author

As Figure 2 informs, factors such as institutional inaction, policy implementation gaps, political ruthlessness, and underfunded projects hamper the absorptive capacities of the social system. Global climate volatility, rampant deforestation, monsoon extremes, rapid glacial retreat, and the morphology of the Indus River are degrading the environmental system.



Figure 3. The Factors Obstructing the Adaptive Capacities of SES in Pakistan
Note. Compiled by the Author

Figure 3 shows the factors that governmental authorities, despite witnessing recurrent flood disasters, remain reluctant to combat them by adopting reflexive, anticipatory, institutional accountability measures and modern technologies.

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Figure 4. The Suggestions for Transformation of SES in Pakistan

Note. Adopted by Author

Figure 2 shows suggestions for transforming SES through resilience-based flood management mechanisms, such as sustainable environmental development, afforestation, restoration of the Indus River Basin, effective floodplain zoning, wetland restoration, planned urbanization, and structural development, such as dams, barrages, floodwalls, and embankments.

Deforestation as an Existential Threat to the Environmental System

The anthropogenic tendencies such as clearing, cutting, consuming, burning, and removal of forest trees for settlements, urbanization, agriculture, infrastructure, roads, farming, industrialization, timber logging, energy, fossil fuels, wildlife, hunting, grazing, mining, and experimentation are primary drivers of deforestation in Pakistan. Unfortunately, Pakistan is a 'forest-poor' state, with only 4.72 million hectares; 5.36% of its land area is covered with forests (Pakistan F. S., 2004). Arid and semi-arid climate and the absence of governmental patronage in the country is increasing deforestation (Pakistan F. M., 2009).

The forest consumption ratio has surpassed the forest production ratio. As of 2018, almost 52.6 million cubic meters have been consumed, whereas only 14 million cubic meters have been produced (Saeed, 2003). Moreover, around 68% of the population is directly reliant on firewood for household use, mostly in northern of country (Jabeen, 2019). Illegal logging and timber smuggling between Pakistan and Afghanistan is also causing deforestation in the country (Khalid, 2020). As assessed by the National Forest Reference Emissions Level (FREL), Pakistan has forest cover of around 4.786 million hectares, whereas the only 5.45% forest in country are rapidly degrading (Hussain, 2024).

Cryosphere and River Indus Upper Basin Hydrological Scheme

Indus River upper basin is the most sensitive hydrological system, providing more than 80 percent of total water discharge of the Indus River (Hamidi, Ford, Novo, Paavola, & Malik, 2026). It comprises almost 5000 glaciers, including the Hindu Kush, Himalaya, and Karakoram (Hasan, Hashmi, Ahmed, & Anees , 2025). The glacial retreat at a rapid pace is attributable to anthropogenic global warming, which accelerates the meltwater and increases the Indus River discharge. Shifting climatic changes are manifesting floods and glacial lake outburst GLOfs in the country (Lutz, Immerzeel, Shrestha, & Bierkens, 2014).

The cryosphere degradation driven responsiveness of the Upper Indus Basin presents formidable challenges to Pakistan. The country is structurally dependent on glacial meltwater of upper Indus basin for hydropower generation and the agricultural sector (Wester, Arabinda, Mukherji, & Sharestha, 2019). Thus the failure of this environmental system is not just a hydrological failure but long term impacts and agricultural anomaly.

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Unrelenting and Expanding Urbanization

Modern unplanned urbanization, including informal settlements, inadequate drainage systems, and rapid expansion of housing schemes, has severely eroded the absorptive capacity of social and environmental systems. It is the structural degradation of both systems that the natural buffering capacity of the lithosphere reduces due to the use of concrete-like materials. Densely populated urban societies emit more pollutants into the atmosphere. The consequent warmer temperatures cause extreme monsoons in the country.

Unregulated urbanization across multiple cities in Pakistan directly amplifies flood recurrence. Unplanned and unauthorized housing schemes, particularly near or alongside river basins and natural channels, are not only at high risk of flooding but also reduce the water absorbing capacity of these areas, resulting in extreme inundation. The theoretical claim of SES here proves that humans, as active agents behind these activities, intensify the flood hazard themselves. The profound transformation of the landscape affects multilayered environmental systems, thus increasing the risk of more frequent and more intense flooding events.

Urban expansion also transforms agricultural land and forests into concrete based structures, thus reducing the natural buffers against flood hazards. Besides these environmental impacts, the urban land cover casts a remote, far reaching impact on social systems. The demographic pressure compels the low income and marginalized segments of society to live in high risk housing zones along flood plains or natural drainage channels or streams. This dynamic gives rise to severe complications due to weak regulatory, institutional, and policy implementations in the country.

Uncontrolled and unplanned urban sprawl not only raises threats of urban flooding but also raises multiple governance issues. These factors jointly convert manageable precipitation into recurrent and intense flood hazards in the country. The torrential rainfall spell in Karachi , during the floods of 2022, overwhelmed the city drainage capacity, causing intense floods and the densely populated city (Taseen, Jawed, & Ameen, 2022). The cities of Hyderabad, Sukkur, Jacobabad, Dadu and Thatta remained submerged for several weeks after floods of 2022, where around 8 million people in the province of Sindh were displaced. Almost 2.2 million homes and similar structures were completely destroyed.

Documented as sites of urban and riverine flooding clustering along the Indus floodplain and its tributaries during the 2025 monsoon season, cities like Mandi Bahauddin, Sialkot, Muzaffargarh, Narowal, Gujrat, Sheikhupura, Hafizabad, Rajanpur along Indus flood plains and catchments experienced riverine and urban flooding during Monsoon 2025 (Nazir, Gomathinayagam, Kamran, & Khalid, 2026). Lahore, Quetta, and Rawalpindi have been identified as highly risky urban flooding cities (MPDSI-Pakistan, 2022). The city of Peshawar is frequently facing urban flooding due to rapid urbanization near Bhudni Nullah Basin (BNB) (Ahmad Jan, et al., 2026).

Governance and Institutional Inertia

Structural and institutional inefficiencies constitute major governance fallouts in Pakistan. The federal level body, the National Disaster Management Authority (NDMA), is responsible for disaster response, recovery, mitigation, and adaptation, including flood advisories and inter-agency emergency announcements. The Federal Flood Commission (FFC) has to implement and coordinate 'National Flood Protection Plans'. In addition to providing technical flood control strategies, FFC issues guidance on managing floodwater in dams, barrages, and canals. Both of these agencies often overlap with Water and Power Development Authority WAPDA's infrastructure schemes; three of these, with the same task of flood management but with distinct mandates and functional diameters, fail to prevent floods and consequential vulnerabilities.

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The National Water Policy (NWP) 2018, approved by the Ministry of Water Resources, and the National Climate Change Policy (NCCP) 2021, approved by the Ministry of Climate Change, lack cross references with each other. In contrast, both are responsible for policy framing and implementation in the climate change and flood water management nexus. During flooding, the Indus River System Authority (IRSA), which is associated with the sharing of water per province, is also responsible for sharing flood water; this policy contradicts the functions of WAPDA, which is associated with the management of water reservoirs like dams for hydropower and irrigation in the country.

The Pakistan Meteorological Department (PMD), along with the Flood Forecasting Division (FFD), is responsible for issuing early warnings about upcoming flooding. Due to institutional communication inconsistencies, information is transmitted on a priority basis to NDMA and PDMAs, while it can also be transmitted simultaneously to the flood-exposed population. The situation makes safe early evacuation impossible. Pakistan, as a lower-riparian state, frequently faces upstream flood threats due to excessive cross border water flows. Thus, the geopolitical rifts between India and Pakistan lead not only to artificial floods but also to minimal water sharing during flooding events.

Critically, despite the establishment of above mentioned authorities along with Provincial Disaster Management Authorities PDMAs, Provincial Irrigation Departments (PIDs), Provincial Irrigation and Drainage Authorities (PIDAs), and Provincial Environmental Protection Agencies (EPAs), why the population does suffer during and after flooding events in the country?

The study, by investigating the governance shortcomings among these agencies, has identified fatal flaws and factors such as a lack of intercoordination, inconsistent and overlapping policies, weak implementation, a lack of dedicated commitment, short term policy thinking, an under resourced institutional response, and avoidance of modern techniques. Institutional fragmentation constitutes structural ineffectiveness among various flood management agencies, with often overlapping tasks and functions.

Through the analytical architecture of SES, the study asserts that efficient flood water governance in the country is hampered by an acute lack of clarity in institutional tasks, unnecessary post allocations to ineligible persons, contested functional attributes between federal and provincial authorities, short-term, less practical, weak policy implementations, and minimal resource allocation for climatic and environmental challenges.

The study suggests a substantial share for environmental protection in the national annual budget. Whereas, according to section 9 of the Punjab Environmental Protection Act, 1997, for the prevention of adverse climatic and environmental impacts, the provincial EPAs have only the option to receive aid and donations not only from the government of Pakistan but also from any foreign government. A pretty unpleasant situation arises in the country, where larger amounts are being allocated in the national budget to almost all major departments. Still, no funds are being allocated for flood resilience and environmental issues (PEPA, 1997, s 9).

Taking into account the recent governmental initiatives to combat flood hazards, including the ‘Living Indus Initiative’ for environmental sustainability of the Indus River Basin (UN-SDG, 2023) and ‘Recharge Pakistan’ for resilience-based flood management (WWF, 2024). With the mission to decarbonize the country, the government in 2020 projected the ‘Ten Billion Tree Tsunami Forestation Initiative’; by 2030, the goal was set to transform 60% of the country’s energy resources to ‘clean and renewable energy ’ resources (MoCC, 2021). Whereas these projects are heavily donor-dependent, co-led by international organizations, and subject to political will.

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Critical Analysis and Concluding Synthesis

Pakistan's susceptibility to acute and recurrent flooding is not merely a manifestation of global climate change; rather, it is symptomatic of the cumulative failure of governmental, social, and environmental systems. A flood may be a trigger, but these are capacities of systems that determine whether the trigger may become a disaster or may be absorbed by the systems. As the preceding discussion has argued, the floods in Pakistan are not mere hazards but, in part, become disasters due to social and environmental systems failure. The highly dense population with pre-existing poverty, trapped in inflation like economic strangulation with minimal access to life accommodations, hardly survives the flood vulnerabilities. Despite witnessing historic, recurrent, and frequent floods, the governance structure fails to adapt and transform for resilience based flood management. Thus, the erosion of human security is a foregone conclusion in this context.

Several pieces of evidence from national and international sources categorically substantiate this argument. The flood of 2022 rendered the country among the most climate vulnerable globally, despite contributing less than 1% of GHG emissions. The flood hazards do not directly impact human security; rather, they do so by causing the loss of homes, livelihoods, infrastructure, agricultural lands, displacement, food scarcity, health disorders, post-disaster mental trauma, community network collapses, environmental deterioration, and political issues. Beyond the apparent and immediate loss, the flooding events cast far-reaching socio-economic and governance crises.

Critically, the flooding catastrophe in the country is exacerbated by demonstrable administrative and institutional lapses. The findings have indicated that institutional inaction and political ruthlessness are major factors. Besides this the institutional misalignment, weak coordination, underfunded developmental projects, hoarding of humanitarian aid, regulatory and policy implementation gaps, maladministration, policy short termism, embezzlement of relief funds, the entrenched power relationships, institutional overlapping mandates, insufficient hydrological measures (dams, barrages, canals, embankments, flood walls), and environmental degradation (deforestation and unplanned urbanization) have transformed flood hazard a full scale challenge to human security.

Due to weak inter institutional coordination, the early warning system fails to disseminate information in advance of floods. Alongside socio-governance failure, environmental contributors such as rampant deforestation and rapidly expanding urbanization, climate change induced erratic monsoons, and accelerated glacial retreat make flooding events in the country a critical threat to human security.

System diagnosis has revealed that the social and environmental systems in Pakistan are not absorptive and robust enough to withstand flood hazards and bounce back to their original state while maintaining their earlier performance. Despite experiencing frequent flooding, the authorities remain reluctant to introduce adaptation protocols based on modern technologies. Besides determining the loss and damage, the institutions never focused on shifting to adaptive and community defined flood management measures. With outdated hydrological infrastructure and persistent institutional inertia, the country fails to overcome flood related shocks in a timely and adequate manner. Moreover, the colonial legacy oriented systems restrain innovative technological advancement and modern adaptive mechanisms.

The floods deepen the existing miseries of communities, producing inequalities, eroding livelihoods, and weakening trust in governmental systems, especially when recovery measures are unjust, inadequate, and slow. Most of the time, the flood affected communities remain politically sidelined and underfunded. The country's disaster response architecture often activates only after a flood has occurred, whereas it should be prepared in every monsoon spell with early preparedness protocols. Furthermore, the political instability and documented

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corruption across every department augment the flood challenges. Due to governance deficits and weak policy implementation, there is a persistent failure to prevent encroachments near and along river catchments, which are the most flood prone regions in the country.

For flood resilience, just and innovative environmentally grounded flood governance in the country, social learning, community level preparedness, determination to transform vulnerability into adaptive capability, institutional accountability and coherence, clarification of goals among institutions, and reflexive and anticipatory governance are suggested.

The analysis culminates with suggestions that, in Pakistan, flood resilience can be upgraded through adopting the following environmentally sustainable mechanisms: afforestation, restoration of Indus flood plains, natural wetland restoration, flood water diversion for crop harvesting, seasonal flood water wells, tanks, lakes, diversion of floodwater into recharge wells or basins to replenish the ground water through 'Managed Aquifer Recharge (MAR) technique, construction of multipurpose dams, and rejuvenating the community based traditional flood management techniques.

Through floodwater recycling, and by consuming, storing, and utilizing the floodwater in flood wells, tanks, and underground reservoirs, the blamable water source can be transformed into a source of hydro energy production, used for agricultural needs, ecosystem restoration, and groundwater recharge. By converting to nature based solutions like green and renewable energy resources, mangrove restoration, tree corridors along the River Indus, and climate resistant agriculture, construction of multipurpose barrages along with other seasonal water reservoirs, adaptive Indus River basin management, timely dissemination of early warning information, efficient floodplain zoning, and other measures for governance system, flood resilience in the country can be enhanced.

In summation, the rainwater/floodwater can be utilized as a water security asset. Through floodwater diversion schemes, the flood influxes can be consumed for crop harvesting. By chemical water purification techniques, the flood water can be recycled and used as clean/fresh water. The dams, and water reservoirs are needed to be with high storage capacity. An improved drainage system would prevent flooding in the urban areas. By controlling deforestation, restricting unplanned urbanization, and shifting to clean energy the environmental degradation can be mitigated. By adopting sustainable practices, the cyclic processes of climate volatility and hydrological extremes, intense monsoons, rapid glacial retreat, and consequent floods can be prevented. Without efficient and willing political patronage, the disconnected and under resourced institutions are in vain. The floods challenges should have been declared a national level threat and warranted as emergency level response from all bodies.

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