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Explicating the Causes of Frequent Floods in Pakistan: A Structural Modeling and Analysis

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Abstract
Aim of study is explicating the causes of frequent floods in Pakistan. Overall design of the study comprises of relevant literature review, primary data collection and structural modelling & analysis of the phenomena. The method of modelling is ISM (Interpretive Structural Modeling) and method of analysis is MICMAC (cross impact matrix multiplication applied to classification). The population under study comprises the folk stakeholders of the phenomenon. The sampling design is purposive (i.e. a focus group consisting of a panel of experts) and the sample size is eleven experts (a medium-sized panel). Results of modeling show that causes namely: changes in land use, poor waste management, slums along rivers, erosion and sedimentation, improper flood control systems, river physiography, high rainfall, inadequate river capacity, water structures, land subsidence, damage to flood control structures, poor drainage system fall at Level I (the top level), therefore, are least critical. The causes namely: effects of high tides, lack of discipline among people, glacial melt fall at Level II (middle level) therefore are moderate critical. The cause namely: deforestation falls at Level III (the bottom level) therefore is the most critical. The scale-centric MICMAC analysis shows that all the causes are categorized in the linkage quadrant and the independent, dependent, and autonomous quadrants are empty. The data-centric MICMAC analysis shows that the effects of high tides, glacial melt, and deforestation fall in the independent quadrant. The erosion sedimentation and river physiography fall in the dependent quadrant. The changes in land use, poor waste management, improper flood control systems, slums along rivers, high rainfall, land subsidence, inadequate river capacity, water structures, lack of discipline among people, damage to flood control structures, and poor drainage system categorized in the linkage fall in the linkage quadrant, whereas, the autonomous quadrant is empty. The results of MICMAC analysis implicitly corroborate the results of modeling. It is an original valuable study because it is based on first-hand real experimental data collected by authors who have hands on job of data collection for decades. It also uses unique and different methodologies to collect data, perform modeling and analysis. This methodology is simple, unique, and understandable by a wide range of stakeholders. Its results are also logical and realistic that correspond to ground realities.
Keywords: Flood Causes, Pakistan, Interpretive Structural Modeling, MICMAC Analysis

1. Introduction

The floods that threaten lives, destroy belongings, inundate properties and businesses, damage vital infrastructure and prevent access to essential public services are high on the agenda of contemporary research (Amirmoradi & Shokoohi, 2024). Floods are globally considered as on one of the most destructive natural hazards. Magnitude and frequency of destructive floods have increased during the past decades due to climate change which is further escalated by anthropogenic activities in river proximity (Wang et al., 2024; Malik 2022). Floods are brought about by heavy rainfall, melting of glaciers and snow falls (Sun et al., 2024). The slums along rivers, unplanned changes in land use and poor waste management become common causes of intensification of floods. Although the devastations from floods are evident but the economic and human losses in developing countries are worthy of more attention (Abbas et al., 2022; Shah et al., 2022; Patri et al., 2022). Pakistan is significantly impacted by climate change, particularly by heavy rains, and subsequent flooding that has threatened many lives, severe damages to infrastructure, livelihood and belongings (Mahmood et al., 2021). The frequency, duration and intensity of floods is increasing in the country with every passing year due to natural and human-induced factors with more number of people getting affected from floods (Ali et al., 2022; Amirmoradi & Shokoohi, 2024). Floods are caused by the release in large volume of water when the natural dams carrying these glacial lakes break (Taylor et al., 2023; Singh et al., 2023; Zhang et al., 2024; Ahmed et al., 2021; Bazai et al., 2021). Along with the monsoon rainfall, glacial melt and other natural phenomenon, and several human-induced factors have accelerated the pace of floods that often exacerbates the effects of natural causes. Soil erosion, a result of deforestation clogs the streams and rivers, is making them susceptible to overflowing (Toimil et al., 2023). South Asian region particularly Pakistan is susceptible to urban flooding induced by monsoon weather (Manandhar et al., 2023). From mid of July to late August every year, Pakistan experiences monsoon rainfall leaving the several parts of country submerged. The Indus River bursts its banks across thousands of square kilometers while the urban floods are led by intense rainfall (Otto et al., 2023). In addition to monsoon rainfall, rapidly melting glaciers are another cause of floods. As the temperature of earth is rising day by day, the glaciers are melting more rapidly leading to the formation of glacial lakes. Surfaces of buildings and roads infrastructure prevent the water from being absorbed into the ground, consequently resulting into urban flooding (Zia et al., 2023). The most of these studies focus on either a specific cause of floods or a country other than Pakistan and to the best of authors' knowledge, no comprehensive study is found that addresses the multitude causes of floods in Pakistan. Undoubtedly the phenomenon of floods is highly researched area of the world but some very simple but vital issues particularly in the context of developing countries like Pakistan are either not studied or less studies. There many issues that qualify for afresh evaluation. Causes of frequent floods in Pakistan is one of these topic that qualify to be studied thoroughly and afresh. Therefore, the research problem is to explicate and evaluate the causes of frequent floods in Pakistan afresh with some different techniques. Objectives of the study are: i) to explicating the causes of frequent floods in Pakistan, ii) to put them into an order of precedence, iii) to build a theoretical model of underlying relationships among the causes, iv) to analyze and classify the causes for developing framework of dependencies and v) to develop some policy guidelines to circumvent the causes. The research questions that need to be specifically answered include: Which causes of floods that need high priority? Which are the causes of floods that

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relatively attract less important and are in fact driven by other factors? What is the contextual relationship structure for among the causes of floods? To answer these questions wide variety of methodologies are found to be helpful. An Array of methodological choices is considered to achieve the objectives of the study. The choices considered include GRA, DEA, TOPSIS, SWARA, VIKOR, ISM, MICMAC, TISM, Modified-TISM, Polarized-TISM, Fuzzy-ISM/TISM, DEMATEL, Wavelet Analysis, SEM, AHP), ANP, ANN, and MOORA. It is also considered use the methods in combination. ISM in combination with MICMAC is found to be the most appropriate because of its simplicity and ease to apply & understand (Arshad & Mukhtar, 2019; Abbass, et al., 2022; Basit, et al. 2021; Fu, et al. 2022; Niazi, et al. 2021; Niazi, et al. 2023; Qazi, et al. 2020; Qazi, et al. 2022; Qazi, et al., 2019; Niazi, et al., 2021a; Niazi, et al., 2023c). Hence the study uses ISM and MICMAC as mixed methods. Remaining part of the article is arranged as review of literature, methodology, discussion, and conclusion.

2. Literature Review

Since literature review provides the foundation of knowledge on the topic, prevents duplication, and helps to give credit to other researchers, uncovers questions left from other research, verifies justification of further research, the relationship of works in the context of its contribution, and places the research study within the context of existing literature, therefore, it is continually advisable to review the contemporary relevant literature in a bit depth. It is also important that the reviewer should mention the extent of access to literature they have got in fact. Therefore, a survey of contemporary literature has been conducted by way of exploring the renowned research databases of the world to which the Higher Education Commission of Pakistan has provided official access to Higher Education Institutions (i.e. Wiley Online Library, Taylor & Francis Online, Springer Link, Emerald Insight, Elsevier-ScienceDirect, JStor, etc.) through advanced search tab with appropriate filters. The key used for the search includes 'causes of floods in Pakistan' 'causes of floods', 'severity of floods', 'floods in Pakistan', 'issues of floods in Pakistan', 'damages of floods in Pakistan', etc. The search resulted in an influx of research articles that are screened on the basis of relevance. Some relevant studies are reported to set out the very outset of the current research. The studies are in abundance regarding the monsoon flood risks (Zia et al., 2023; Liu et al., 2022), climate change, and floods (Sivakumar & Kumar, 2019; Hirabayashi et al., 2021; Atanga and Tankpa 2021; Adams & Nkoro, 2021; Nanditha et al., 2023; Wang et al., 2024; Dharmarathne et al., 2024; Lan et al., 2024; Ahmad, D & Afzal, 2024; Audi & Al Masri, 2024), relationship of land use patterns with floods (Pal et al., 2022), impacts of deforestation and urbanization on flooding (Jean et al., 2022; Tang et al., 2024), inadequate capacities of rivers and floods (Xia and Chen, 2021), challenges in urban flood control (Arya and Kumar, 2023), connection of land subsidence with floods (Mealli, 2021; Takagi et al., 2021; Bott et al., 2021; Nicholls et al., 2021), impacts and patterns of floods (Merz et al., 2021; Adjasi & Yu, 2021; Muhammad, 2023). The de Azevedo Couto et al., (2023) and Lindersson et al., (2023) emphasized that floods have recently caused havoc and devastations across the globe.

Urbanization, inadequate infrastructure, and climate change are the major factors contributing to the occurrence of floods, the impacts of which are far-reaching and multifaceted. Northeast monsoon and Southwest monsoon are the two monsoon seasons during winters and summers respectively. Extreme weather events such as intense storms, heavy rainfall, and flash flooding occur in these seasons. While other countries in the world plan for disastrous events, the unpredictable acute weather conditions make it difficult for developing countries to respond (Zia et al., 2023). Previously regarded as a natural variation in season, the severity of floods has been accelerated by the human activities (Echendu, 2023). In many regions of the world, the level of urbanization has increased in recent decades but at an accelerated pace in Asia and Africa (Sakib et al., 2023; Rashiq & Prakash 2023; Danegulu et al., 2023; Baig et al., 2024). Unplanned urbanization can result into the changes in land use, consequently leading to floods (Halder & Majed, 2023). Use of lots of concrete and asphalt makes the surface impermeable, where the rainwater instead of being absorbed into the soil flows over the ground. Surface runoff from intense rainfall flows into urban sewage systems or surface waterbodies (Abass, 2022). For the collection and storage of water, drainage systems play a pivotal role in infrastructure. Following the increase in population, urbanization has resulted in the replacement of natural phenomenon of drainage such as infiltration with culverts and pipes. These drainage systems when inadequately maintained, become easily overwhelmed, especially during heavy rains leading to potential flooding (Singh et al., 2023). According to (Shah et al., 2020), Pakistan has encountered extremely disastrous events of floods that hit in the consecutive years of 2010 and 2011 due to environmental degradation like deforestation. This has been majorly due to the lack of discipline among farmers and the use of wood as a source of energy.

The rising temperature of Pakistan is relative to the rate deforestation being carried out in Pakistan (Ullah et al., 2022). While the increase in the flooding is connected to a wide range of atmospheric drivers, one among the often-neglected driver is river physiography. The change in the river conveyance capacity is one of the main causes of variability in the flood intensity (Sofia & Nikolopoulos, 2020). Billions of meter-cubed of water is held into the controlled structures such as dams that require continuous maintenance and monitoring in order to prevent from failures and resulting catastrophes. Damage to this flood control water structure can be highly deadly. Communities downstream can be washed away by the release of reservoir water generating fast-moving currents. Poor management, insufficient spillways, and in adequate slopes are the different technical problems causing damage to these flood control infrastructures (Heidarzadeh & Feizi, 2022). During the 2022 floods, legal force was brought into use to vacate the areas in Pakistan. The fatalities occurred on large scale could have been avoid if the people had discipline and civic sense. It is speculated that illegitimate activities which were against River Protection Ordinance 2002, such as land grabbing around the torrent flow resulted into the incurrence of socio-economic loss. The intensity of havoc after recent floods has shown that the flood control agencies failed to prevent the causes of floods from occurring due to shortcomings in technical capacities (Manzoor et al., 2022). Identifying and explicating the causes of floods is crucial to protect against the devastation. From the critical literature discourse, sixteen major causes of floods are identified as mentioned in Table 1.

Therefore, the study is built on sixteen major causes of frequent floods in Pakistan i.e. changes in land use (1), poor waste management (2), erosion and sedimentation (3), slums along rivers (4), improper flood control systems (5), high rainfall (6), river physiography (7), inadequate river capacity (8), effects of high tides (9), land subsidence (10), water structures (11), damage to flood control structures (12), lack of discipline among people (13), glacial melt (14), poor drainage system (15), and deforestation (16).

Table 1: List of Causes of Floods

Code	Issues Arising out of Floods	Source
1	Changes in land use	(Abass, 2022)
2	Poor waste management	(Echendu, 2023)
3	Erosion and sedimentation	(Toimil et al., 2023)
4	Slums along rivers	(Manzoor et al., 2022)
5	Improper flood control systems	(Manzoor et al., 2022)
6	High rainfall	(Otto et al., 2023; Shehzad, 2023)
7	River physiography	(Sofia & Nikolopoulos, 2020).
8	Inadequate river capacity	(Sofia & Nikolopoulos, 2020)
9	Effects of high tides	(Piecuch et al., 2022; Nicholls et al., 2021)
10	Land subsidence	(Takagi et al., 2021; Bott et al., 2021)
11	Water structures	(Shehzad 2023; Hussain & Khan, 2024)
12	Damage to flood control structures	(Heidarzadeh & Feizi, 2022)
13	Lack of discipline among people	(Manzoor et al., 2022)
14	Glacial melt	(Aslam et al., 2022; Wang et al., 2024)
15	Poor drainage system	(Singh et al., 2023).
16	Deforestation	(Ullah et al., 2022)

3. Methodology

The study follows the qualitative paradigm of research and interpretivism as the research philosophy research approach is inductive by design. Overall design of the study comprises of review of relevant literature, primary data collection and structural modelling & analysis of the phenomena (Niazi, et al., 2020a; Niazi, et al., 2020b; Farid, et al. 2023). The population under study comprises the folk of stakeholders of the phenomenon. To be exact population includes social beneficiary groups affected by floods, non-social beneficiary groups affected by floods, socially adversely affected groups affected by floods, and non-social adversely affected groups affected by floods (i.e. policymakers, planners, project executors, plethora of departments and ministries viz planning and development department, housing and town planning department, environmental protection agencies, revenue authorities, forest and wildlife departments, water and power development authorities, canals, rivers and lakes management departments etc.), regulators, local government and other employees, industry representatives, landowners, farmers (who have lost their crops), general public (including households, local communities, village committees community workers local labor, disabled people, minorities, senior citizens and women), scientific community and others contributors to system, institutions engaged in disaster management, international donor agencies, academia, politicians & political parties, flood-prone communities, NGOs, volunteers, regional institutions, media, suppliers, of goods & material, civil organizations, private institutions and other affected, interested or vulnerable groups. The sampling design is purposive (i.e. a focus group consisting of a panel of experts) and the sample size is eleven experts (a medium-sized panel) (Qazi, et al., 2023a; Qazi, Niazi, & Basit, 2020; Niazi, Qazi, & Basit, 2019). The focus group that best represents the population is constituted by the authors by setting as criteria according to the norms of the ISM studies (Tariq, et al. 2023; Shaukat, et al., 2023; Qazi, et al., 2023). A panel of experts of eleven experts is constituted on the basis of predetermined criteria (Basit, et al., 2019; Basit, Qazi, & Niazi, 2020; Niazi, et al., 2020). The data has been elicited from the minds of the experts using VAXO based classical type of $n(n-1)/2$ matrix type questionnaire (Shaukat, et al. 2021; Qazi, et al., 2021; Qazi, et al., 2021a; Qazi, Niazi, & Basit, 2021; Niazi, et al. 2023b). The list of factors is finalized through review of literature Table 1.The data are collected in field/office setting from experts. Background of the study is briefed to them face to face one on one method for completing the questionnaires (Rashid, et al., 2021; Qazi, et al., 2020a; Qazi, Niazi, & Inam, 2019;). The survey is administered by the authors themselves. The data is aggregated using some basic functions of MS-Excel (Niazi, et al. 2023a; Niazi, Qazi, & Sandhu, 2019). Principle of aggregation is minority gives way to majority (Niazi, et al., 2019; Niazi, Qazi, & Basit, 2019a). The method of modelling is interpretive structural modeling (ISM) and method of analysis is cross impact matrix multiplication applied to classification (MICMAC) as used in Basit, Khan, & Qazi (2021), and Basit, Qazi, & Khan (2021).

Panel of Experts: The panel of experts is a common methodology used to generate data if the same is either not available or is unauthentic/insufficient (Basit, Qazi, & Niazi, 2020a). Since no data is available as required to support the study, a panel is constituted to generate the data for analyzing the issue (Niazi, Qazi, & Basit, 2021). The experts on panels are recruited on predetermined criteria. A minimum of 10 years of work experience/exposure to flooding situations is the primary requirement of an expert to be included in the panel. Other conditions include: i) minimum university graduate, ii) reasonable exposure to related areas and issues, iii) sufficient research acumen, and iv) willingness to participate as a respondent of the study. Total of twenty experts were identified sixteen consented but only eleven actually participated. Since it is a heterogeneous panel the size of eleven experts on heterogeneous panels is considered sufficient (Basit, et al., 2023; Niazi, et al., 2019a), therefore, the study is built on the data collected from eleven experts. The Delphi method, nominal group technique, discussion session, matrix type questionnaire, repertory-grid interview technique, idea engineering, laddering interview, idea generation method with small group exercise, in-depth discussion (structured, semi structured), triadic sorting task approach, one-to-one, face-to-face in-depth interview, brainstorming session, approval voting on alternatives (VAOX) for every pair of relations through software/questionnaire, elect alternatives (VAOX), workshop, problem solving group session, etc. (Abbass, et al., 2022a; Niazi, Qazi, & Basit, 2019b) are the common methods to elicit the data from minds of the experts. The study uses one-to-one, face-to-face in-depth interview in combination with approval voting on alternatives for every pair of relations through questionnaire.

Modelling: ISM model has been build using the classical procedure as entailed in Warfeild 1973. As a first step, the primary data are collected from panel of experts on a matrix type questionnaire and the data are aggregated by applying one of the popular measures of central tendency i.e. mode. As a result, a structural self-interaction matrix (Table 1) is obtained.

Table 2: Structural Self-Interaction Matrix (SSIM)

Code	Causes of Floods	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Changes in land use		A	V	A	A	A	O	O	O	A	V	A	A	A	V	X
2	Poor waste management			O	X	O	V	O	O	O	A	O	V	A	A	X	O
3	Erosion and sedimentation				X	A	A	V	A	O	V	X	A	A	A	O	O
4	Slums along rivers					V	A	V	O	V	V	X	A	X	A	A	O
5	Improper flood control systems						X	V	V	V	V	V	X	O	X	X	O
6	High rainfall							V	V	X	V	V	X	O	V	X	O
7	River physiography								A	O	V	V	A	X	A	A	A
8	Inadequate river capacity									A	V	V	X	O	X	X	O
9	Effects of high tides										V	A	X	O	O	X	V
10	Land subsidence											V	A	O	O	A	A
11	Water structures												X	V	A	A	O
12	Damage to flood control structures													O	A	A	O
13	Lack of discipline among people														O	V	O
14	Glacial melt															A	O
15	Poor drainage system																O
16	Deforestation																

The SSIM is converted into initial reachability matrix (Table 2) by using classical rules of converting VAXO symbols in to binary codes (i.e. into 0s, 1s) under the set of rules usually applied to the ISM procedure.

V: $i \rightarrow j$	A: $i \leftarrow j$	X: $i \leftrightarrow j$	O: $i \not\leftrightarrow j$
1	0	1	0

Table 3: Binary Matrix of Data Point

Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1	0	1	0	0	0	0	0	0	0	1	0	0	0	1	1
2	1	1	0	1	0	1	0	0	0	0	0	1	0	0	1	0
3	0	1	1	1	0	0	1	0	0	1	1	0	0	0	0	0
4	1	1	0	1	1	0	1	0	1	1	1	0	1	0	0	0
5	0	0	1	0	1	1	1	1	1	1	1	1	0	1	1	0
6	1	1	1	0	1	1	1	1	1	1	1	1	0	1	1	0
7	0	1	0	0	0	0	1	0	0	1	1	0	1	0	0	0
8	0	1	0	0	1	1	1	1	0	1	1	1	0	1	1	0
9	0	1	1	1	0	1	0	0	1	1	0	1	0	0	1	1
10	1	1	1	1	0	0	0	1	0	1	1	0	0	0	0	0
11	0	0	0	1	1	1	1	1	0	1	1	1	1	0	0	0
12	0	0	0	0	0	1	0	1	1	0	0	1	0	0	0	0
13	0	1	0	0	1	0	0	1	0	1	0	0	1	0	1	0
14	0	1	1	1	1	1	1	0	0	1	0	1	1	1	0	0
15	0	0	1	1	0	0	1	0	0	1	0	0	1	1	1	0
16	1	0	1	1	0	0	1	1	0	0	0	0	1	0	0	1

The initial reachability matrix (Table 2) is converted into a fully transitive binary matrix of data points (Table 3). During this procedural step every 0 (no relationship) is checked for possible transitive relationship by using some functions of MS Excel.
The hierarchies are developed from fully transitive binary matrix (Table 3) by applying a binary-matrix-partitioning-method. This method is iteratively applied to fully partition the matrix. This procedure employs the elementary concept set theory (i.e. intersection sets). As a result, Tables 5-7 have been obtained.
According to procedure of ISM modelling after iteration conical matrix and digraph were developed but being an opting step in reporting for the purpose of brevity these are not reported here. Directly the IMS model prepared from them is reported as Figure 1 below.

Table 4: Fully Transitive Binary Matrix of Data Points

Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Deriving:
1	1	1*	1	1*	1*	1*	1*	1*	0	1*	1	1*	1*	1*	1	1	15
2	1	1	1*	1	1*	1	1*	1*	1*	1*	1*	1	1*	1*	1	1*	16
3	1*	1	1	1	1*	1*	1	1*	0	1	1	1*	1*	0	1*	0	13
4	1	1	1*	1	1	1*	1	1*	1	1	1	1*	1	1*	1*	1*	16
5	1*	1*	1	1*	1	1	1	1	1	1	1	1	1*	1	1	1*	16
6	1	1	1	1*	1	1	1	1	1	1	1	1	1*	1	1	1*	16
7	1*	1	1*	1*	1*	1*	1	1*	0	1	1	1*	1	0	1*	0	13
8	1*	1	1*	1*	1	1	1	1	1*	1	1	1	1*	1	1	0	15
9	1*	1	1	1	1*	1	1*	1*	1	1	1*	1	1*	1*	1	1	16
10	1	1	1	1	1*	1*	1*	1	1*	1	1	1*	1*	1*	1*	1*	16
11	1*	1*	1*	1	1	1	1	1	1*	1	1	1	1	1*	1*	0	15
12	1*	1*	1*	1*	1*	1	1*	1	1	1*	1*	1	0	1*	1*	1*	15
13	1*	1	1*	1*	1	1*	1*	1	1*	1	1*	1*	1	1*	1	0	15
14	1*	1	1	1	1	1	1	1*	1*	1	1*	1	1	1	1*	0	15
15	1*	1*	1	1	1*	1*	1	1*	1*	1	1*	1*	1	1	1	0	15
16	1	1*	1	1	1*	1*	1	1	1*	1*	1*	1*	1	1*	1*	1	16
Dependence:	16	16	16	16	16	16	16	16	13	16	16	16	15	14	16	9	

Table 5: Iteration 1

Code	Reachability	Attendance	Set Product	Level
1	1,2,3,4,5,6,7,8,10,11,12,13,14,15,16	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	1,2,3,4,5,6,7,8,10,11,12,13,14,15,16	I
2	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	I
3	1,2,3,4,5,6,7,8,10,11,12,13,15,	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	1,2,3,4,5,6,7,8,10,11,12,13,15,	I
4	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	I
5	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	I
6	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	I
7	1,2,3,4,5,6,7,8,10,11,12,13,15,	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	1,2,3,4,5,6,7,8,10,11,12,13,15,	I
8	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	I
9	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	2,4,5,6,8,9,10,11,12,13,14,15,16	2,4,5,6,8,9,10,11,12,13,14,15,16	
10	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	I
11	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	I
12	1,2,3,4,5,6,7,8,9,10,11,12,14,15,16	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	1,2,3,4,5,6,7,8,9,10,11,12,14,15,16	I
13	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	1,2,3,4,5,6,7,8,9,10,11,13,14,15,16	1,2,3,4,5,6,7,8,9,10,11,13,14,15	
14	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	1,2,4,5,6,8,9,10,11,13,14,15,16	1,2,4,5,6,8,9,10,11,13,14,15	
15	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	I
16	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	1,2,4,5,6,9,10,12,16	1,2,4,5,6,9,10,12,16	

Table 6: Iteration 2

Code	Reachability	Attendance	Set Product	Level
9	9,13,14,16	2,4,5,6,8,9,10,11,12,13,14,15,16	9,13,14,16	II
13	9,13,14	1,2,3,4,5,6,7,8,9,10,11,13,14,15,16	9,13,14	II
14	9,13,14	1,2,4,5,6,8,9,10,11,13,14,15,16	9,13,14	II
16	9,13,14, 16	1,2,4,5,6,9,10,12,16	16	

Table 7: Iteration 3

Code	Reachability	Attendance	Set Product	Level
16	16	1,2,4,5,6,9,10,12,16	16	III

It is observable from Figure 1 above of the model that causes coded as (1), (2), (3), (4), (5), (6), (7), (8), (10), (11), (12), (15), fall at *Level I*, causes codes as (9), (13), (14) fall at *Level II* and the cause coded as (16) fall at *Level III.*

Analysis: MICMAC is used as the technique of analysis. There are two approaches to MICMAC analysis i.e. scale-centric, and data-centric approaches. The study uses both approaches to provide more insights to the readers. By applying the scale-centric approach Figure 2 is obtained by plotting the causes of floods on the Cartesian plane using driving-dependence as two continuums.

Figure 2 reveals that all the causes i.e. 1-16 are categorized in the linkage quadrant and the independent, dependent, and autonomous quadrants are empty (Kim, et al., 2023). Although it provides a lot of information about the phenomena, it is found appropriate to analyze the data on a scale-centric approach (Figure 3) as well.

Figure 3 reveals that causes coded as 9, 14, and 16 fall in the independent quadrant, causes coded as 3, and 7 falls in the dependent quadrant, and causes coded as 1, 2, 4, 5, 6, 8, 10, 11, 12, 13, and 15 fall in linkage quadrant, whereas, the autonomous quadrant is empty.

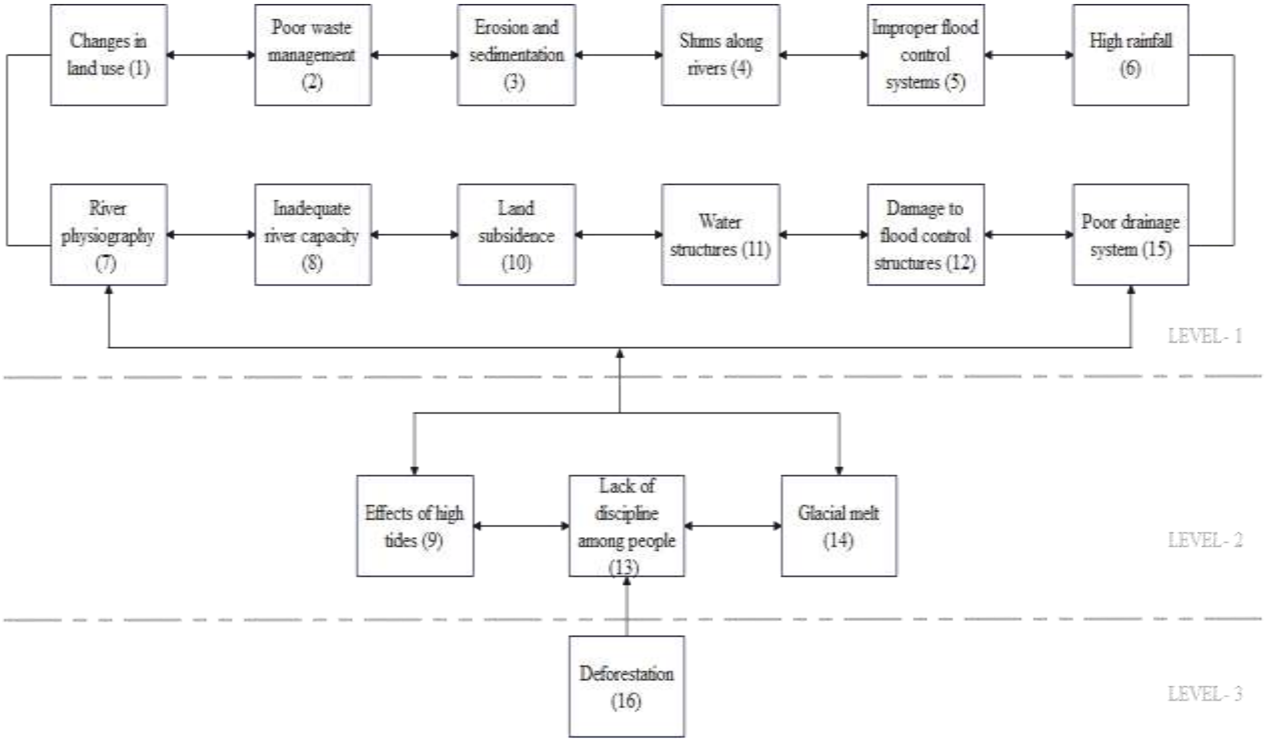

Figure 1: ISM Model

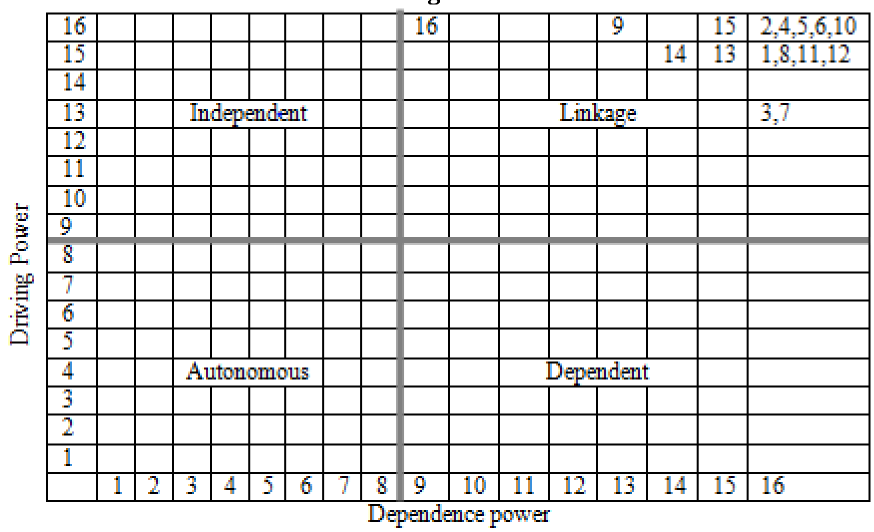

Figure 2: Scale-centric Driving-Dependence Diagram of Causes of Frequent Floods

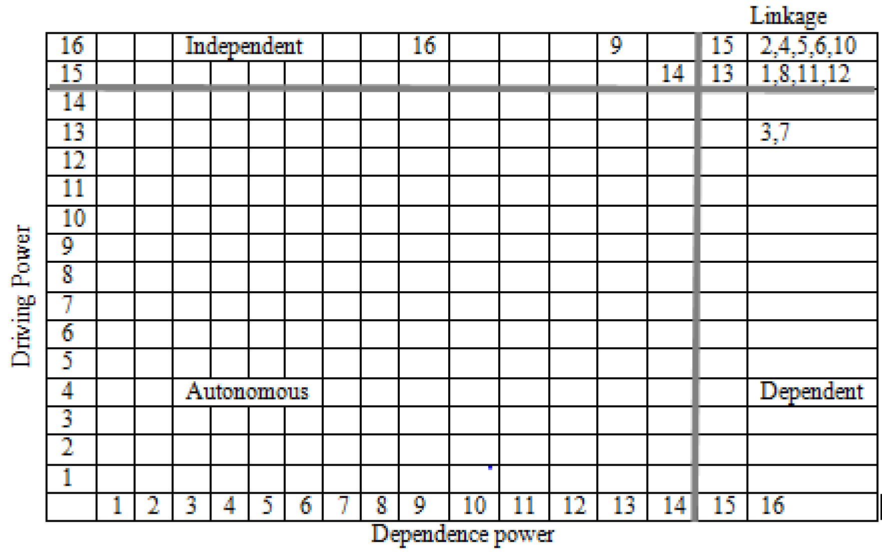

Figure 3: Data-centric Driving-Dependence Diagram of Causes of Frequent Floods

4. Results

The issue of explicating the causes of frequent floods in Pakistan being subject of the study and being recognizant of the fact of its importance the study aimed to ascertain the list of causes, modeling them and classifying them the authors applied the procedure of literature discourse, ISM and MICMAC. That resulted in a list of causes (Table 1), a model Figure 1, and a classification diagram Figure 2. That provides a deeper understanding of the issue to all stakeholders. Results of literature discourse show that the total sixteen causes of floods in Pakistan namely changes in land use (1), poor waste management (2), erosion and sedimentation (3), slums along rivers (4), improper flood control systems (5), high rainfall (6), river physiography (7), inadequate river capacity (8), effects of high tides (9), land subsidence (10), water structures (11), damage to flood control structures (12), lack of discipline among people (13), glacial melt (14), poor drainage system (15), deforestation (16). Results of ISM show that the causes namely: changes in land use (1), poor waste management (2), erosion and sedimentation (3), slums along rivers (4), improper flood control systems (5), high rainfall (6), river physiography (7), inadequate river capacity (8), land subsidence (10), water structures (11), damage to flood control structures (12), poor drainage system (15) fall at *Level I*. Causes namely: effects of high tides (9), lack of discipline among people (13), glacial melt (14) fall at *Level II*. The cause namely: deforestation (16) falls at *Level III*. The scale-centric MICMAC analysis shows that all the causes (i.e. changes in land use (1), poor waste management (2), erosion and sedimentation (3), slums along rivers (4), improper flood control systems (5), high rainfall (6), river physiography (7), inadequate river capacity (8), effects of high tides (9), land subsidence (10), water structures (11), damage to flood control structures (12), lack of discipline among people (13), glacial melt (14), poor drainage system (15), and deforestation (16)) are categorized in the linkage quadrant and the independent, dependent, and autonomous quadrants are empty (Kim, et al., 2023). The data-centric MICMAC analysis shows that the effects of high tides (9), glacial melt (14), and deforestation (16) fall in the independent quadrant. The erosion and sedimentation (3), and river physiography (7) fall in the dependent quadrant. The changes in land use (1), poor waste management (2), slums along rivers (4), improper flood control systems (5), high rainfall (6), inadequate river capacity (8), land subsidence (10), water structures (11), damage to flood control structures (12), lack of discipline among people (13), and poor drainage system (15) categorized in the linkage fall in the linkage quadrant. Whereas, the autonomous quadrant is empty.

Table 8: Juxtaposed Results of Literature, MICMAC, and ISM

Results of Literature Review		Results of MICMAC Analysis					Results of ISM	Comment
					Cluster			
Code	Determinants	Driving	Dependence	Effectiveness	Scale-Centric	Data-Centric	Level	
1	Changes in land use	15	16	-1	Linkage	Linkage	Level I	
2	Poor waste management	16	16	0	Linkage	Linkage	Level I	
3	Erosion and sedimentation	13	16	-3	Linkage	Dependent	Level I	
4	Slums along rivers	16	16	0	Linkage	Linkage	Level I	
5	Improper flood control systems	16	16	0	Linkage	Linkage	Level I	
6	High rainfall	16	16	0	Linkage	Linkage	Level I	
7	River physiography	13	16	-3	Linkage	Dependent	Level I	
8	Inadequate river capacity	15	16	-1	Linkage	Linkage	Level I	
9	Effects of high tides	16	13	3	Linkage	Independent	Level II	
10	Land subsidence	16	16	0	Linkage	Linkage	Level I	
11	Water structures	15	16	-1	Linkage	Linkage	Level I	
12	Damage to flood control structures	15	16	-1	Linkage	Linkage	Level I	
13	Lack of discipline among people	15	15	0	Linkage	Linkage	Level II	
14	Glacial melt	15	14	1	Linkage	Independent	Level II	
15	Poor drainage system	15	16	-1	Linkage	Linkage	Level I	
16	Deforestation	16	9	7	Linkage	Independent	Level III	Key Factor

5. Discussion

Since the study is designed to explicate the causes of frequent floods in Pakistan and the design includes data collection modeling and analysis, therefore, the discussion section also follows the same scheme. Although the researchers tried best to reach the full set of causes but still there is no claim of exhaustiveness however the major set of causes is covered i.e. changes in land use (1), poor waste management (2), erosion and sedimentation (3), slums along rivers (4), improper flood control systems (5), high rainfall (6), river physiography (7), inadequate river capacity (8), effects of high tides (9), land subsidence (10), water structures (11), damage to flood control structures (12), lack of discipline among people (13), glacial melt (14), poor drainage system (15), and deforestation (16) as a result of literature discourse. In the SM Model, the causes that occupy top level (*Level-I*) are the driven factors and are least critical, therefore, the policymakers are at bit liberty to deal with them comparatively at ease. The causes that occupy middle of the model *(Level-II)* are mediators/moderators have moderate severe/critical effects and need relatively more attention and care of policymakers. The cause that occupies bottom of the model *(Level-III)* is the most critical cause and therefore needs immediate attention of the policymakers. They are required to deal this issue with utmost attention and care as it drives the whole phenomenon. In this case, deforestation occupies the bottom hence it is the key cause of the whole phenomenon. This result is also corroborated by data-centric MICMAC analysis. There are two different approaches to apply MICMAC analysis i.e. scale centric and data-centric. The study uses both of the approaches. According to scale-centric analysis the situation could not be simplified as all the causes have high driving and high dependence and are concentrated in linkage cluster. That necessarily means that all the causes are agile, not settled, conundrum by nature, and action on any of them will affect other counterparts and itself in turn. However, one thing is clear from this analysis that there is no autonomous factor hence all factors are important and relevant to the phenomenon. On the other hand, data-centric analysis is clearer. It identifies that erosion & sedimentation, and river physiography are dependent factors. It also segregates independent causes i.e. effects of high tides, lack of discipline among people, and deforestation. The data-centric MICMAC analysis implicitly corroborated the results ISM modeling and scale-centric MICMAC analysis. On having the contemporary literature examined the study can be distinguished and differentiated on many counts to say the context, preciseness, data collection technique, methods of modeling and analysis however is results to large extent align to the contemporary literature. The study provides understanding of ground realities to a wide range of stakeholders i.e. to political governments, flood-prone communities, NGOs, civil public organizations & private institutions, industry/suppliers, landowners, public/farmers, and other affected. The study is also subject to some limitations as well. Firstly, it has contextual limitation because it is conducted in the context of Pakistan and the data is collected from few respondents of Pakistan, therefore, the implications are limited accordingly. Secondly, it uses primary-data collected from focus-group, therefore, insights are also limited according to dataset. Thirdly, the methodology used is simple and qualitative, it is necessary to generate some statistical evidence to validate the results. Fourthly, list causes is prepared from review of relatively small set of studies generated with filters which is not exhaustive. Fifthly, the data are taken from medium sized heterogeneous panel of experts that should be taken from rather larger panel/population to generate rather optimum results. In view of the aforementioned limitations the authors recommend that future researchers should use structural equation modeling, etc. or some other weighing methods for future investigation of the proposed relationships. The research should also be replicated in different contexts/countries/sectors to enhance the frontiers of theoretical contributions.

6. Conclusion

Floods are high impact natural phenomenon that have both positive and negative effects on lives, properties, businesses, livestock, crops, natural resources, infrastructure, wildlife, forests, and so on. Hardly any community, group or thing is left that is not affected by floods. Therefore, it has high degree of importance in research agenda. Issue understudy 'causes of floods' is related to it hence very important. The study employed qualitative design to address the issue. Overall design consist of literature review, data collection, and analysis using literature discourse, ISM and MICMAC analysis. Results of literature discourse show that the total sixteen causes of floods in Pakistan namely changes in land use (1), poor waste management (2), erosion and sedimentation (3), slums along rivers (4), improper flood control systems (5), high rainfall (6), river physiography (7), inadequate river capacity (8), effects of high tides (9), land subsidence (10), water structures (11), damage to flood control structures (12), lack of discipline among people (13), glacial melt (14), poor drainage system (15) and deforestation (16). Results of ISM show that causes coded as (1), (2), (3), (4), (5), (6), (7), (8), (10), (11), (12), (15), fall at *Level I*, causes codes as (9), (13), (14) fall at *Level II* and the cause coded as (16) fall at *Level III* at ISM model. The results of scale-centric MICMAC analysis show that all the causes (i.e. 1-16 Table 1) are categorized in the linkage quadrant and the independent, dependent, and autonomous quadrants are empty. The results of data-centric MICMAC analysis show that causes coded as 9, 14, and 16 fall in the independent quadrant, causes coded as 3, and 7 falls in the dependent quadrant, and causes coded as 1, 2, 4, 5, 6, 8, 10, 11, 12, 13, and 15 fall in linkage quadrant, whereas, the autonomous quadrant is empty. The study has contributed list of frequent causes of floods in Pakistan, a structural model of the inter-relationships of the causes that provides a lot of information about level to level, and at-level relationships of the causes, scale-centric driving-dependence diagram, and data-centric driving-dependence diagram of the phenomena towards the contemporary body of knowledge. The study has capability to enrich the understanding of national/local governments, regulators, industry representatives, landowners/farmers, the general public (including households, local communities, village committees community workers local labor, disabled people, minorities, senior citizens and women etc.), scientific community and others contributors to system, institutions engaged in disaster management, international donor agencies, academia, politicians & political parties, flood-prone communities, NGOs, volunteers, regional institutions, media, suppliers of goods & material, civil organizations, private institutions and other affected, interested or vulnerable groups (like social beneficiary groups, non-social beneficiary groups, social adversely affected groups and non-social adversely affected groups) by way of deeper insights into the conundrum issue of floods. The key lesson learnt is that the policymakers should focus the deforestation on top priority.

References

Abass, K. (2022). Rising incidence of urban floods: Understanding the causes for flood risk reduction in Kumasi, Ghana. *GeoJournal*, *87*(2), 1367-1384.

Abass, K., Dumedah, G., Frempong, F., Muntaka, A. S., Appiah, D. O., Garsonu, E. K., & Gyasi, R. M. (2022). Rising incidence and risks of floods in urban Ghana: Is climate change to blame?. *Cities*, *121*, 103495.

Abbass, K., Asif, M., Niazi, A. A. K., Qazi, T. F., Basit, A., & Al-Muwaffaq Ahmed, F. A. (2022). Understanding the interaction among enablers of quality enhancement of higher business education in Pakistan. *Plos one*, 17(5), e0267919.

Abbass, K., Niazi, A. A. K., Qazi, T. F., Basit, A., & Song, H. (2022a). The aftermath of COVID-19 pandemic period: barriers in implementation of social distancing at workplace. *Library Hi Tech*, 40(2), 569-585.

Adams, S., & Nkoro, E. (2021). Optimizing Yam Production in Rivers State: Insights from a Cobb-Douglas Model Analysis. *Journal of Business and Economic Options*, *4*(2).

Adjasi, C. K., & Yu, D. (2021). Investigating South Africa's Economic Growth: The Role of Financial Sector Development. *Journal of Business and Economic Options*, *4*(3), 19-29.
Ahmad, D., & Afzal, M. (2024). Climate change flood risks and post-flood agricultural and non-agricultural economic losses in flood-prone Bait households Muzaffargarh district of Punjab, Pakistan. *Environment, Development and Sustainability*, 1-37.
Ahmed, R., Wani, G. F., Ahmad, S. T., Sahana, M., Singh, H., & Ahmed, P. (2021). A review of glacial lake expansion and associated glacial lake outburst floods in the Himalayan region. *Earth Systems and Environment*, *5*(3), 695-708.
Ali, A., Rana, I. A., Ali, A., & Najam, F. A. (2022). Flood risk perception and communication: The role of hazard proximity. *Journal of environmental management*, *316*, 115309.
Amirmoradi, K., & Shokoohi, A. (2024). River flash flood economical loss and its uncertainty in developing countries. *Water Resources Management*, *38*(1), 81-105.
Arshad, Z., & Mukhtar, S. (2019). Understanding Pakistan's Trade Dynamics: Import-Export Trends and Trade Balance Analysis. *Journal of Business and Economic Options*, *2*(3), 115-122.
Arya, S., & Kumar, A. (2023). Evaluation of stormwater management approaches and challenges in urban flood control. *Urban Climate*, *51*, 101643.
Aslam, A. B., Rana, I. A., Shah, S. S., & Mohuddin, G. (2022). Climate change and glacial lake outburst flood (GLOF) risk perceptions: An empirical study of Ghizer District, Gilgit-Baltistan Pakistan. *International Journal of Disaster Risk Reduction*, *83*, 103392.
Atanga, R. A., & Tankpa, V. (2021). Climate change, flood disaster risk and food security nexus in Northern Ghana. *Frontiers in Sustainable Food Systems*, *5*, 706721.
Audi, M., & Al Masri, R. (2024). Examining the Impacts of Regulatory Framework on Risk in Commercial Banks in Emerging Economies. *Journal of Business and Economic Options*, *7*(2), 10-19.
Baig, A., Atif, S., & Tahir, A. (2024). Urban development and the loss of natural streams leads to increased flooding. *Discover Cities*, *1*(1), 9.
Basit, A., Khan, A. A., & Qazi, T. F. (2021). Who performed more on worth going to see? Country-wide Ranking and Categorization based on Performance in Travel and Tourism. *sjesr*, 4(2), 119-130.
Basit, A., Niazi, A. A. K., Qazi, T. F., & Imtiaz, S. (2019). Evaluation and Ranking of Pakistani Islamic Banks: Using CAMELS Model with GRA. *COMSATS Journal of Islamic Finance (CJIF)*, 4(2).
Basit, A., Qazi, T. F., & Khan, A. A. (2021). A Country-Level Analysis of Worldwide Official Financing by International Financial Institutions. *sjesr*, 4(2), 139-146.
Basit, A., Qazi, T. F., & Niazi, A. A. K. (2020). Expounding dynamics of tacit knowledge critical to credit decision making: Juxtaposed findings of GRA and RIDIT. *Journal of Accounting and Finance in Emerging Economies*, 6(1), 87-106.
Basit, A., Qazi, T. F., & Niazi, A. A. K. (2020a). Expounding dynamics of tacit knowledge critical to credit decision making: Juxtaposed findings of GRA and RIDIT. *Journal of Accounting and Finance in Emerging Economies*, 6(1), 87-106.
Basit, A., Qazi, T. F., Niazi, A. A. K., & Niazi, I. A. K. (2023). Structural Analysis of the Barriers to Address Cyber Security Challenges. *Journal of Policy Research*, 9(1).
Basit, A., Scholz, M., Niazi, A. A. K., Qazi, T. F., Shaukat, M. Z., Rao, Z. U. R., & Mahmood, A. (2021). Structural modeling on the determinants of effectiveness of SOPs containing COVID-19 in mass gatherings. *Frontiers in Psychology*, 12, 755221.
Bazai, N. A., Cui, P., Carling, P. A., Wang, H., Hassan, J., Liu, D., ... & Jin, W. (2021). Increasing glacial lake outburst flood hazard in response to surge glaciers in the Karakoram. *Earth-Science Reviews*, *212*, 103432.
Bott, L. M., Schöne, T., Illigner, J., Haghighi, M. H., Gisevius, K., & Braun, B. (2021). Land subsidence in Jakarta and Semarang Bay–The relationship between physical processes, risk perception, and household adaptation. *Ocean & Coastal Management*, *211*, 105775.
Danegulu, A., Karki, S., Bhattarai, P. K., & Pandey, V. P. (2024). Characterizing urban flooding in the Kathmandu Valley, Nepal: the influence of urbanization and river encroachment. *Natural Hazards*, 1-25.
de Azevedo Couto, G., Sanchez, A., dos Santos Alvalá, R. C., & Nobre, C. A. (2023). Natural hazards fatalities in Brazil, 1979–2019. *Natural Hazards*, *118*(2), 1487-1514.
Dharmarathne, G., Waduge, A. O., Bogahawaththa, M., Rathnayake, U., & Meddage, D. P. P. (2024). Adapting cities to the surge: A comprehensive review of climate-induced urban flooding. *Results in Engineering*, 102123.
Echendu, A. J. (2023). Flooding and Waste Disposal Practices of Urban Residents in Nigeria. *GeoHazards*, *4*(4), 350-366.
Farid, H., Qazi, T. F., Basit, A. and Niazi, A. A. K. (2023). Expounding the Environment of Small and Medium Enterprises (SMEs): A Qualitative Study Conducted in Pakistan. *Bulletin of Business and Economics*, 12(4), 321-334.
Fu, H., Abbass, K., Qazi, T. F., Niazi, A. A. K., & Achim, M. V. (2022). Analyzing the barriers to putting corporate financial expropriations to a halt: A structural modeling of the phenomenon. *Frontiers in Environmental Science*, 10, 967418.
Halder, A., & Majed, N. (2023). The effects of unplanned land use and heavy seasonal rainfall on the storm-water drainage in Dhaka metropolitan city of Bangladesh. *Urban Water Journal*, *20*(6), 707-722.
Heidarzadeh, M., & Feizi, S. (2022). A cascading risk model for the failure of the concrete spillway of the Toddbrook dam, England during the August 2019 flooding. *International Journal of Disaster Risk Reduction*, *80*, 103214.
Hirabayashi, Y., Alifu, H., Yamazaki, D., Imada, Y., Shiogama, H., & Kimura, Y. (2021). Anthropogenic climate change has changed frequency of past flood during 2010-2013. *Progress in Earth and Planetary Science*, *8*(1), 1-9.
Hussain, W., & Khan, M. A. (2024). Climate change-induced glacial lake outburst floods in Hunza valley of Pakistan: An assessment of indigenous farming community perceptions and adaptation. *Environment, Development and Sustainability*, *26*(5), 11515-11539.
Jean Louis, Madoche, Alessandra Crosato, Erik Mosselman, and Shreedhar Maskey. "Effects of urbanization and deforestation on flooding: Case study of Cap-Haïtien City, Haiti." *Journal of Flood Risk Management* (2024): e13020.

Kim, Y. N., Krasilnikova, N., Choi, Y. S., & Yeo, G. T. (2023). Structural analysis of factors for revitalizing lena river logistics using ISM method. The Asian Journal of Shipping and Logistics, 39(2), 46-51.

Lan, H., Zhao, Z., Li, L., Li, J., Fu, B., Tian, N., ... & Clague, J. J. (2024). Climate change drives flooding risk increases in the Yellow River Basin. *Geography and Sustainability*, *5*(2), 193-199.

Lindersson, S., Raffetti, E., Rusca, M., Brandimarte, L., Mård, J., & Di Baldassarre, G. (2023). The wider the gap between rich and poor the higher the flood mortality. *Nature Sustainability*, *6*(8), 995-1005.

Liu, J., Feng, S., Gu, X., Zhang, Y., Beck, H. E., Zhang, J., & Yan, S. (2022). Global changes in floods and their drivers. *Journal of Hydrology*, *614*, 128553.

Mahmood, S., Sajjad, A., & Rahman, A. U. (2021). Cause and damage analysis of 2010 flood disaster in district Muzaffar Garh, Pakistan. *Natural hazards*, *107*(2), 1681-1692.

Malik, I. H. (2022). Anthropogenic causes of recent floods in Kashmir Valley: a study of 2014 flood. *SN Social Sciences*, *2*(8), 162.

Manandhar, B., Cui, S., Wang, L., & Shrestha, S. (2023). Urban flood hazard assessment and management practices in south asia: a review. *Land*, *12*(3), 627.

Manzoor, Z., Ehsan, M., Khan, M. B., Manzoor, A., Akhter, M. M., Sohail, M. T., ... & Abioui, M. (2022). Floods and flood management and its socio-economic impact on Pakistan: A review of the empirical literature. *Frontiers in Environmental Science*, *10*, 1021862.

Mealli, F. (2021). Currency Integration and Bilateral Trade: Evidence from the Eurozone. *Journal of Business and Economic Options*, *4*(2), 30-34.

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

Muhammad, A. A. (2023). Examining the Relationship among Unemployment, Inflation, and Economic Growth. *Journal of Business and Economic Options*, *6*(2), 23-31.

Nanditha, J. S., Kushwaha, A. P., Singh, R., Malik, I., Solanki, H., Chuphal, D. S., ... & Mishra, V. (2023). The Pakistan flood of August 2022: causes and implications. *Earth's Future*, *11*(3), e2022EF003230.

Niazi, A. A. K., Asghar, W., Basit, A., & Zeeshan Shaukat, M. (2021). Evaluation of Global Goals Promoting Sustainability: A Study of Selected Sixty-Eight Countries. *Elementary Education Online*, 20(1), 2821-2821.

Niazi, A. A. K., Qazi, T. F., & Basit, A. (2019). An interpretive structural model of barriers in implementing corporate governance (CG) in Pakistan. *Glob. Region. Rev*, 4, 359-375.

Niazi, A. A. K., Qazi, T. F., & Basit, A. (2019a). What hinders to promote tourism in Pakistan? Using binary matrices for structuring the issue. *Review of Economics and Development Studies*, 5(4), 881-890.

Niazi, A. A. K., Qazi, T. F., & Basit, A. (2021). Evaluating unemployment through grey incidence analysis model: A study of one hundred thirteen selected countries. *Global Regional Review*, 6(1), 23-35.

Niazi, A. A. K., Qazi, T. F., & Sandhu, K. Y. (2019). Uncovering the myths of TQM in readymade garment sector of Pakistan: an interpretive structural modeling approach. *Review of Economics and Development Studies*, 5(3), 531-540.

Niazi, A. A. K., Qazi, T. F., Ali, I., & Ahmad, R. (2020). Prioritizing determinants of effective whistle blowing (WB) Interpretative structural modeling approach. *International Journal of Law and Management*, 62(3), 213-230.

Niazi, A. A. K., Qazi, T. F., Aziz, M., Basit, A., & Niazi, I. A. K. (2023). Using the Binary Matrices for Modeling the Supply Chain Issues of Virtual Shops: An Evidence from Pakistan. *Journal of Policy Research*, 9(2), 548-564.

Niazi, A. A. K., Qazi, T. F., Basit, A., & Khan, K. S. (2019). Curing expensive mistakes: applying ISM on Employees' emotional behaviors in environment of mergers. *Review of Economics and Development Studies*, 5(1), 79-94.

Niazi, A. A. K., Qazi, T. F., Basit, A., & Khan, R. A. (2019a). Expounding Complex Relations among Criticisms on Islamic Banking through Interpretive Structural Modeling. *Paradigms*, 13(2), 151-159.

Niazi, A. A. K., Qazi, T. F., Basit, A., & Shaukat, M. Z. (2021a). Evaluation of climate of selected sixty-six countries using grey relational analysis: Focus on Pakistan. *Journal of Business and Social Review in Emerging Economies*, 7(1), 95-106.

Niazi, A. A. K., Qazi, T. F., Butt, H. T., Niazi, I. A. K., & Basit, A. (2023a). A structural analysis of barriers being faced by green banking initiatives in Pakistan. *Journal of Policy Research*, 9(2), 182-199.

Niazi, A. A. K., Qazi, T. F., Hameed, R., & Basit, A. (2020a). How They Get Stuck? Issues of Women Entrepreneurs: An Interpretive Structural Modeling Approach. *Paradigms*, 14(1), 73-80.

Niazi, A. A. K., Qazi, T. F., Khan, K. S., Basit, A., & Ahmad, R. (2020b). Identification and Ranking Of Employees' Physical Behaviors Critical To Mergers. *International Journal of Management Research and Emerging Sciences*, 10(4).

Niazi, A. A. K., Qazi, T. F., Sarwar, A., Niazi, I. A. K., & Basit, A. (2023b). A Structural Model of Hindrances to Switch from Traditional to Virtual Real Estate Marketing in Pakistan. *Journal of Policy Research*, 9(2), 1-16.

Niazi, A. A. K., Saleem, M., Basit, A., Iqbal, Z., & Khan, I. A. (2023c). Analysing the Barriers in Tacit Knowledge Sharing among Skilled Workers: An Evidence from Technical & Vocational Education and Training (TVET) Sector of Pakistan. *Journal of Technical Education and Training* Vol, 1(1), 46-59.

Niazi, A. A., Qazi, T. F., & Basit, A. (2019b). Expounding the structure OF slyer ways of tunneling in Pakistan. *Global Regional Review*, IV (II), 329-343.

Nicholls, R. J., Lincke, D., Hinkel, J., Brown, S., Vafeidis, A. T., Meyssignac, B., ... & Fang, J. (2021). A global analysis of subsidence, relative sea-level change and coastal flood exposure. *Nature Climate Change*, *11*(4), 338-342.

Otto, F. E., Zachariah, M., Saeed, F., Siddiqi, A., Kamil, S., Mushtaq, H., ... & Clarke, B. (2023). Climate change increased extreme monsoon rainfall, flooding highly vulnerable communities in Pakistan. *Environmental Research: Climate*, *2*(2), 025001.

Pal, S. C., Chowdhuri, I., Das, B., Chakrabortty, R., Roy, P., Saha, A., & Shit, M. (2022). Threats of climate change and land use patterns enhance the susceptibility of future floods in India. *Journal of environmental management*, *305*, 114317.

Patri, P., Sharma, P., & Patra, S. K. (2022). Does economic development reduce disaster damage risk from floods in India? Empirical evidence using the ZINB model. *International Journal of Disaster Risk Reduction*, *79*, 103163.

Piecuch, C. G., Coats, S., Dangendorf, S., Landerer, F. W., Reager, J. T., Thompson, P. R., & Wahl, T. (2022). High-tide floods and storm surges during atmospheric rivers on the US West Coast. *Geophysical Research Letters*, *49*(2), e2021GL096820.

Qazi, T. F., Basit, A., Asghar, W., & Niazi, A. A. K. (2020). Composite appraisal of women development in selected thirty-six countries with special focus on Pakistan: Applying grey incidence analysis model. *Journal of Business and Social Review in Emerging Economies*, 6(4), 1227-1236.

Qazi, T. F., Basit, A., Asghar, W., & Niazi, A. A. K. (2020a). Composite appraisal of women development in selected thirty-six countries with special focus on Pakistan: Applying grey incidence analysis model. *Journal of Business and Social Review in Emerging Economies*, 6(4), 1227-1236.

Qazi, T. F., Basit, A., Niazi, A. A. K. and Saleem, M. (2023). What Stops to Switch on to Solar Energy? An Empirical Evidence from Pakistan. *Bulletin of Business and Economics*, 12(4), 288-298.

Qazi, T. F., Niazi, A. A. K., & Basit, A. (2020). Investigating Critical Resemblances of Islamic Banking with Conventional: Binary Matrices as Solution Methodology. *Journal of Business and Social Review in Emerging Economies*, 6(1), 349-364.

Qazi, T. F., Niazi, A. A. K., & Basit, A. B. (2021). Assessment of agricultural performance of districts of Punjab based on composite agricultural indicators using grey relational analysis. *Global Social Sciences Review*, 6(I), 158-172.

Qazi, T. F., Niazi, A. A. K., & Inam, S. (2019). Evaluating Research Performance of Leading Pakistani Universities: A Grey Relational Analysis. *Journal of Research & Reflections in Education (JRRE)*, 13(2).

Qazi, T. F., Niazi, A. A. K., Asghar, W., & Basit, A. (2021a). Ease of doing business: analysis of trade facilitations of one hundred twenty-seven countries of the world. *Journal of Accounting and Finance in Emerging Economies*, 7(1), 65-75.

Qazi, T. F., Niazi, A. A. K., Basit, A., Rehman, A., & Nazir, A. (2019). The jostle of workplace pressures on credit managers: interpretive structural modeling to underpin the severity. *Bulletin of Business and Economics (BBE)*, 8(3), 155-163.

Qazi, T. F., Niazi, A. A. K., Mahmood, A., Basit, A., & Niazi, I. A. K. (2023a). An Analysis of the Determinants of Trust in Virtual Buying: An Interpretive Structural Modeling Approach. *Journal of Policy Research*, 9(2), 87-102.

Qazi, T. F., Niazi, A. A. K., Sheikh, S., Niazi, I. A. K., & Basit, A. (2022). Analysis of Vulnerability Factors of NGOs: An Interpretive Structural Modeling (ISM) Approach. *Journal of Policy Research*, 8(4), 483-497.

Qazi, T. F., Shaukat, M. Z., Niazi, A. A. K., & Basit, A. (2021). Evaluating the immediate response of country-wide health systems to the Covid-19 pandemic: applying the gray incidence analysis model. *Frontiers in Public Health*, 9, 635121.

Rashid, M. K., Basit, A., Qazi, T. F., & Niazi, A. A. K. (2021). Comprehensive Analysis of Tariff Barriers Worldwide: A Composite Assessment Approach. *Journal of Accounting and Finance in Emerging Economies*, 7(1), 205-215.

Rashiq, A., & Prakash, O. (2023). Urban floods: A case study of Patna floods 2019–Natural or anthropogenic?. In *Impacts of urbanization on hydrological Systems in India* (pp. 57-78). Cham: Springer International Publishing.

Sakib, M. S., Alam, S., Shampa, Murshed, S. B., Kirtunia, R., Mondal, M. S., & Chowdhury, A. I. A. (2023). Impact of Urbanization on Pluvial Flooding: Insights from a Fast Growing Megacity, Dhaka. *Water*, *15*(21), 3834.

Shah, A. A., Ajiang, C., Khan, N. A., Alotaibi, B. A., & Tariq, M. A. U. R. (2022). Flood risk perception and its attributes among rural households under developing country conditions: the case of Pakistan. *Water*, *14*(6), 992.

Shah, S. M. H., Mustaffa, Z., Teo, F. Y., Imam, M. A. H., Yusof, K. W., & Al-Qadami, E. H. H. (2020). A review of the flood hazard and risk management in the South Asian Region, particularly Pakistan. *Scientific African*, *10*, e00651.

Shaukat, M. Z., Saleem, M., Mirza, M. U. A., Basit, A., & Niazi, A. A. K. (2023). Using Interpretive Structural Modelling (ISM) to Impose Hierarchy on Critical Issues of Contractual Bargaining: A Study of Construction Industry of Pakistan. *Journal of Policy Research*, 9(3), 69-84.

Shaukat, M. Z., Scholz, M., Qazi, T. F., Niazi, A. A. K., Basit, A., & Mahmood, A. (2021). Analyzing the stressors for frontline soldiers fighting against coronavirus disease 2019 pandemic. *Frontiers in psychology*, 12, 751882.

Shehzad, K. (2023). Extreme flood in Pakistan: Is Pakistan paying the cost of climate change? A short communication. *Science of The Total Environment*, *880*, 162973.

Singh, A., Dawson, D., Trigg, M. A., Wright, N., Seymour, C., & Ferriday, L. (2023). Drainage representation in flood models: Application and analysis of capacity assessment framework. *Journal of Hydrology*, *622*, 129718.

Singh, H., Varade, D., de Vries, M. V. W., Adhikari, K., Rawat, M., Awasthi, S., & Rawat, D. (2023). Assessment of potential present and future glacial lake outburst flood hazard in the Hunza valley: A case study of Shisper and Mochowar glacier. *Science of The Total Environment*, *868*, 161717.

Sivakumar, R., & Kumar, L. (2019). Unlocking Organizational Potential: The Synergy of Performance Management and Knowledge Management. *Journal of Business and Economic Options*, *2*(4), 159-165.

Sofia, G., & Nikolopoulos, E. I. (2020). Floods and rivers: A circular causality perspective. *Scientific reports*, *10*(1), 5175.

Sun, H., Yao, T. D., Su, F. G., Ou, T., He, Z., Tang, G., & Chen, D. (2024). Increased glacier melt enhances future extreme floods in the southern Tibetan Plateau. *Advances in Climate Change Research*.

Takagi, H., Esteban, M., Mikami, T., Pratama, M. B., Valenzuela, V. P. B., & Avelino, J. E. (2021). People's perception of land subsidence, floods, and their connection: A note based on recent surveys in a sinking coastal community in Jakarta. *Ocean & Coastal Management*, *211*, 105753.

Tang, Z., Wang, P., Li, Y., Sheng, Y., Wang, B., Popovych, N., & Hu, T. (2024). Contributions of climate change and urbanization to urban flood hazard changes in China's 293 major cities since 1980. *Journal of Environmental Management*, *353*, 120113.

Tariq, S., Shaukat, M. Z., Niazi, A. A. K., & Basit, A. (2023). Evaluating the Counterproductive Behaviors of Employees at Work Place: Empirical Evidence from Public Sector Organizations. *Bulletin of Business and Economics*, 12(2), 178-187.

Taylor, C., Robinson, T. R., Dunning, S., Rachel Carr, J., & Westoby, M. (2023). Glacial lake outburst floods threaten millions globally. *Nature Communications*, *14*(1), 487.

Toimil, A., Álvarez-Cuesta, M., & Losada, I. J. (2023). Neglecting the effect of long-and short-term erosion can lead to spurious coastal flood risk projections and maladaptation. *Coastal Engineering*, *179*, 104248.

Ullah, S., Syed, N. M., Gang, T., Noor, R. S., Ahmad, S., Waqas, M. M., ... & Ullah, S. (2022). Recent global warming as a proximate cause of deforestation and forest degradation in northern Pakistan. *PloS one*, *17*(1), e0260607.

Wang, L., Huang, Z., Gan, B., Zhang, Z., Fu, H., Fang, D., ... & Dong, X. (2024). Climate change impacts on magnitude and frequency of urban floods under scenario and model uncertainties. *Journal of Environmental Management*, *366*, 121679.

Wang, Y., Cui, P., Zhang, C. D., Zhang, G. T., Hao, J. S., Yuan, X., ... & Wang, L. (2024). Antecedent snowmelt and orographic precipitation contributions to water supply of Pakistan disastrous floods, 2022. *Advances in Climate Change Research*, *15*(3), 419-430.

Xia, J., & Chen, J. (2021). A new era of flood control strategies from the perspective of managing the 2020 Yangtze River flood. *Science China Earth Sciences*, *64*(1), 1-9.

Zhang, G., Carrivick, J. L., Emmer, A., Shugar, D. H., Veh, G., Wang, X., ... & Lützow, N. (2024). Characteristics and changes of glacial lakes and outburst floods. *Nature Reviews Earth & Environment*, 1-16.

Zia, A., Rana, I. A., Arshad, H. S. H., Khalid, Z., & Nawaz, A. (2023). Monsoon flood risks in urban areas of Pakistan: A way forward for risk reduction and adaptation planning. *Journal of Environmental Management*, *336*, 117652.