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Pakistan Journal of Economic Studies

ISSN (E) 2708-1486 (P) 2708-1478
Volume 7: Issue 4 December 2024
Journal homepage: https://journals.iub.edu.pk/index.php/pjes/index

Unveiling the Complexities: An ISM Approach to Understanding the Challenges in Biodiversity Finance Adoption

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ARTICLE DETAILS

History:
Accepted: 24 December 2024
Available Online: 31 December 2024

Keywords:
Biodiversity Finance
ISM Model
MICMAC Analysis
Environment Protection
Ecosystem Services

JEL Codes:
G18
I15
Q56
F65
Q01

ABSTRACT

Objective: Environmental damage is directly impacting the living creatures present all over the globe. Direct exploitation, deforestation, nuclear weapons, and carbon emissions are the leading factors in biodiversity loss. It enhances the need to adopt biodiversity finance, which lacks conceptualization. This study identifies and categorizes the impediments to the biodiversity finance adoption system.

Research Gap: The natural ecosystem and its reproduction system are declining due to climate change and environmental deregulation, adversely affecting biodiversity and creating global concerns for all. The adoption of biodiversity finance is significant in ensuring the sustainable management of biodiversity, but this emerging concept is hindered almost at every stage of its adoption. Still, no study has highlighted the challenges of the biodiversity finance implementation system.

Design/Methodology/Approach: The present research is conducted in two phases. Initially, an extensive literature review was done to enlist biodiversity finance challenges. It was presented to a panel of fifteen experts who shortlisted them to a final set of twenty-seven barriers. Later, these barriers were ranked in eight levels of a hierarchical model. ISM and MICMAC analysis was conducted to categorize the challenges according to their intensity levels.

The Main Findings: The results presented the knowledge gap as the critical factor causing limitations in biodiversity finance. The lack of standardized criteria and global pressures are not forcing economies to adopt biodiversity protection practices.

Theoretical / Practical Implications of the Findings: A proper regulatory framework is essential to ensure global and country-level sustainability. This study will assist financial institutions, regulatory and governing bodies, and researchers.

Originality/Value: It will add value to the existing body of knowledge of biodiversity finance by highlighting and categorizing the challenges in its implementation system.

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Recommended Citation:

Khan, K. I. & Shahzad, A. (2024). Unveiling the complexities: An ISM approach to understanding the challenges in biodiversity finance adoption. *Pakistan Journal of Economic Studies,* 7(4), 268-285. Available at: https://journals.iub.edu.pk/index.php/pjes/article/view/3166

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1. Introduction

The world of the twenty-first century is experiencing a rapid evolution that is dragging people away from nature. The sustainable management of ecosystem processes is becoming significant, and the emphasis on adopting environment-friendly projects is increasing (Hussain et al., 2024). Almost every country is highlighting the need to endorse green practices (OECD, 2020). The natural reproduction process of nature is reducing and leading to significant biodiversity loss. It is causing the extinction of various animal and

plant species. Likewise, the natural reserves of resources are instantly depleted (Kedward et al., 2023). There is an urgent need to halt biodiversity loss and ensure natural environment restoration. The successful adoption of sustainable practices guaranteeing the preservation of biodiversity requires a considerable amount of investment. Unfortunately, emerging countries with economic instabilities are not strong enough to invest sufficient funds towards this practice individually (Shehzad & Khan, 2024a).

Biodiversity finance can be beneficial in reducing resource scarcity and achieving sustainability goals. This practice ensures the generation and management of funds and the utilization of economic incentives for sustainably managing biodiversity (Flammer et al., 2023). The emerging concept of biodiversity finance is in its conceptualization phase. There are gaps in the clarification and adoption of the idea. Though initial practices are done in developed economies, including Japan and China, developing economies are still behind in their adoption. The successful implementation of biodiversity finance is impeded by several challenges (Karolyi & Puente, 2023). Therefore, to cover this gap, the present study has presented the basic conceptualization of biodiversity finance and identified the factors challenging its implementation.

Harmful toxins in the natural environment gradually increase due to radioactive elements, pollution, burnings, and harmful agricultural means (Shehzad & Khan, 2024c). These circumstances directly impact the natural environment and its ability to regenerate and restore the damages. The deregulation of the natural environment is rapidly increasing and is creating global concerns for all. Therefore, adopting sustainable practices like biodiversity finance is essential to ensure the sustainable management of biodiversity and the natural environment (Shehzad & Khan, 2024b). Biodiversity finance faces challenges at different levels of its execution, including global, national, and individual. The implementation system is hindered due to the unavailability of various elements, including policy frameworks, rules and regulations, governing authorities, and political uncertainties, etc. (Cumming et al., 2021; Young & Castro, 2021). The lack of technological advancements and expertise is leading to the usage of harmful production means, which are directly causing environmental deregulation.

Similarly, the unavailability of eco-friendly projects and sustainable practices limits the adoption of green practices (Khan et al., 2022). The lack of involvement of financial institutions and the disinterests of international bodies also impede biodiversity finance (Shehzad & Khan, 2024b). Hence, the participation and collaboration of research institutions are crucial to adopting sustainable practices. No study has presented the challenges to biodiversity finance classified in different levels based on their challenging intensity. This research aims to unveil the complexities by identifying the challenges in adopting biodiversity finance and developing a hierarchical model of challenges. To successfully achieve the objectives, the study was initially identified through an extensive literature review, and the expert panel finalized the final list of challenges. Interpretive Structural Modeling (ISM) and Cross-Impact Matrix Multiplication Applied to Classification (MICMAC) analysis were conducted to drive the study's results, presenting the multiple challenges to the biodiversity finance implementation system. The barriers' conceptualization and hierarchic classification will add to the existing literature on biodiversity finance. It will also assist in the formation of regulatory frameworks and policies accordingly.

The next sections of the study are constructed as follows: Section 2 presents the mechanism and existing literature on biodiversity finance and its impediments. Section 3 comprises the materials and methods used to conduct the analysis and drive the results presented in Section 4. Section 5 exhibits the essential findings and discussions, and the final section 6 is composed of the concluding remarks of the present study.

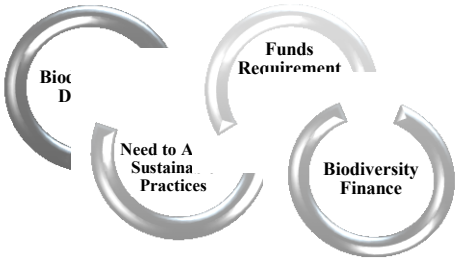
2. Literature Review

Natural processes of ecosystems and biodiversity are declining gradually. Biodiversity comprises all living creatures alive in the world. It includes the variety of life on land and below water, including animals, plants, fungi, micro-organisms, etc. (Tisdell, 1994). All the elements of biodiversity interact with each other to support life in the ecosystem. The natural environment and reproduction capacity of biodiversity are decreasing due to different natural, accidental circumstances and human actions (Saxena, 2023). Events like floods, earthquakes, droughts, and the outbreak of biological hazards can cause Natural hazards.

Harmful production means over-pollution, deforestation, excess usage of natural resources, explosions, blasts, etc., and unwanted human activities directly harming biodiversity (Kedward et al., 2023). This situation is raising concerns for the protection of biodiversity for all. The sustainable management of the processes created by nature is possible by the inward flow of capital towards this activity.

Eco-friendly practices are becoming moderately common in developed economies with abundant resources and capital. Sustainable practices are still neglected in underdeveloped and developing economies with resource scarcity (Shehzad & Khan, 2024a). Although developing economies have natural resources like land and cheap labor, they have limited flow to required capital (Akram et al., 2023). Therefore, sustainable practices generating low financial returns on investments are neglected by developing economy investors. Moreover, these practices are usually riskier and generate long-term returns for investors (Adeel et al., 2022). The low-risk appetite of investors majorly limits the flow of funds towards sustainability projects. Biodiversity finance is the best solution in this situation, ensuring the conservation and preservation of biodiversity (see Figure 1). The concept of biodiversity finance is still in its emerging phase and lacks basic conceptualization. Prior researchers have highlighted the idea with its basic conceptualization and measures.

Figure 1: Biodiversity Finance Mechanism



Source: Authors' Estimation

Karolyi & Puente (2023) called attention to biodiversity finance and described it as raising and managing capital and using financial tools and incentives to ensure sustainable biodiversity management. The emerging concept of biodiversity finance is still in its development phase. People are still not aware of the basic conceptualization and significance of biodiversity finance. Rachel et al. (2021) have presented biodiversity expenditure as a significant element for reducing pressure on biodiversity. The lack of conceptual development and consensus creates fundamental misconceptions about biodiversity finance. Practitioners relate it with green finance, CSR, and sustainable investment practices (Ansari et al., 2023).

The successful implementation of biodiversity finance is facing problems at various levels of its adoption. Many impediments to biodiversity finance are discussed in the literature. The lack of awareness and knowledge gap are the foremost challenges to adopting biodiversity finance systems. Once the stakeholders know the basic concept and its significance, they will adopt this practice quickly (Rubino, 2000). Knowledge gaps create misperceptions in investors, certain perceptions, and psychological barriers from the viewpoints of international and domestic investors of biodiversity finance (Khan et al., 2024). The obstacles to biodiversity finance are not limited to the lack of global pressures, which is also a significant challenge for the initial adoption phase of biodiversity finance (Ziolo et al., 2021). Global pressures can compel countries to launch sustainable and eco-friendly projects. It will force regulatory bodies and governments to make strict laws and regulations to protect biodiversity and natural resources (Ali & Khan, 2022). The unavailability of the regulatory framework is a crucial challenge to the adoption system of biodiversity finance (Desalegn & Tangl, 2022).

Investors still avoid SRI practices due to the conflicts of interest in social investments. They consider SRI a purposeless investment decision, giving them minimal financial returns (Shehzad & Khan, 2024a). Similarly, financial institutions are also not interested in stainability projects and schemes. The lack of interest in financial institutions creates problems in raising funds for sustainability projects (Khan et al., 2022). Furthermore, assessment is also a significant concern for investors when making sustainable

investment decisions. The financial return is the essential requirement of every investor, and a lack of proper risk management directly hinders the biodiversity finance adoption system (Darus et al., 2014). Individual investors in emerging economies usually have a limited risk appetite and avoid investing in social return-generating investment opportunities (Desalegn & Tangl, 2022). Similarly, the emerging states have limited monetary resources and provide minimal or no support to non-financial return-generating businesses. Lack of state support impedes the adoption of biodiversity finance systems (Du et al., 2018). In brief, the successful implementation of a system of biodiversity finance is limited by global, country-level, and individual challenges. These challenges directly affect sustainable biodiversity management. Controlling these impediments will help create a better place for all to live.

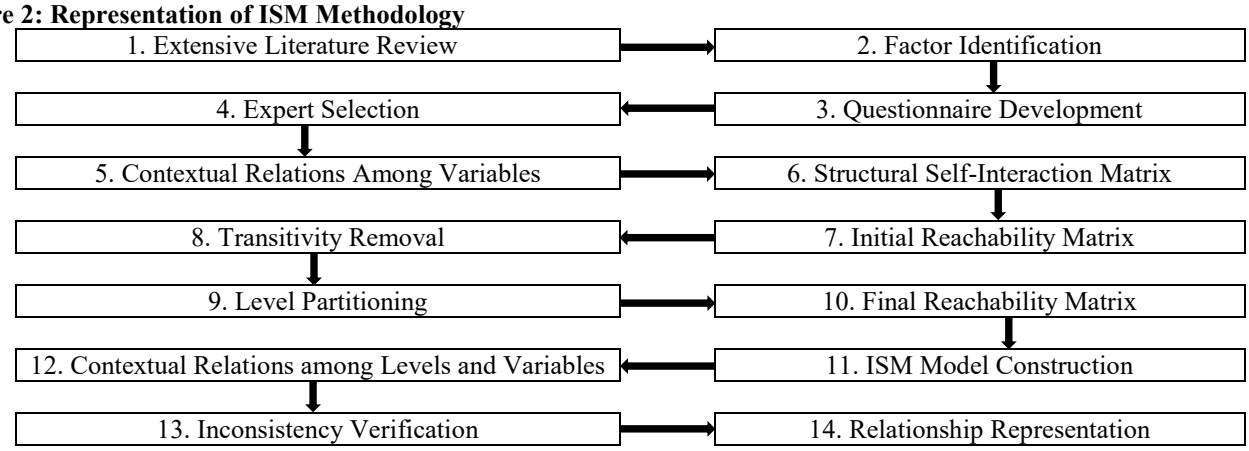
3. Materials and Methods

3.1 Interpretive Structural Modelling

ISM is a significant research methodology with various advantages. It is considered an essential technique for establishing and transforming complex phenomena. It also helps construct frameworks for understanding and resolving complex problems. Similarly, it can be used to identify the relationship among different items. ISM methodology includes multiple steps that present the relations among factors. Initially, it starts with an extensive literature review to identify the barriers already highlighted by prior researchers. Later, a comprehensive list of factors presenting the impediments to the biodiversity finance implementation system is made through an in-depth literature review. A questionnaire protocol was developed to get expert opinion, including the fundamental question for each identified factor and their proper consent. The study seeks expert opinion in two phases and makes sure to avoid repetition of the panel to avoid biasedness in the opinion. In phase I, 59 identified barriers are presented to the three experts to seek their opinion in finalizing the barriers list for the phase II study.

After this, the relevant experts were requested to participate in the research process, selected based on their expertise and availability. The complete study objective and answering procedures are explained to the experts to get the best output from them. The contextual relationship of each variable is made with the other variable; the same process is continuous for all variables. Structural Self Interaction Matrix (SSIM) is developed to present the relations existing in all variables. This step is considered one of the most critical steps based on relationship identification. This identification is based on the classifications made after discussing with the panel of three experts in Phase I who are not part of the research process of Phase II. The relationships are presented through 'V,' 'A', 'X,' and 'O'. The steps of ISM remain continuous until the Initial Reachability Matrix (IRM) is changed to a conical matrix after transitivity removal and level partition. The formation of the ISM model is the next step, and lastly, the relationships among variables are presented. The complete steps of the ISM methodology are presented in Figure 2, including ISM steps specifically in 2, 6, 7, 9.10, and 11.

Figure 2: Representation of ISM Methodology



Source: Authors' Estimation

3.2 Research Design

The present study has adopted the ISM approach to develop and investigate the relationships among the different factors to identify the barriers to adopting biodiversity finance (Khan et al., 2022). An in-depth literature review was conducted to determine the challenges to biodiversity finance, which were later used to develop a questionnaire protocol. A panel of fifteen experts was finalized through purposive sampling to obtain assistance from their skills, knowledge, and expertise. The key reason for involving experts was to verify the barriers and their categorization to form a multi-layered structural model. Experts were selected based on their direct linkage with biodiversity protection projects, experiences, and awareness about the environmental and other factors causing biodiversity decline. Moreover, experts working on the financial mechanisms for the conservation and restoration of biodiversity were also part of the selected panel. The demographic details of the expert cluster are below in Table 1.

Table 1. Demographic Details of the Sample Respondents

Sr. No.	Title	Gender	Designation	Qualification	Experience (Years)	Nature of Expert
1	A***	Female	Lecturer	M.S	5	Subject Expert
2	B***	Male	Assistant Director	MBA	10	Environmentalist
3	C***	Male	Environmental Officer	MBA	12	Banker
4	D***	Male	Senior Lecturer	M.S.	11	Subject Expert
5	E***	Male	Environment Officer	Ph.D	15	Environmentalist
6	F***	Female	Data Analyst	M.S	12	Economist
7	G***	Male	Corporate Manager	CFA	10	Other
8	H***	Female	Senior researcher	M.S	9	Biodiversity Researcher
9	I***	Male	Lecturer	MBA	8	Subject Expert
10	J***	Male	Social Activist	MBA	15	Other
11	K***	Female	Credit Manager	M.S	11	Banker
12	L***	Female	Professor	M.S	9	Biodiversity Researcher
13	M***	Male	Environmental Officer	M.S	10	Environmentalist
14	N***	Male	Operations Manager	MBA	11	Banker
15	O***	Male	Social Activist	MBA	10	Other

Source: Authors' Estimation

3.3 Data Collection

Initially, 59 barriers to the adoption of biodiversity finance systems were identified through an extensive literature review. The comprehensive list of these barriers was presented to the panel of three experts in Phase I, who removed and added them according to their expertise. Finally, an ISM questionnaire was formulated for 30 barriers and provided to the 15 experts who were requested to rank them first based on their expertise. They also identified overlapping barriers and suggested excluding them (see Table 2). We removed three barriers, "pressure to attain SDGs," "inadequate recycling process," and "massive industrialization," based on their advice that they suggested did not directly impede biodiversity adoption. Finally, they end up with 27 barriers that have the highest score. After assigning them individual codes, the final list of barriers was presented in Appendix A. They were further asked to confirm and rank the barriers through the ISM approach and highlight their contextual relations. The respondents were asked about the effect of every individual barrier on the other barriers and their relationship directions. The exact process was followed continuously till the final extraction of the different clusters of challenges.

Table 2. Barrier Verification by the Panel of Experts

Sr. No.	Barriers	Experts															Total		Included/ Neglected
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	✓	✗	
1	Lack of Global Pressure	✓	✓	✓	✓	✓	✓	✓	✗	✗	✓	✓	✓	✓	✗	✗	11	4	Included
2	Difficulties in International Fundraising	✓	✗	✓	✓	✗	✗	✓	✓	✓	✓	✗	✗	✗	✓	✗	8	7	Included
3	Perception-Related Barriers	✗	✓	✓	✗	✓	✓	✓	✗	✗	✓	✓	✗	✗	✓	✓	9	6	Included
4	Inadequate Recycling Process	✗	✓	✓	✗	✗	✓	✗	✗	✗	✓	✓	✗	✗	✗	✓	6	9	Neglected
5	Political Conflicts	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	14	1	Included
6	Unavailability of Regulatory Framework	✗	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓	✓	✗	✓	✓	12	3	Included
7	Lack of futuristic approach	✓	✓	✗	✗	✗	✓	✓	✓	✓	✗	✗	✓	✓	✓	✗	9	6	Included
8	Social and Cultural Practices	✓	✓	✗	✗	✓	✓	✗	✓	✗	✓	✓	✗	✗	✗	✓	8	7	Included
9	Lack of Subsidies and Alternatives	✗	✓	✓	✓	✓	✓	✓	✗	✗	✓	✓	✓	✗	✗	✓	10	5	Included
10	Knowledge Gap	✗	✗	✓	✓	✓	✓	✓	✗	✓	✗	✓	✓	✓	✓	✓	11	4	Included

11	Massive Industrialization	✗	✗	✓	✗	✗	✓	✗	✓	✓	✓	✗	✗	✗	✗	✗	5	10	Neglected
12	Insufficient Budget Allocation	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	14	1	Included
13	Psychological Barriers	✗	✗	✓	✓	✓	✓	✗	✓	✗	✓	✗	✓	✓	✓	✗	10	5	Included
14	Lack of Standardized Criteria	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓	✓	14	1	Included
15	Less Interest in Financial Institutions	✓	✗	✓	✓	✓	✓	✓	✓	✗	✓	✗	✓	✓	✓	✓	12	3	Included
16	SRI Practice	✗	✗	✓	✓	✓	✓	✗	✓	✓	✗	✓	✓	✗	✗	✓	9	6	Included
17	Eco-Friendly Projects	✓	✓	✓	✓	✓	✓	✓	✗	✗	✓	✓	✗	✓	✓	✓	12	3	Included
18	Economic Instability	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	13	2	Included
19	Technical Expertise and Skilled Personnel	✗	✓	✓	✓	✗	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	12	3	Included
20	Institutional and Research Collaboration	✓	✓	✓	✓	✓	✓	✗	✓	✓	✓	✗	✓	✓	✓	✗	12	3	Included
21	Lack of Private Finance Flows	✓	✗	✗	✗	✓	✓	✓	✓	✓	✗	✓	✗	✓	✓	✓	10	5	Included
22	Role of NGOs	✗	✓	✓	✓	✗	✓	✓	✓	✗	✓	✓	✗	✗	✓	✓	10	5	Included
23	Risk Management	✓	✓	✗	✓	✗	✗	✓	✓	✓	✗	✗		✗	✓	✓	9	6	Included
24	No Mechanism for Tracking Biodiversity Loss	✓	✗	✗	✓	✓	✓	✓	✗	✓	✓	✓	✓	✗	✓	✗	10	5	Included
25	Low Financial Returns	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓	13	2	Included
26	Absence of Sustainable Practices	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	10	5	Included
27	Inflationary Pressure	✓	✓	✓	✗	✗	✗	✓	✓	✓	✓	✓	✗	✗	✓	✓	10	5	Included
28	Absence of Governance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	14	1	Included
29	Conflicts of Interest within Social Investments	✓	✗	✓	✗	✓	✓	✓	✗	✗	✗	✓	✗	✗	✓	✓	8	7	Included
30	Pressure to Attain SDGs	✓	✗	✗	✗	✓	✗	✗	✓	✓	✗	✓	✗	✗	✗	✗	5	10	Neglected

Source: Authors' Estimation

4. Analysis and Results

The present study has selected the ISM approach to analyze the significant challenges of the biodiversity finance adoption system. An in-depth literature review and a panel of experts have helped identify and shortlist the barriers. The inter-relations present among the challenges of biodiversity finance are determined through SSIM. The finalized 27 challenges and their relation are presented through SSIM, which was constructed through aggregating (w,z) data in the form of VAXO. The contextual relationship existing among the challenges of biodiversity finance is presented as; 'V': challenge w is influencing challenge z, 'A': challenge z is influencing challenge w, 'X': both w and z influence each other, and a relation is present among them, and 'O': w is not having any relation with z. The relationships existing among all variables were represented through the defined symbols. The contextual relations of the challenges to biodiversity finance are presented in Table 3.

Table 3. Structural Self-Interaction Matrix

Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1		V	V	A	V	X	X	V	A	V	V	X	V	V	V	O	X	V	V	X	O	V	O	V	V	O	O
2			O	A	A	V	O	V	A	V	O	A	X	V	O	A	O	X	X	X	A	A	A	V	A	A	O
3				O	A	X	X	O	X	O	X	A	O	X	V	O	A	X	O	A	V	O	A	V	A	O	X
4					V	V	O	V	O	V	O	A	V	O	O	V	O	O	V	V	O	O	V	O	V	X	O
5						X	O	V	A	V	V	A	V	V	V	A	O	A	V	V	V	V	O	V	V	A	V
6							A	A	A	A	X	X	A	A	V	O	O	X	O	O	O	A	O	O	O	O	V
7								O	A	O	X	A	O	V	V	O	O	O	O	V	O	O	O	O	O	O	X
8									A	X	O	A	V	V	V	A	O	V	X	V	O	A	X	V	O	A	O
9										V	X	A	V	V	V	O	V	X	V	A	V	V	O	V	O	O	V
10											O	A	V	V	V	A	O	V	V	V	O	A	O	V	A	A	O
11												X	O	X	V	A	O	X	X	A	O	O	A	V	A	O	X
12													V	V	V	O	O	V	V	V	O	A	O	V	O	O	O
13														V	V	A	O	A	V	V	O	A	O	A	O	A	O
14															X	A	O	A	A	A	A	A	A	A	A	A	X
15																A	O	A	A	A	A	A	A	A	A	A	X
16																	O	O	V	O	O	O	V	V	V	A	O
17																		V	O	O	V	O	O	O	O	O	O
18																			O	X	V	X	O	V	O	O	V
19																				A	O	O	A	V	O	A	A
20																					O	V	O	V	O	A	V
21																						O	O	V	A	O	X
22																							O	V	O	O	O
23																								V	A	A	V
24																									A	A	A
25																										A	V
26																											O
27																											

Source: Authors' Estimation

The relationship between the "absence of governance" and other barriers to the adoption of biodiversity finance systems is presented in the first row. The presence of 'V' presents that the "absence of governance" can influence "difficulties in international fundraising," which is supported by prior researchers as well

(Anej et al., 2023). The absence of governance can lead to multiple factors, including "political conflicts" and further to "economic instability" (Nedopil et al., 2021). Likewise, row 26 presents the relation of "lack of global pressure" with the other barriers to biodiversity finance. Global pressure imposed by foreign regulatory bodies and countries can force domestic organizations to adopt biodiversity finance mechanisms, which are hindered by the "unavailability of the regulatory framework" (Xu et al., 2022). Similarly, the presence of 'A' in the next row presents that "political conflicts, lack of standardized criteria, economic instability (Mngumi et al., 2022), and absence of governance, etc." lead to "difficulties in international fundraising." "Political instability" leading to "economic instability" creates uncertainties in funding bodies and causes difficulties in international fundraising. "Absence of governance is a foremost challenge to the biodiversity finance adoption system, resulting in problems in fundraising from foreign sources (Khan et al., 2022).

The assignment of 'X' to the barriers of row 3 shows that "perception-related barriers" and the different other barriers, including "SRI practices (Bakry et al., 2023), social and cultural practices, knowledge gap and psychological barriers, etc." have a bilateral relationship among these challenges of biodiversity finance adoption. Stakeholders' perceptions are changed by institutional and research collaboration, and likewise, the potential research outcomes can be influenced by the perceptions of stakeholders (Niemczyk et al., 2023). Perception is a psychological process; perception barriers, including language gaps, projections, and expectations, can influence psychological barriers like emotions, opinions, etc., or vice versa (Nilsson, 2009). The issuance of 'O' in row 4 presents that the barrier "lack of standardized criteria" is not related to "social and cultural practices" and "inflationary pressures" (Shehzad & Khan, 2024a), etc. respectively. Inflationary pressures present in an individual country do not impact the global criteria of the biodiversity finance adoption system (Aamir et al., 2011).

Table 4. Initial Reachability Matrix

Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1	0	1	1	1	1	0	1	0	1	1	0	0
2	0	1	0	0	0	1	0	1	0	1	0	0	1	1	0	0	0	1	1	1	0	0	0	1	0	0	0
3	0	0	1	0	0	1	1	0	1	0	1	0	0	1	1	0	0	1	0	0	1	0	0	1	0	0	1
4	1	1	0	1	1	1	0	1	0	1	0	0	1	0	0	1	0	0	1	1	0	0	1	0	1	1	0
5	0	1	1	0	1	1	0	1	0	1	1	0	1	1	1	0	0	0	1	1	1	1	0	1	1	0	1
6	1	0	1	0	1	1	0	0	0	0	1	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1
7	1	0	1	0	0	1	1	0	0	0	1	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	1
8	0	0	0	0	0	1	0	1	0	1	0	0	1	1	1	0	0	1	1	1	0	0	1	1	0	0	0
9	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1	0	1	1	0	1	0	0	1
10	0	0	0	0	0	1	0	1	0	1	0	0	1	1	1	0	0	1	1	1	0	0	0	1	0	0	0
11	0	0	1	0	0	1	1	0	1	0	1	1	0	1	1	0	0	1	1	0	0	0	0	1	0	0	1
12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	0	0	1	0	0	0
13	0	1	0	0	0	1	0	0	0	0	0	0	1	1	1	0	0	0	1	1	0	0	0	0	0	0	0
14	0	0	1	0	0	1	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1
15	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1
16	0	1	0	0	1	0	0	1	0	1	1	0	1	1	1	1	0	0	1	0	0	0	1	1	1	0	0
17	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0
18	0	1	1	0	1	1	0	0	1	0	1	0	1	1	1	0	0	1	0	1	1	1	0	1	0	0	1
19	0	1	0	0	0	0	0	1	0	0	1	0	0	1	1	0	0	0	1	0	0	0	0	1	0	0	0
20	1	1	1	0	0	0	0	0	1	0	1	0	0	1	1	0	0	1	1	1	0	1	0	1	0	0	1
21	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	1	0	0	1
22	0	1	0	0	0	1	0	1	0	1	0	1	1	1	1	0	0	1	0	0	0	1	0	1	0	0	0
23	0	1	1	0	0	0	0	1	0	0	1	0	0	1	1	0	0	0	1	0	0	0	1	1	0	0	1
24	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0
25	0	1	1	0	0	0	0	0	0	1	1	0	0	1	1	0	0	0	0	0	1	0	1	1	1	0	1
26	0	1	0	1	1	0	0	1	0	1	0	0	1	1	1	1	0	0	1	1	0	0	1	1	1	1	0
27	0	0	1	0	0	0	1	0	0	0	1	0	0	1	1	0	0	0	1	0	1	0	0	1	0	0	1

Source: Authors' Estimation

An IRM was made for SSIM. The development and replacement rules for the construction of the IRM are as follows: with the input (w,z) 'V' in SSIM, input (w,z) will be '1' in IRM, and for input (z,w) it will be '0', with the input (w,z) 'A' in SSIM, input (w,z) will be '0' in IRM, and for input (z,w) it will be '1', with the input (w,z) 'X' in SSIM, input (w,z) will be '1' in IRM, and for input (z,w) it will be '1', and finally with the input (w,z) 'O' in SSIM, input (w,z) will be '0' in IRM, and for input (z,w) it will be '0'. The results of the IRM are presented in Table 4.

The barriers in the first column with the input of 'V' in SSIM, including the obstacles, lack of global pressure, and difficulties in international fundraising, for instance, are assigned '1', and this '1' is replaced with '0' for the input: difficulties in international fundraising and lack of global pressure. Similarly, input factors like lack of global pressure and knowledge gap are 'A' in SSIM and '0' in the IRM. The input barriers of knowledge and lack of global pressure are '1'. When the lack of global pressure and perception-related barriers are assigned 'X' in SSIM, input in the IRM is '1', and input perception-related barriers and lack of global pressure are also '1'. Lastly, suppose input factors lack of global pressure and lack of subsidies and alternatives" is 'O' in SSIM, it is '0' in IRM, and the value of the input of lack of subsidies and alternatives and lack of global pressure is also '0'. The values of '0' and '1' are allocated to all other barriers presented in the matrix using the same rule of value allocation. The IRM is further used to construct the Final Reachability Matrix (FRM), presented in Table 5.

Table 5. Final Reachability Matrix

Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	Driving
1	1	1	1	1*	1	1	1	1	1*	1	1	1	1	1	1	0	1	1	1	1	1*	1	1*	1	1	0	1*	25
2	1*	1	1*	0	1*	1	0	1	1*	1	1*	1*	1	1	1*	0	0	1	1	1	1*	1*	1*	1	0	0	1*	21
3	1*	1*	1	0	1*	1	1	1*	1	1*	1	1*	1*	1	1	0	1*	1	1*	1*	1	1*	0	1	0	0	1	22
4	1	1	1*	1	1	1	1*	1	1*	1	1*	1*	1	1*	1*	1	1*	1*	1	1	1*	1*	1	1*	1	1	1*	27
5	1*	1	1	0	1	1	1*	1	1*	1	1	1*	1	1	1	0	0	1*	1	1	1	1	1*	1	1	0	1	23
6	1	1*	1	1*	1	1	1*	1*	1*	1*	1	1	1*	1*	1	0	1*	1	1*	1*	1*	1*	0	1*	1*	0	1	24
7	1	1*	1	0	1*	1	1	1*	1*	1*	1	1*	1*	1	1	0	1*	1*	1*	1	1*	1*	0	1*	1*	0	1	23
8	1*	1*	1*	0	1*	1	0	1	1*	1	1*	1*	1	1	1	0	0	1	1	1	1*	1*	1	1	0	0	1*	21
9	1	1	1	0	1	1	1	1	1	1	1	1*	1	1	1	0	1	1	1	1*	1	1	1*	1	1*	0	1	24
10	1*	1*	1*	0	1*	1	0	1	1*	1	1*	1*	1	1	1	0	0	1	1	1	1*	1*	1*	1	0	0	1*	21
11	1*	1	1*	1*	1	1	1	1*	1	1*	1	1	1*	1	1	0	1*	1	1	1*	1*	1*	0	1	0	0	1	23
12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1*	1*	1	1	1	1*	1*	1*	1	1*	1*	1*	27
13	1*	1	1*	0	1*	1	0	1*	1*	1*	1*	1*	1	1	1	0	0	1*	1	1	0	1*	0	1*	0	0	1*	19
14	1*	0	1	0	1*	1	1*	0	1*	0	1	1*	0	1	1	0	0	1*	1*	0	1*	0	0	1*	0	0	1	15
15	0	0	1*	0	0	1*	1*	0	0	0	1*	0	0	1	1	0	0	0	1*	0	1*	0	0	1*	0	0	1	10
16	0	1	1*	0	1	1*	1*	1	1*	1	1	1*	1	1	1	1	0	1*	1	1*	1*	1*	1	1	1	0	1*	23
17	1	1*	1	0	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	0	1	1	1*	1*	1	1*	0	1*	1*	0	1*	23
18	1*	1	1	0	1	1	1*	1*	1	1*	1	1*	1	1	1	0	1*	1	1*	1	1	1	0	1	1*	0	1	23
19	0	1	1*	0	0	1*	1*	1	1*	1*	1	1*	1*	1	1	0	0	1*	1	1*	0	0	1*	1	0	0	1*	18
20	1	1	1	0	1*	1*	1*	1*	1	1*	1	1*	1*	1	1	0	1*	1	1	1	1*	1	0	1	1*	0	1	23
21	0	1	1*	0	0	1*	1*	1*	0	1*	1*	0	1*	1	1	0	0	1*	1*	1*	1	0	0	1	0	0	1	16
22	1*	1	1*	1*	1*	1	1*	1	1*	1	1*	1	1	1	1	0	0	1	1*	1*	1*	1	1*	1	0	0	1*	23
23	0	1	1	0	0	1*	1*	1	1*	1*	1	1*	1*	1	1	0	0	1*	1	1*	1*	0	1	1	0	0	1	19
24	0	1*	1*	0	0	1*	0	0	0	0	1*	0	1	1	1	0	0	0	1*	1*	0	0	0	1	0	0	1*	11
25	0	1	1	0	0	1*	1*	1*	1*	1	1	1*	1*	1	1	0	0	1*	1*	1*	1	0	1	1	1	0	1	20
26	1*	1	1*	1	1	1*	0	1	1*	1	1*	0	1	1	1	1	0	1*	1	1	1*	1*	1	1	1	1	1*	24
27	1*	1*	1	0	0	1*	1	1*	1*	0	1	1*	1*	1	1	0	0	1*	1	1*	1	0	0	1	0	0	1	18
Dependence	20	25	27	7	20	27	21	24	24	23	27	23	25	27	27	4	11	25	27	25	24	19	14	27	13	3	27	

Source: Authors' Estimation

A transitivity test is applied to IRM to form FRM, and '*' fills the gap by inference. If barrier 'A' is related to barrier 'B,' and barrier 'B' is related to barrier 'C,' then 'A' is automatically associated with 'C'. '0' and '1' entries were verified to construct FRM. The final step is calculating the driving and dependence power of the barriers to biodiversity finance adoption. These powers are calculated after finalizing all relationships through accounting transitivity.

Figure 3: MICMAC Analysis

Driving Power																												
27							4																	12				
26																												
25																				1								
24			26																						9			6
23				16							17								22	5	7					18, 20		11
22																												3
21																								10	8	2		
20													25															
19														23												13		

18					**Independent**														**Linkage**							19, 27
17																										
16																						21				
15																										14
14																										
13																										
12																										
11																										24
10																										15
9																										
8																										
7																										
6																										
5																										
4					**Autonomous**														**Dependent**							
3																										
2																										
1																										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**
	Dependence Power																										

Source: Authors' Estimation

Dependence power represents the total number of the first row, and driving power is the total number of the respective column. The calculation of driving and dependence power is further used in MICMAC analysis, which classifies the barriers in different clusters, including dependent, autonomous, linkages, and independent. MICMAC analysis of the present study is presented in Figure 3. MICMAC analysis shows no challenge to biodiversity finance adoption in the autonomous cluster. At the same time, only two barriers, including the "absence of sustainable practices" and "eco-friendly projects," are present in the dependent cluster. Linkage cluster has the maximum number of challenges, including "absence of governance," "political conflicts," "inflationary pressures," "SRI practices," and "unavailability of regulatory framework," etc. Interlinkage of challenges presents their high dependence and driving powers, respectively. Changes and actions in one challenge can affect others and themselves easily. FRM was further used to drive reachability and antecedent sets. These two sets were further used in constructing the intersection set, including all the common reachability and antecedent set challenges. The similarity of the intersection and the reachability set identifies the final levels. The final classification of barriers into VIII different levels is presented in Table 6.

Table 6. Summarizing Interactions

Code	Reachability Set	Antecedent Set	Intersection Set	Level
		Iteration *I*		
1	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,17,18,19,20,21,22,23,24,25,27	1,2,3,4,5,6,7,8,9,10,11,12,13,14,17,18,20,22,26,27	1,2,3,4,5,6,7,8,9,10,11,12,13,14,17,18,20,22,27	
2	1,2,3,5,6,8,9,10,11,12,13,14,15,18,19,20,21,22,23,24,27	1,2,3,4,5,6,7,8,9,10,11,12,13,16,17,18,19,20,21,22,23,24,25,26,27	1,2,3,5,6,8,9,10,11,12,13,18,19,20,21,22,23,24,27	
3	1,2,3,5,6,7,8,9,10,11,12,13,14,15,17,18,19,20,21,22,24,27	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27	1,2,3,5,6,7,8,9,10,11,12,13,14,15,17,18,19,20,21,22,24,27	*I*
4	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27	1,4,6,11,12,22,26	1,4,6,11,12,22,26	
5	1,2,3,5,6,7,8,9,10,11,12,13,14,15,18,19,20,21,22,23,24,25,27	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,20,22,26	1,2,3,5,6,7,8,9,10,11,12,13,14,18,20,22	
6	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,17,18,19,20,21,22,24,25,27	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,17,18,19,20,21,22,24,25,27	*I*
7	1,2,3,5,6,7,8,9,10,11,12,13,14,15,17,18,19,20,21,22,24,25,27	1,3,4,5,6,7,9,11,12,14,15,16,17,18,19,20,21,22,23,25,27	1,3,5,6,7,9,11,12,14,15,17,18,19,20,21,22,25,27	
8	1,2,3,5,6,8,9,10,11,12,13,14,15,18,19,20,21,22,23,24,27	1,2,3,4,5,6,7,8,9,10,11,12,13,16,17,18,19,20,21,22,23,25,26,27	1,2,3,5,6,8,9,10,11,12,13,18,19,20,21,22,23,27	
9	1,2,3,5,6,7,8,9,10,11,12,13,14,15,17,18,19,20,21,22,23,24,25,27	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,19,20,22,23,25,26,27	1,2,3,5,6,7,8,9,10,11,12,13,14,17,18,19,20,22,23,25,27	

10	1,2,3,5,6,8,9,10,11,12,13,14,15,18,19,20,21,22,23,24,27	1,2,3,4,5,6,7,8,9,10,11,12,13,16,17,18,19,20,21,22,23,25,26	1,2,3,5,6,8,9,10,11,12,13,18,19,20,21,22,23	
11	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,17,18,19,20,21,22,24,27	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,17,18,19,20,21,22,24,27	*I*
12	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,19,20,22,23,25,27	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,19,20,22,23,25,27	
13	1,2,3,5,6,8,9,10,11,12,13,14,15,18,19,20,22,24,27	1,2,3,4,5,6,7,8,9,10,11,12,13,16,17,18,19,20,21,22,23,24,25,26,27	1,2,3,5,6,8,9,10,11,12,13,18,19,20,22,24,27	
14	1,3,5,6,7,9,11,12,14,15,18,19,21,24,27	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27	1,3,5,6,7,9,11,12,14,15,18,19,21,24,27	*I*
15	3,6,7,11,14,15,19,21,24,27	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27	3,6,7,11,14,15,19,21,24,27	*I*
16	2,3,5,6,7,8,9,10,11,12,13,14,15,16,18,19,20,21,22,23,24,25,27	4,12,16,26	12,16	
17	1,2,3,5,6,7,8,9,10,11,12,13,14,15,17,18,19,20,21,22,24,25,27	1,3,4,6,7,9,11,12,17,18,20	1,3,6,7,9,11,12,17,18,20	
18	1,2,3,5,6,7,8,9,10,11,12,13,14,15,17,18,19,20,21,22,24,25,27	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,19,20,21,22,23,25,26,27	1,2,3,5,6,7,8,9,10,11,12,13,14,17,18,19,20,21,22,25,27	
19	2,3,6,7,8,9,10,11,12,13,14,15,18,19,20,23,24,27	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27	2,3,6,7,8,9,10,11,12,13,14,15,18,19,20,23,24,27	*I*
20	1,2,3,5,6,7,8,9,10,11,12,13,14,15,17,18,19,20,21,22,24,25,27	1,2,3,4,5,6,7,8,9,10,11,12,13,16,17,18,19,20,21,22,23,24,25,26,27	1,2,3,5,6,7,8,9,10,11,12,13,17,18,19,20,21,22,24,25,27	
21	2,3,6,7,8,10,11,13,14,15,18,19,20,21,24,27	1,2,3,4,5,6,7,8,9,10,11,12,14,15,16,17,18,20,21,22,23,25,26,27	2,3,6,7,8,10,11,14,15,18,20,21,27	
22	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,18,19,20,21,22,23,24,27	1,2,3,4,5,6,7,8,9,10,11,12,13,16,17,18,20,22,26	1,2,3,4,5,6,7,8,9,10,11,12,13,18,20,22	
23	2,3,6,7,8,9,10,11,12,13,14,15,18,19,20,21,23,24,27	1,2,4,5,8,9,10,12,16,19,22,23,25,26	2,8,9,10,12,19,23	
24	2,3,6,11,13,14,15,19,20,24,27	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27	2,3,6,11,13,14,15,19,20,24,27	*I*
25	2,3,6,7,8,9,10,11,12,13,14,15,18,19,20,21,23,24,25,27	1,4,5,6,7,9,12,16,17,18,20,25,26	6,7,9,12,18,20,25	
26	1,2,3,4,5,6,8,9,10,11,13,14,15,16,18,19,20,21,22,23,24,25,26,27	4,12,26	4,26	
27	1,2,3,6,7,8,9,11,12,13,14,15,18,19,20,21,24,27	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27	1,2,3,6,7,8,9,11,12,13,14,15,18,19,20,21,24,27	*I*
		Iteration II		
1	1,2,4,5,7,8,9,10,12,13,17,18,20,21,22,23,25	1,2,4,5,7,8,9,10,12,13,17,18,20,22,26	1,2,4,5,7,8,9,10,12,13,17,18,20,22	
2	1,2,5,8,9,10,13,18,20,21,22,23	1,2,4,5,7,8,9,10,12,13,16,17,18,20,21,22,23,25,26	1,2,5,8,9,10,13,18,20,21,22,23	*II*
4	1,2,4,5,7,8,9,10,12,13,16,17,18,20,21,22,23,25,26	1,4,12,22,26	1,4,12,22,26	
5	1,2,5,8,9,10,12,13,18,20,21,22,23,25	1,2,4,5,7,8,9,10,12,16,17,18,20,22,26	1,2,5,8,9,10,12,18,20,22	
7	1,2,5,7,8,9,10,12,13,17,18,20,22,25	1,4,7,9,12,17,18,20,22	1,7,9,12,17,18,20,22	
8	1,2,5,8,9,10,13,18,20,21,22,23	1,2,4,5,7,8,9,10,12,13,16,17,18,20,21,22,23,25,26	1,2,5,8,9,10,13,18,20,21,22,23	*II*
9	1,2,5,7,8,9,10,12,13,17,18,20,21,22,23,25	1,2,4,5,7,8,9,10,12,13,17,18,20,22,26	1,2,5,7,8,9,10,12,13,17,18,20,22	
10	1,2,5,8,9,10,13,18,20,21,22,23	1,2,4,5,7,8,9,10,12,13,16,17,18,20,21,22,23,25,26	1,2,5,8,9,10,13,18,20,21,22,23	*II*
12	1,2,4,5,7,8,9,10,12,13,16,17,18,20,21,22,23,25,26	1,4,5,7,9,12,17,18,20,22	1,4,5,7,9,12,17,18,20,22	
13	1,2,8,9,10,13,18,20,22	1,2,4,5,7,8,9,10,12,13,16,17,18,20,21,22,23,25,26	1,2,8,9,10,13,18,20,22	*II*
16	2,5,8,10,13,16,18,20,21,22,23,25	4,12,16,26	16	
17	1,2,5,7,8,9,10,12,13,17,18,20,21,22,25	1,4,7,9,12,17,18,20	1,7,9,12,17,18,20	
18	1,2,5,7,8,9,10,12,13,17,18,20,21,22,25	1,2,4,5,7,8,9,10,12,13,16,17,18,20,21,22,23,25,26	1,2,5,7,8,9,10,12,13,17,18,20,21,22,25	*II*
20	1,2,5,7,8,9,10,12,13,17,18,20,21,22,25	1,2,4,5,7,8,9,10,12,13,16,17,18,20,21,22,23,25,26	1,2,5,7,8,9,10,12,13,17,18,20,21,22,25	*II*
21	2,8,10,13,18,20,21	1,2,4,5,8,9,10,12,16,17,18,20,21,22,25,26	2,8,10,18,20,21	
22	1,2,4,5,7,8,9,10,12,13,18,20,21,22,23	1,2,4,5,7,8,9,10,12,13,16,17,18,20,22,26	1,2,4,5,7,8,9,10,12,13,18,20,22	
23	2,8,10,13,18,20,23	1,2,4,5,8,9,10,12,16,22,23,25,26	2,8,10,23	
25	2,8,10,13,18,20,21,23,25	1,4,5,7,9,12,16,17,18,20,25,26	18,20,25	
26	1,2,4,5,8,9,10,13,16,18,20,21,22,23,25,26	4,12,26	4,26	
		Iteration III		
1	1,4,5,7,9,12,17,21,22,23,25	1,4,7,9,12,17,22,26	1,4,7,9,12,17,22	
4	1,4,5,7,12,16,17,21,22,23,25,26	1,4,12,22,26	1,4,12,22,26	
5	5,12,21,22,23,25	1,4,5,7,9,12,16,17,22,26	5,12,22	
7	1,5,7,12,17,22,25	1,4,7,9,12,17,22	1,7,12,17,22	
9	1,5,7,9,12,17,21,22,25	1,9,12,22	1,9,12,22	
12	1,4,5,7,9,12,16,17,21,22,23,25,26	1,4,5,7,9,12,17,22	1,4,5,7,9,12,17,22	
16	5,16,21,22,23,25	4,12,16,26	16	
17	1,5,7,12,17,21,22,25	1,4,7,9,12,17	1,7,12,17	
21	21	1,4,5,9,12,16,17,21,25,26	21	*III*
22	1,4,5,7,9,12,22	1,4,5,7,9,12,16,17,22,26	1,4,5,7,9,12,22	*III*

23	23	1,4,5,12,16,23,25,26	23	*III*
25	21,23,25	1,4,5,7,9,12,16,17,25,26	25	
26	1,4,5,16,21,22,23,25,26	4,12,26	4,26	
		Iteration IV		
1	1,4,5,7,9,12,17,25	1,4,7,9,12,17,26	1,4,7,9,12,17	
4	1,4,5,7,12,16,17,25,26	1,4,12,26	1,4,12,26	
5	5,25	1,4,5,7,9,12,16,17,26	5	
7	1,5,7,12,17,25	1,4,7,9,12,17	1,7,12,17	
9	1,5,7,9,12,17,25	1,9,12	1,9,12	
12	1,4,5,7,9,12,16,17,25,26	1,4,7,9,12,17	1,4,7,9,12,17	
16	5,16,25	4,12,16,26	16	
17	1,5,7,12,17,25	1,4,7,9,12,17	1,7,12,17	
25	25	1,4,5,7,9,12,16,17,25,26	25	*IV*
26	1,4,5,16,25,26	4,12,6	4,26	
		Iteration V		
1	1,4,5,7,9,12,17	1,4,7,9,12,17,26	1,4,7,9,12,17	
4	1,4,5,7,12,16,17,26	1,4,12,26	1,4,12,26	
5	5	1,4,5,7,9,12,16,17,26	5	*V*
7	1,5,7,12,17	1,4,7,9,12,17	1,7,12,17	
9	1,5,7,9,12,17	1,9,12	1,9,12	
12	1,4,5,7,9,12,16,17,26	1,4,7,9,12,17	1,4,7,9,12,17	
16	5,16	4,12,16,26	16	
17	1,5,7,12,17	1,4,7,9,12,17	1,7,12,17	
26	1,4,5,16,26	4,12,26	4,26	
		Iteration VI		
1	1,4,7,9,12,17	1,4,7,9,12,17,26	1,4,7,9,12,17	*VI*
4	1,4,7,12,16,17,26	1,4,12,26	1,4,12,26	
7	1,7,12,17	1,4,7,9,12,17	1,7,12,17	*VI*
9	1,7,9,12,17	1,9,12	1,9,12	
12	1,4,7,9,12,16,17,26	1,4,7,9,12,17	1,4,7,9,12,17	
16	16	4,12,16,26	16	*VI*
17	1,7,12,17	1,4,7,9,12,17	1,7,12,17	*VI*
26	1,4,16,26	4,12,6	4,26	
		Iteration VII		
4	4,26	4,12,26	4,26	*VII*
9	9	9,12	9	*VII*
12	4,9,12,26	12	12	
26	4,26	4,12,26	4,26	*VII*
		Iteration VIII		
12	12	12	12	*VIII*

Source: Authors' Estimation

A conical matrix was developed in the final steps of this ISM analysis, which is presented in Table 7. The sum of '1' in rows and columns was used to identify the driving and dependence powers, respectively. The driving and dependence powers were determined by the presence of '1', representing the presence of each barrier in rows and columns. This constructed conical matrix has assisted in creating the graphical representation of the obstacles to biodiversity finance presented in Figure 4, demonstrating the relationships of barriers.

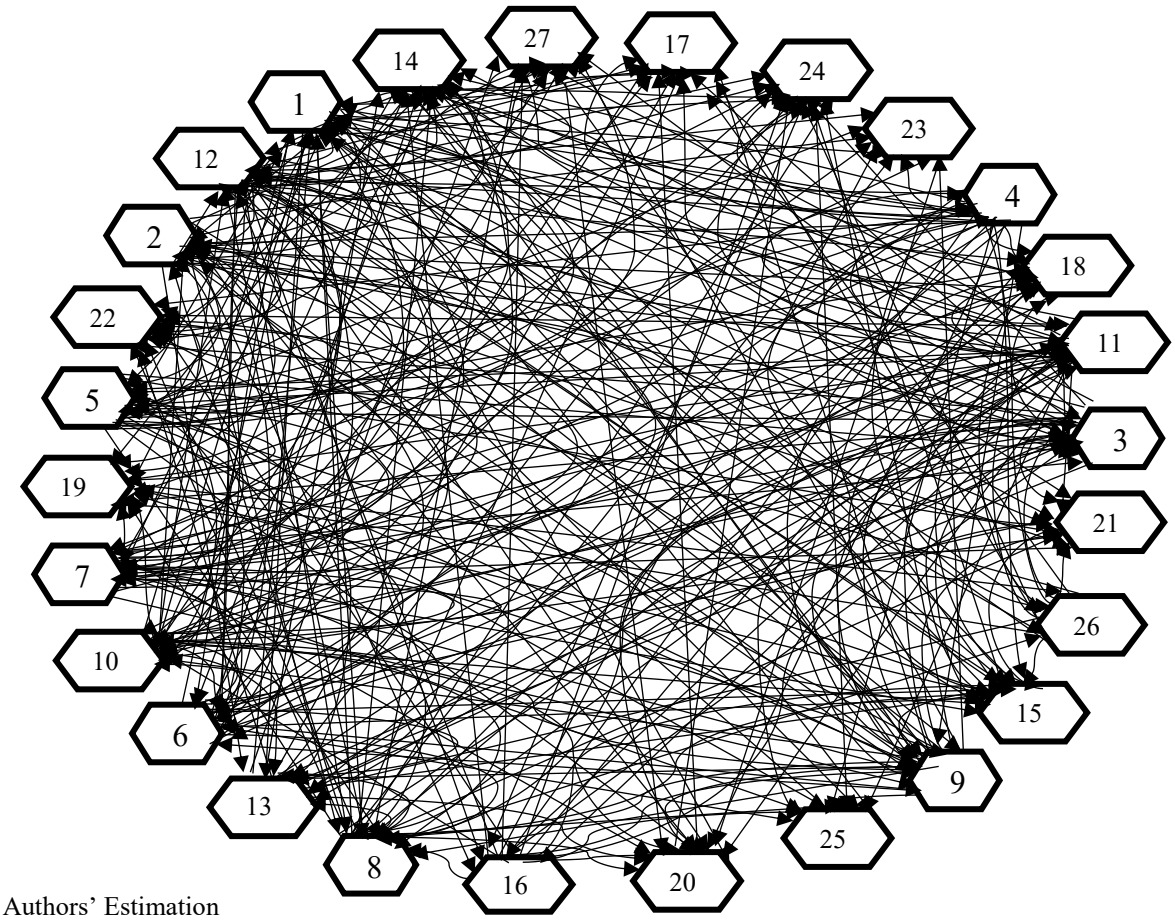
Table 7: Conical Matrix

Code	3	6	11	14	15	19	24	27	2	8	10	13	18	20	21	22	23	25	5	1	7	16	17	4	9	26	12
3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	1	0	1	0	1
6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1	1	1	0	1
11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	1	1	1	0	1
14	1	1	1	1	1	1	1	0	0	0	0	0	1	0	1	0	0	0	1	1	1	0	0	1	1	0	1
15	1	1	1	1	1	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
19	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	0	0	0	1	0	0	0	1	0	1
24	1	1	1	1	1	1	1	1	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
27	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	0	0	0	1	1	0	0	0	0	1	1
2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	0	0	1	0	1
8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	0	0	1	0	1
10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	0	0	1	0	1
13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	0	1	1	0	0	0	0	1	0	1
18	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1	0	1	0	1
20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1	0	1	0	1
21	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0
22	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	0	1	1	0	1
23	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	0	0	1	0	0	0	1	0	1
25	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	0	0	0	1	0	1
5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	0	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1
7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1	0	1	0	1
16	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	0	1	1	0	1
17	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1	0	1	0	1

4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	0	1
26	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	0
12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Source: Authors' Estimation

Figure 4: Graphical Representation of the Relationship among Biodiversity Finance Challenges



Source: Authors' Estimation

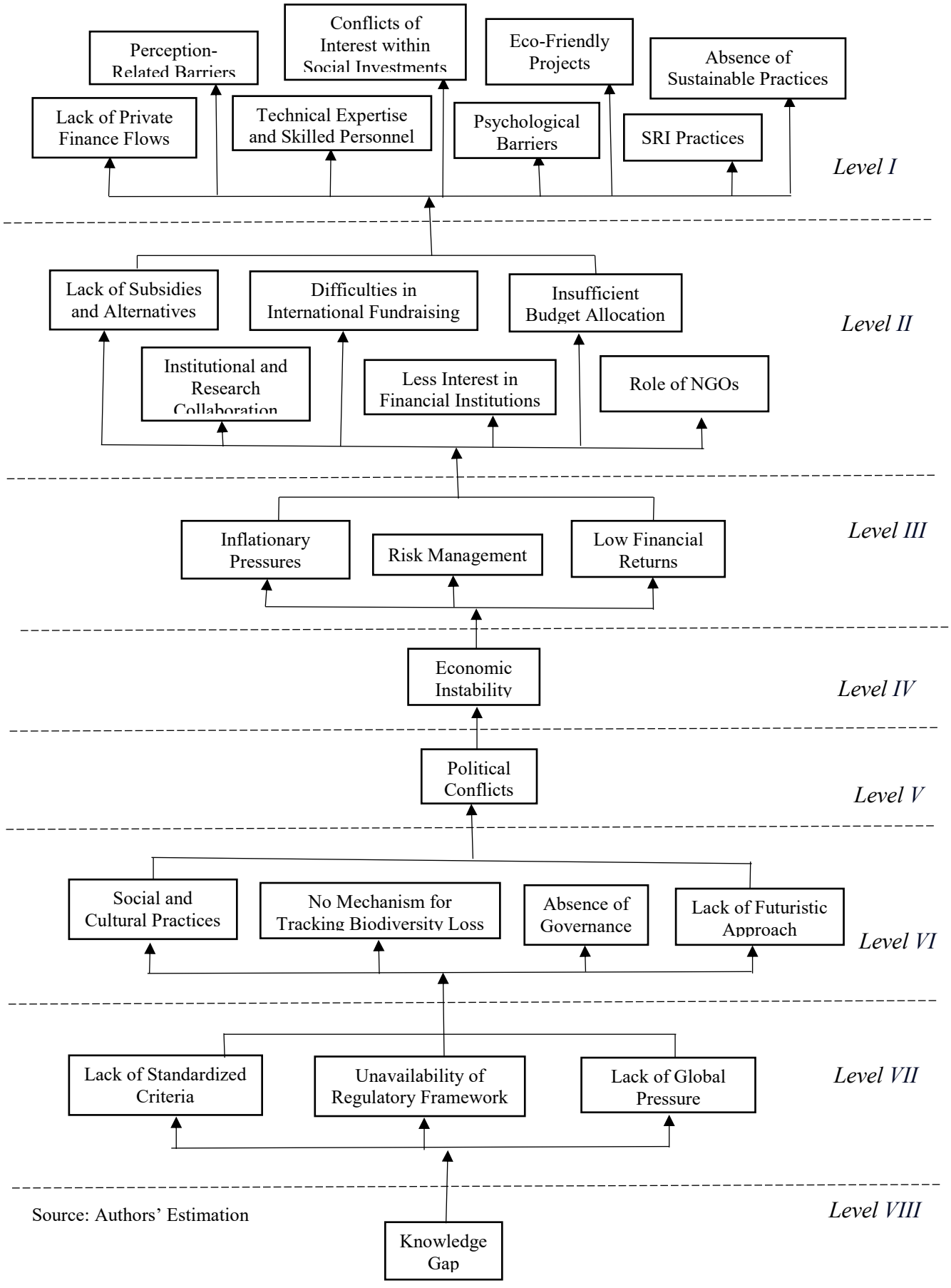
5. Key Findings and Discussion

The results of the present study are presented graphically through an ISM model, as shown in Figure 5. The challenges to biodiversity finance are categorized from levels I to VIII based on their challenging power. Barriers of level I have less impact on the implementation than those present below. Thus, level VIII comprises the most significant barrier in the biodiversity finance adoption system. "Knowledge gap" is challenging the international practice of biodiversity finance, affecting its' global adoption. It presents the "lack of standardized criteria" directly impeding the biodiversity finance implementation system. There are no defined rules and laws ensuring the protection and restoration of biodiversity. So, the "unavailability of the regulatory framework" intensifies biodiversity finance adoption challenges. The "lack of global pressure" is causing uneven adoption of conservation practices, and emerging economies are still lagging in its implementation.

The ISM model presents the "absence of governance" as the first factor in level VI. The non-existence of and lack of social and cultural practices regarding biodiversity finance are directly hindering it. Investors usually follow typical investment practices and invest in financial assets (Khan & Mushtaq, 2020). "Social and cultural practices" and previous investment trends limit the flow of funds towards sustainability projects. "No mechanism for tracking biodiversity loss" and "lack of futuristic approach" also limit long-term goals for the protection and well-being of biodiversity and the flow of funds towards this practice. The two levels (IV and V) present that "political conflicts" and "economic instability" are country-level factors

that directly impact investment objectives and policies.

Figure 5: ISM Model for Barriers to Biodiversity Finance Adoption



Source: Authors' Estimation

Challenging national situations restrict investors while making green investment decisions for sustainable biodiversity management. The unstable economic situation raises "inflationary pressures" in emerging economies, where investors usually avoid long-term risky investments (see Level III). The flaws in "risk management" techniques further reduce financial returns for investors. Socially responsible investment practices generate both social and monetary returns. Investors typically avoid the practices that create "low financial returns," which directly limits the adoption of biodiversity finance (Khan et al., 2023).

Levels I and II of this ISM model have the most minor challenges in biodiversity finance implementation, but these factors cannot be neglected entirely. "Difficulties in international fundraising" is a critical impediment arising due to the emerging nature of the concept. The misconception of the idea creates confusion among investors who consider it green finance, CSR, impact fund, etc. (John al., 2022). Hence, the lack of conceptualization directly limits the funding generation for biodiversity protection. The lack of "subsidies and alternatives" and "insufficient budget allocation" hinder the movement of capital towards sustainability practices. Similarly, the "fewer interests in financial institutions" limit loan proposals and schemes formulated for cultivators, eco-friendly projects, and startups (Baloch et al., 2022). The lack of "institutional and research collaboration" creates a vague image for practitioners and limits them from practicing biodiversity finance. The difficulties in international fundraising constitute a significant hurdle in pooling funds for preserving and protecting biodiversity.

The natural environment and biodiversity are declining at an alarming ratio, and there is no proper mechanism to track biodiversity loss. The lack of procedures to measure biodiversity loss limits the calculation of the proportion of biodiversity finance required. NGOs usually work to protect human rights and social welfare. Their attentiveness towards biodiversity finance is foremost for its adoption. Socially responsible investments typically generate less financial returns than other investment practices. Though sustainable management practices are becoming common, the adoption of fundraising for protecting natural ecosystems is becoming a global challenge. The conservation and restoration of biodiversity requires massive investment, which is not readily available in developing economies. Investors typically avoid investing in long-term risky "SRI practice," which gives them less financial and more social returns.

Risky investments with improper "risk management" mechanisms impede biodiversity finance and eco-friendly projects. "Technical and skilled personals" affect the successful execution of biodiversity finance. Likewise, "psychological and perception barriers" cause discrimination in the mindsets of investors and restrain them from practicing biodiversity finance. The system of biodiversity finance is limited in all stages of its adoption system. The constructed hierarchical model presents that the knowledge gap is the foremost challenge to its successful implementation. Lack of knowledge and conceptualization leads to subsequent impediments, including the unavailability of regulatory framework, lack of standardized criteria, etc. In sum, this study has explored the barriers to sustainable biodiversity management. It highlights the need to adopt sustainable practices, ensuring the flow of funds in the right direction.

6. Conclusion

The present study has developed a hierarchical model of the challenges to biodiversity finance adoption system through ISM analysis. The data was collected through an in-depth literature review to identify the barriers. Later, the list was shared with the panel of experts who finalized the challenges to biodiversity finance adoption. The ISM technique was applied to conduct the MICMAC analysis that classified the barriers into independent, dependent, and linkage clusters based on their dependence and driving powers. The ISM hierarchical model presents multiple biodiversity finance challenges categorized into eight levels based on intensity. The knowledge gap is the root cause of the limited practice of biodiversity finance. The lack of conceptualization further leads to global, national, and individual barriers to adoption. Sustainable practices are mainly hindered in emerging economies with limited resources. The lack of factor endowments creates various economic problems in a country. However, biodiversity finance's complete adoption and successful implementation are challenging and cannot be achieved soon. However, sustainable biodiversity management will be ensured once this practice is common, and ecosystem cycles will continue. It will make the globe a better place to live for all.

6.1 Study Implications

The implications of the present study are for many stakeholders. First, the basic conceptualization of the emerging concept of biodiversity finance and adopting this practice will ensure the protection and restoration of natural ecosystem processes. Biodiversity finance is practiced in developed economies but is unpracticed in underdeveloped economies, which need it more. The identification of the barriers to biodiversity finance requires proper consideration. Hence, policymakers can take assistance from the presented model to study the challenges impeding the adoption of biodiversity finance. Second, the identified impediments and their hieratical distribution at eight levels will help adopt sustainable, eco-friendly practices and will guide the understanding of the intensity level of each barrier. Third, discussing the basic concept of biodiversity finance and explaining the relations between different variables will help scholars and researchers. They can study each level of the model separately or can analyze some theories allied with the challenges of the biodiversity finance adoption system. Fourth, the identified barriers will aid government and regulatory bodies in prescribing laws, ensuring the easy adoption of sustainable practices by all stakeholders.

6.2 Limitations and Future Directions

Initially, the present study has identified and finalized twenty-seven barriers to biodiversity finance adoption according to their intensity levels. Future researchers should explore more obstacles to get an in-depth view of the root causes of the factors hindering its adoption system. The present study has taken assistance from fifteen experts. The size of the experts' panel can also be increased to get more valuable comments and suggestions. Future researchers' involvement of more foreign experts will help to gain insight into the global challenges to biodiversity finance adoption. It will also help conceptualize and make theoretical frameworks accordingly. Further, in the initial phase of the study, the barriers are listed in the existing literature. Therefore, future researchers can conduct semi-structured or open-ended interviews with different stakeholders of biodiversity finance. It will help identify real-time impediments and further help conduct a categorical analysis or an empirical study.

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Acknowledgments

The authors would like to acknowledge the panel of experts who provided expert advice for the impediments.

Disclosure statement

The authors declare no financial or non-financial conflict of interest.

Disclaimer

The views and opinions expressed in this paper are those of the authors alone and do not necessarily reflect the views of any institution.

Appendix A. Finalized Barriers with Assigned Codes

Code	Barrier
1	Absence of governance
2	Difficulties in international fundraising
3	Perception-related barriers
4	Lack of standardized criteria
5	Political conflicts
6	Technical expertise and skilled personnel
7	Social and cultural practices
8	Lack of subsidies and alternatives
9	Unavailability of regulatory framework
10	Insufficient budget allocation
11	Psychological barriers
12	Knowledge gap
13	Less interest in financial institutions
14	SRI practice
15	Eco-friendly projects
16	No mechanism for tracking biodiversity loss
17	Lack of futuristic approach
18	Institutional and research collaboration
19	Lack of private finance flows.
20	Role of NGOs
21	Inflationary pressures
22	Risk management
23	Low financial returns
24	Absence of sustainable practices
25	Economic instability
26	Lack of global pressure
27	Conflicts of interest within social investments

Source: Authors' Estimation