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EVALUATING THE MEDIATING ROLE OF RISK PERCEPTION ON FISHERIES PERFORMANCE USING SEM

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ABSTRACT

This study investigates the relationship between risk management and performance in the fishing sector of Pakistan, focusing on the mediating role of risk perception. A survey of 512 participants, including stakeholders such as fishermen, researchers, and consumers from Karachi, Thatta, and Sujawal was conducted to assess various risks affecting the sector. Five main categories of risks were identified: management, economic, occupational, environmental, and technical risks. The results revealed that all types of risks negatively affect performance, with management risks having the most significant impact. Using Structural Equation Modeling (SEM), the study examined the mediating role of risk perception in the risk-performance relationship. The findings indicated that risk perception significantly influences performance outcomes, with regional variations observed between Karachi, Thatta, and Sujawal. These regional differences highlight the need for region-specific risk management strategies. The study also emphasized the importance of stakeholder involvement in the risk management process, with suggestions for enhancing training programs and improving coordination between various management bodies. The study concluded that improving risk perception, enhancing stakeholder collaboration, and implementing effective enforcement measures are crucial for improving the performance of the fisheries sector in Pakistan.

Keywords: Risk perception, Fisheries, SEM, Karachi, Thatta, Sujawal

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INTRODUCTION

The principal objective of fisheries risk management is to ensure food security and economic sustainability (McClanahan *et al*., 2015). This management depends on certain rules aimed at protecting the fishing sector from several risks (Martinet *et al*., 2016). The first step in developing a management measure is the assessment of risk. Risk assessment is done through the cognitive process of risk perception (Salas and Gaertner, 2004; Mehak *et al*., 2023). Fundamentally, risk perception denotes the psychological evaluation of stakeholders concerning the diverse and unclear risks (Tingley *et al*., 2010; Ahsan, 2011). Risk perception constitutes the foundation of the entire fisheries risk management process (Le and Cheong, 2010; Joffre *et al*., 2018). It ensures the long-term use of fishing resources and ecosystem conservation (Sethi, 2010). In Pakistan, various federal and provincial regulations attempt to address the risks that the fisheries sector faces. This sector accounts for around 0.4 percent of national GDP and employs over 3 million people (Noman *et al*., 2022; Mehak *et al*., 2023). It supplies critical protein, fatty acid, and vitamin sources to the population. This sector also creates export revenue by trading fishery products such as prawns, shrimps, and fish fillets to other nations throughout the world (Jawaid *et al*. 2019). However, this industry contributes significantly less than its potential (Rehman *et al*., 2019). According to published research, Pakistan's fisheries sector encounters a variety of main and sub-risks. Frequently reported main risks include management risk, environmental risk and economic risk (Sethi, 2010; Fletcher, 2005; Hilmi *et al*., 2021; Heck *et al*., 2023). On the other hand, major sub-risks comprise overexploitation, pollution, environmental degradation, and a lack of coordination among several regulatory authorities (Noman *et al*., 2022).

Fisheries risk management heavily depends on stakeholders' perceptions and evaluations of risks (Chen *et al*., 2021). An effective management plan cannot be established without recognizing risks through risk perception. The risk perception of stakeholders informs managers in making judicious and effective management decisions. Consequently, adaptive techniques can be developed to address hazards. Including stakeholders in the risk assessment process builds trust and cooperation between different groups in the fisheries sector, which

makes it easier to reach common goals. Consequently, risk perception constitutes the foundation of risk management (Sethi, 2010; Soma *et al*., 2018; Jones and Seara, 2020). Risk perception serves as a lens that emphasizes critical risks requiring prioritization for mitigation (Lambert *et al*., 2001). Moreover, the risk perception mechanism helps people think about dangers and come up with well-thought-out strategies to deal with them (Trochta *et al*., 2018; Woods *et al*., 2022). Regrettably, despite the significant influence of risk perception on the risk management process, it is typically overlooked in the formulation of the risk mitigation plan. This phenomenon is especially prevalent in underdeveloped nations, where insufficient risk perception often results in inadequate management techniques (Hebbsale and Shivamurthy, 2021; dos Santos *et al*., 2024). So, there aren't many scientific studies in developing countries that look into how people think about risk and how that affects the relationship between fisheries risk management and risk awareness (Mehak *et al*., 2023).

Various statistical methods can be utilized to assess the mediating role of risk perception on the relationship between risk management and risk performance. Multivariate analysis is a renowned technique in this regard which is frequently employed to identify complex mediating role of certain factors on the relationship between other factors. However, the method of data collection and the study's objective significantly influence the execution of multivariate analysis (Byrne, 2001; Narayanan, 2012). Typically, a multivariate analysis is a method for examining extensive datasets retaining significant interpretable information. This approach categorizes variables based on their attributes. This method's reliability is evidenced by its frequent application in testing specific hypotheses. A specific factor may also be examined for its effect on another (Gallagher *et al*., 2008; Fan *et al*., 2016). Therefore, the utilization of multivariate analysis presents numerous benefits. Multivariate analysis is a robust method for data examination as it simultaneously accounts for multiple variables. To identify the component affecting the dependent variable, multiple independent variables are evaluated (Nunkoo and Ramkissoon, 2012; Guo *et al*., 2024).

The occurrence of risks in Pakistan despite the implementation of management measures raises significant concerns about the effectiveness of these measures (Noman *et al*., 2022; Mehak *et al*., 2023). Two pertinent questions regarding this scenario are: 1) What are the main risks facing Pakistan's fisheries sector, and how do they impact its performance? 2) How does the perception of risks in fisheries influence the relationship between risk management and performance? Published literature concerning fisheries predominantly addresses the biological management of fishery resources, along with additional factors such as pollution, environmental change, and the interaction between fisheries and these elements (Khan and Khan, 2011; Kaczan and Patil, 2020; Ahmad *et al*., 2024). Nonetheless, the classification of fisheries risks, their effects on performance, and the knowledge of such risks remain ambiguous; and hence, this study aims to address this deficiency. The aims of this investigation are as follows: 1) Categorize the main and sub-risks faced by the fishery industry in Pakistan. 2) Analyze the relationship between the risks and performance. 3) Evaluate the mediating role of risk perception on the relationship between risk management and risk performance.

MATERIALS AND METHODS

Study framework and questionnaire development: This study was conducted systematically following various steps as demonstrated in Figure 1. In order to fetch statistical data, a structured questionnaire survey employing a 9-point rating scale proposed by Wind and Saaty (1980) and Saaty (2005) was employed. This questionnaire comprised three distinct parts. Questionnaire is given at the end of the paper. First part contained the demographic features of the survey participants. Second part included questions related to the relationship between risk and performance. The third part incorporated questions about risk perception and performance. Later on, this questionnaire was discussed with the stakeholders and academicians to remove unnecessary questions. A pretest of this questionnaire was conducted before the formal survey involving 9 survey respondents. The objective of this pretest was to ensure the effectiveness and validity of this questionnaire.

Data collection: This study aimed to investigate fisheries risks dynamics in Pakistan within the context of risk management. Furthermore, it explored how risk perception can mediate relationship between risk management and risk performance. Data was collected via a questionnaire survey between May 2022 and October 2022. To identify potential survey participant's local fishery organizations and various stakeholder were contacted. This method helped to identify knowledgeable and professional survey participants. Furthermore, these survey participants were asked to introduce more participants in their circle. This method helped to collect data from suitable and professional survey participants and is generally termed the snowball sampling method. This method was adopted considering its suitability to this study. Stakeholders were contacted for availability, followed by interviews to collect data mostly after meetings. Prior to the distribution of printed survey forms, the questionnaire survey's purpose was described. Every survey respondent was encouraged to submit accurate responses to all questions. In some circumstances, data

was also acquired over the phone. Based on the literature review and discussions with the stakeholders' fisheries risks were classified into five main and 23 sub-risks as shown in Figure 2. Main risks were placed in the first layer (independent variables) whereas their corresponding sub-risks were list in the second layer (dependent variables). According to the research questions and aims of this study, following five hypotheses were developed: 1) Management risk impacts performance (H1). 2) Economic risk impacts performance (H2). 3) Occupational risk impacts performance (H3). 4) Environmental risk impacts performance (H4). 5) Technical risk impacts performance (H5).

Data analysis: This study employed two statistical tools, Analysis of Moment Structures (AMOS) 18.0 and Statistical Package for Social Sciences (SPSS) 18.0, to analyze the data and determine the validity of our ideas. Two primary methods exist in statistics for analyzing data: inferential statistics and descriptive statistics. In this study, confirmatory factor analysis was done with the AMOS, and exploratory factor analysis, frequency analyses, and random sample t-tests were done with the SPSS. AMOS analysis is particularly suitable for the assessment of both direct and indirect effects of the different factors studied together in a study. The choice of AMOS is justified by its ability to handle large datasets and its capacity to estimate complex models that include multiple dependent and independent variables. On the other hand, SPSS facilitates exploring the differences in the responses across different groups with the sample. This analysis helps ensure that the data is well understood before applying more complex SEM techniques. Considering these peculiar qualities of AMOS and SPSS, they were selected for this study. The estimations from the structural equation model were used to evaluate the model's suitability and to verify the hypotheses. This study makes use of structural equations because, in this model, we can estimate not only the correlations between independent and dependent variables but also the causal links between different dependent variables. A structural equation model combines confirmatory factor analysis with regression evaluation to form a multivariate model.

One research model can also handle the correlations of mistakes between endogenous variables and the correlations of exogenous variables. This means that analyses that would normally need to be run separately can be run at the same time (Ong and Puteh, 2017). One good thing about structural equation models is that they can show both direct and indirect effects across variables that are linked to each other. The ability to incorporate direct, indirect, and total effects all at once gives it an edge in understanding causal relationships (Gallagher *et al*., 2008). In order to ensure that the data fits the model, AMOS suggests several indications. (Byrne, 2001; Shek and Yu, 2014; Narayanan *et al*., 2012; Byrne, 2001; Kline, 1998) all state that there are approximately twenty fit measures. The following table displays some of the most widely used fit metrics. Figure 3 depicts the research model used in this study. To illustrate SEM, this research employed three different matrix models. In mathematics, the first matrix is as follows:

$$\eta = B\eta + \Gamma\xi + \varsigma \quad (1)$$

Here, ξ and η represent exogenous variables and endogenous variables, in that order. The coefficients of variables are represented by Γ and B. The second matrix model which is also called the measurement model can be written as below:

$$Y = \Lambda y\eta + \varepsilon \quad (2)$$

In above expression, measurement of all the endogenous variables is represented by Y. In addition, correlation coefficient between endogenous variables and their corresponding measured variables is denoted by Λy. ε stands for all those errors that occur during this method. The third matrix model can be represented as follows:

$$X = \Lambda x\xi + \delta \quad (3)$$

In above mathematical expression, calculation of all exogenous variables is given by X. Here, correlation coefficient between exogenous variables and their corresponding measured variables is denoted by Λx. δ is used to represent all errors that occur during this algorithm (Narayanan, 2012; Shek and Yu, 2014). To ensure the validity and reliability of the questionnaire, a pretest was conducted to assess the clarity, relevance, and effectiveness of the questions. Feedback from stakeholders and academicians was incorporated to refine the questionnaire, eliminating unnecessary items and enhancing its overall content validity. Moreover, the use of established statistical tools such as AMOS and SPSS, along with confirmatory and exploratory factor analyses, further strengthened the reliability and validity of the data analysis process, ensuring that the research findings were both accurate and robust. Furthermore, we established convergent validity by ensuring that the Average Variance Extracted (AVE) for each construct exceeds 0.50, and Construct Reliability (CR) values are above 0.70, indicating strong item correlations within constructs. For discriminant validity, we confirmed that the AVE for each construct is greater than the squared correlations between pairs of constructs, as shown in Table 4. These analyses ensure that both convergent and discriminant validity are adequately addressed in our study. In addition, AVE and Composite Reliability (CR) using the results from the Confirmatory Factor Analysis (CFA) conducted in our SEM analysis. AVE was calculated by taking the average of squared standardized loadings of the indicators for each construct, which is reported in Table 3. CR was computed using the formula that considers the squared loadings and error variances of the indicators,

ensuring that the reliability of each construct is above the recommended threshold of 0.70.

RESULTS

Survey Participants Profile: A total of 512 participants completed the questionnaires and were thus considered worthy of evaluation in the current study. Table 1 summarizes the key features of survey respondents. In terms of relationship status, 458 of the respondents (89.5%) were married, while 54 of the respondents (10.5%) were unmarried. On the other hand, 501 (97.8%) respondents were male, while 11 (02.2%) were female. The respondents' ages included 396 individuals (77.3%) between the ages of 21 and 40, and 116 individuals (22.7%) between the ages of 41 and 60. Of those who responded, 86 (16.8%) had only completed primary school, while 426 (83.2%) had completed education ranging from secondary school to a master's degree. Moreover, 256 (50%) respondents were from Karachi and 256 (50%) from Thatta and Sujawal. Out of all respondents, 328 (64.1%) had 11 to 15 years of professional experience, while 184 (35.9%) had 15 years or more. In terms of the stakeholder group, 205 (40.0%) of respondents were fishermen, 17 (3.4%) were researchers, 24 (4.7%) were members of public or private bodies, and 266 (51.9%) were consumers. It is pertinent to mention that previous studies do not compare risks in the order of their importance suitable for management purposes. Moreover, published literature also lacks comprehensive classification involving various stakeholders, which is necessary for making directional as well as effective management policies.

Validation of reliability: To verify the data's reliability, a reliability test was carried out. Table 2 presents specific results of this test. Management risk included five questions and a calculated Cronbach's alpha (CA) score of 0.975. Moreover, economic risk comprised four questions and CA value was 0.932. In addition, there were five questions included in occupational risk and the estimated CA value was 0.939. Furthermore, environmental risk comprised four questions and the calculated CA value was 0.923. Additionally, there were five questions included in technical risk and the accessed CA value was 0.896. Moreover, four questions were included in the performance and the computed CA value was 0.855. There were 27 questions in total and the calculated CA value was 0.891. It should be mentioned that all CA estimations were much higher than 0.6, confirming the data's dependability (El-Sheikh *et al*., 2017).

Confirmatory factor analysis: Table 3 provides estimates for confirmatory factor analysis. Numerous indices that indicate the model's fit quality were computed. Some of these indices are "Chi-square" (CMIN) (1003.326), "Normed Fit Index" (NFI) (0.901), "Goodness of Fit Index" (GFI) (0.894), "Root Mean Square Residual" (RMR) (0.042), "Incremental Fit Index" (IFI) (0.933), "Adjusted Goodness of Fit Index" (AGFI) (0.811), "Comparative Fit Index" (CFI) (0.921), and "Tucker-Lewis index" (TLI) (0.921). These indices indicated fitting of the model and its suitability for this analysis. It is important to note that calculated "Construct Reliability" (CR) values are above the generally accepted acceptable norm of 0.70. Additionally, the "Average Variance Extracted" (AVE) estimates exceeded the standard value of 0.05. Therefore, every confirmatory factor analysis estimate was appropriate and acceptable (El-Sheikh *et al*., 2017).

Correlation between constructs: The correlation results between each of the constructs employed in this investigation are listed in Table 4. AVE values are shown at the top of each column, while remaining values represent correlation estimations. Moreover, values show the strength of the correlation. In addition, negative signs show a negative correlation between the constructs. The fact that all of the computed AVE values are higher than squared correlations indicates that the discriminant accuracy of all the variables is adequate.

Validation of structure equation modeling: Statistical indices such as RMR, CFI, and CMIN/DF indicate the structure of an equation modeling technique (El-Sheikh *et al*., 2017). In some cases, NFI can produce more accurate estimates, especially when complicated equations are used. In these circumstances, the CFI index is more appropriate. According to conventional criteria, all of the index values were valid. This indicates robustness of the model (Table 5).

Estimates of structure equation modeling: Two models, namely the free model and the constrained model, were assessed using structural equation modeling approach. These models confirmed the mediating effect of risk perception on the performance of the fishing sector in Karachi and Thatta and Sujawal. The free model yielded χ^2 and degrees of freedom (DF) values of 2137.634 and 986, respectively, while the constrained model produced values of 2151.287 and 992, in that sequence. The estimate of χ^2 in the free model was lower than that in the constrained model. Therefore, the free model exhibited strong performance as a lower value of χ^2 can compensate for DF. Furthermore, it was discovered that risk perception significantly influences performance (Table 6).

Model-wide direct effects: Table 7 shows how each construct directly affects performance and assesses whether the suggested hypothesis is accepted. H1 was accepted since it demonstrated a significant negative effect on performance (estimate = -0.312 and p = 0.000). Similarly, there was a substantial impact on performance

from economic risk (estimate = -0.071 and p = 0.031) and occupational risk (estimate = -0.188 and p = 0.000). In light of these findings, H2 and H3 were accepted. Moreover, environmental risk (estimate = -0.198 and p = 0.000) demonstrated negative impact on performance. Therefore, H4 was also accepted. However, technical risk (estimate = -0.041 and p = 0.063) proved not to have significant impact on performance leading to the rejection of H5.

The mediating effect of risk perception: Table 8 presents a comparison of estimates for Karachi and Thatta and Sujawal. Estimates differ between the two regions. This mismatch implies that risk perception acts as a mediator. In Karachi, the mediating effects of management risk (estimate = -0.421, CR = -2.657**), occupational risk (estimate = 0.298, CR = 2.568**), and technical risk (estimate = 0.445, CR = 3.243***) were found significant. On the other hand, in Thatta and Sujawal, management risk (estimate = 0.362, CR = 2.554**), economic risk (estimate = -0.287, CR = -2.939**), and technical risk (estimate = 0.527, CR = 3.561***) were estimated to have significant mediating effect. Figures 4 and 5 provide path diagrams for Karachi and Thatta and Sujawal. In this table, the findings show that certain risks, like economic and environmental risks, have a non-significant impact on performance compared to others. Economic risk has a negative estimate in both Karachi and Thatta and Sujawal but does not reach significance, suggesting that it may not directly influence performance in these areas. Similarly, environmental risk is also not significant, indicating that factors like climate change or environmental conditions may not be perceived as major risks by the communities in these regions. On the other hand, management and technical risks show a stronger and significant impact on performance, with both regions indicating a clear negative or positive relationship. These results suggest that issues related to management and technology are more directly linked to performance outcomes, likely because they are more tangible or immediate concerns for those involved in the fisheries.

Table 1. Survey participant's portfolio.

Features		Number	Percentage
Relationship status	Married	458	89.5
	Unmarried	54	10.5
Gender	Male	501	97.8
	Female	11	02.2
Age	21~40 years	396	77.3
	41~60 years	116	22.7
Qualification	Primary school	86	16.8
	From secondary school to masters	426	83.2
Area	Karachi	256	50.0
	Thatta and Sujawal	256	50.0
Professional experience	11~15 years	328	64.1
	15 years or more	184	35.9
Stakeholder group	Fishermen	205	40.0
	Researchers	17	3.4
	Public or private bodies	24	4.7
	Consumers	266	51.9
	Total	512	100

Table 2. Validation of reliability.

Construct	Number of questions	Cronbach's Alpha
Management Risk	5	0.975
Economic Risk	4	0.932
Occupational Risk	5	0.939
Environmental Risk	4	0.923
Technical Risk	5	0.896
Performance	4	0.855
Total	27	0.891

Table 3. Confirmatory factors analysis.

Construct	Objects	Factor loading	AVE	CR	Coefficient	SE	t-value
Management risks	MR_1	0.733	0.834	0.961	0.778		
	MR_2	0.741			0.909	0.068	13.912
	MR_3	0.754			0.969	0.064	11.601
	MR_4	0.775			0.837	0.065	13.543
	MR_5	0.736			0.731	0.076	10.716
Economic risks	ER_1	0.737	0.809	0.956	0.764		
	ER_2	0.732			0.729	0.059	14.384
	ER_3	0.795			0.948	0.068	12.226
	ER_4	0.807			0.831	0.047	14.835
Occupational risks	OR_1	0.914	0.812	0.957	0.895		
	OR _2	0.823			0.854	0.057	15.346
	OR _3	0.835			0.919	0.210	15.267
	OR _4	0.784			0.858	0.113	22.464
	OR _5	0.754			0.746	0.078	14.398
Environmental risks	ENR_1	0.751	0.808	0.947	0.793		
	ENR_2	0.854			0.904	0.084	16.498
	ENR _3	0.746			0.926	0.076	19.574
	ENR _4	0.751			0.794	0.095	18.127
Technical risks	TR_1	0.755	0.852	0.983	0.956		
	TR _2	0.864			0.931	0.093	21.465
	TR _3	0.848			0.798	0.091	23.524
	TR _4	0.773			0.797	0.201	20.316
	TR _5	0.726			0.736	0.082	25.875
Performance	PR_1	0.827	0.743	0.929	0.581		
	PR _2	0.841			0.724	0.534	6.845
	PR _3	0.816			0.669	0.424	6.791
	PR _4	0.874			0.788	0.397	6.584

Fit Statistics: CMIN (1003.326), p (0.000), CMIN/DF (1.754), RMR (0.042), GFI (0.894), AGFI (0.811), NFI (0.901), IFI (0.933), TLI (0.921), CFI (0.921)

Table 4. Matrix representing correlation between constructs.

Construct	1	2	3	4	5	6
Management risk	**0.834**					
Economic risk	0.784^{***}	**0.857**				
Occupational risk	0.432^{***}	0.695^{***}	**0.803**			
Environmental risk	0.521^{***}	0.583^{***}	0.732^{***}	**0.724**		
Technical risk	0.589^{***}	0.472^{***}	0.481^{***}	0.515^{***}	**0.811**	
Performance	-0.421^{***}	-0.542^{***}	-0.388^{***}	-0.537^{***}	-0.462^{***}	**0.726**

Table 5. Validation of structure equation modeling.

	CMIN	p	RMR	AGFI	TLI	GFI	NFI	CMIN/DF	IFI	CFI
Fit of Model	979.317	0.000	0.045	0.936	0.919	0.911	0.932	2.014	0.941	0.931
Standard			<0.05	≥0.9	≥0.9	≥0.9	≥0.9	>1, <3	≥0.9	≥0.9

Source: El-Sheikh *et al*., 2017

Table 6. Estimates of structure equation modeling.

Model	χ^2	p	DF	RMR	AGFI	TLI	GFI	NFI	IFI	CFI
Free	2137.634	0.000	986	0.041	0.927	0.924	0.937	0.901	0.921	0.914
Constrained	2151.287	0.000	992	0.043	0.923	0.921	0.936	0.901	0.921	0.857

$^{**}p < 0.01$, $^{***}p < 0.001$

Table 7. Model-wide direct effects.

	Hypothesis		Estimate	SE	CR	p	Accept or not
H1	Management risk →	Performance	− 0.312	0.045	− 6.933***	0.000	Yes
H2	Economic risk →	Performance	− 0.071	0.033	− 2.152*	0.031	Yes
H3	Occupational risk →	Performance	− 0.188	0.050	− 3.760**	0.000	Yes
H4	Environmental risk →	Performance	− 0.198	0.029	− 6.828***	0.000	Yes
H5	Technical risk →	Performance	− 0.041	0.022	− 1.864	0.063	No

Table 8. Mediating effect of risk perception in Karachi, Thatta and Sujawal.

	Hypotheses	Estimate (Karachi)	CR (Karachi)	Accept or not (Karachi)	Estimate (Thatta and Sujawal)	CR (Thatta and Sujawal)	Accept or not (Thatta and Sujawal)
H1	Management risk → Performance	− 0.421	− 2.657**	Yes	0.362	2.554**	Yes
H2	Economic risk → Performance	− 0.072	− 0.781	No	− 0.287	− 2.939**	Yes
H3	Occupational risk → Performance	0.298	2.568**	Yes	− 0.210	− 1.979*	No
H4	Environmental risk → Performance	− 0.047	− 0.598	No	− 0.062	− 0.557	No
H5	Technical risk → Performance	0.445	3.243***	Yes	0.527	3.561***	Yes

*p < 0.05, **p < 0.01, ***p < 0.001

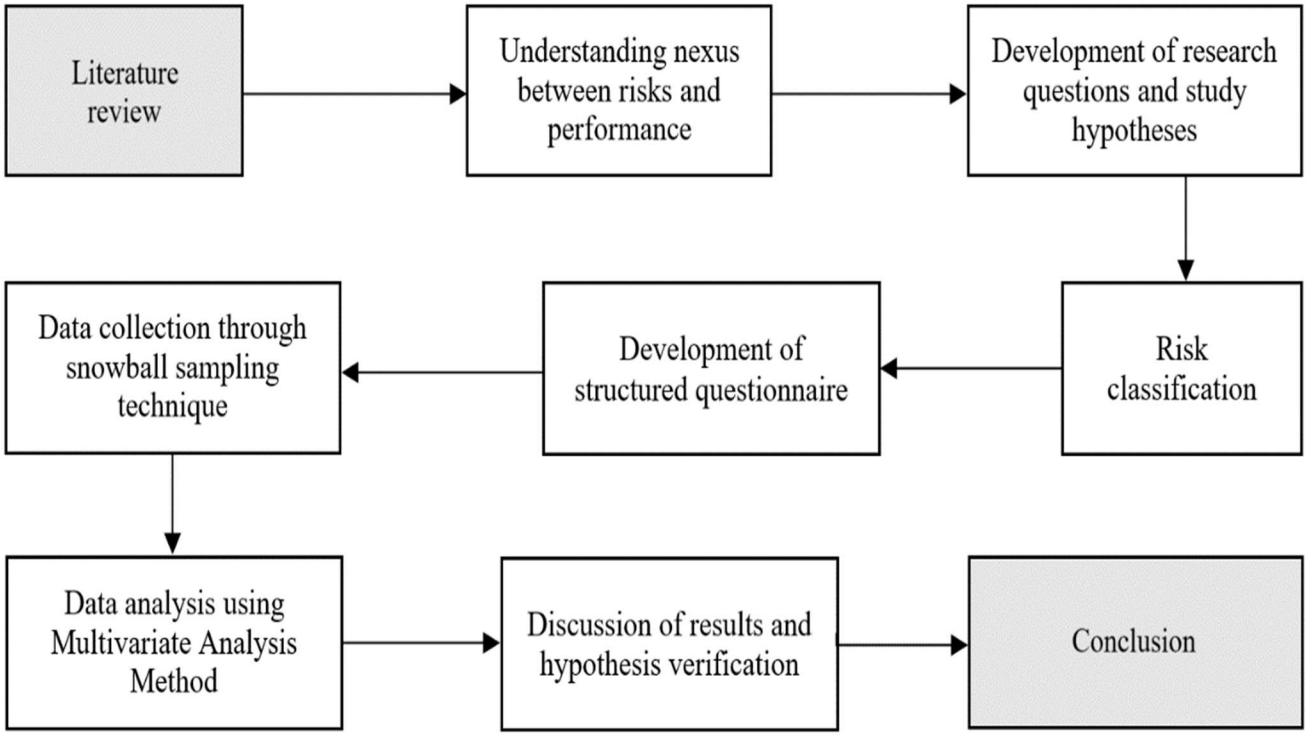

Figure 1. Study framework.

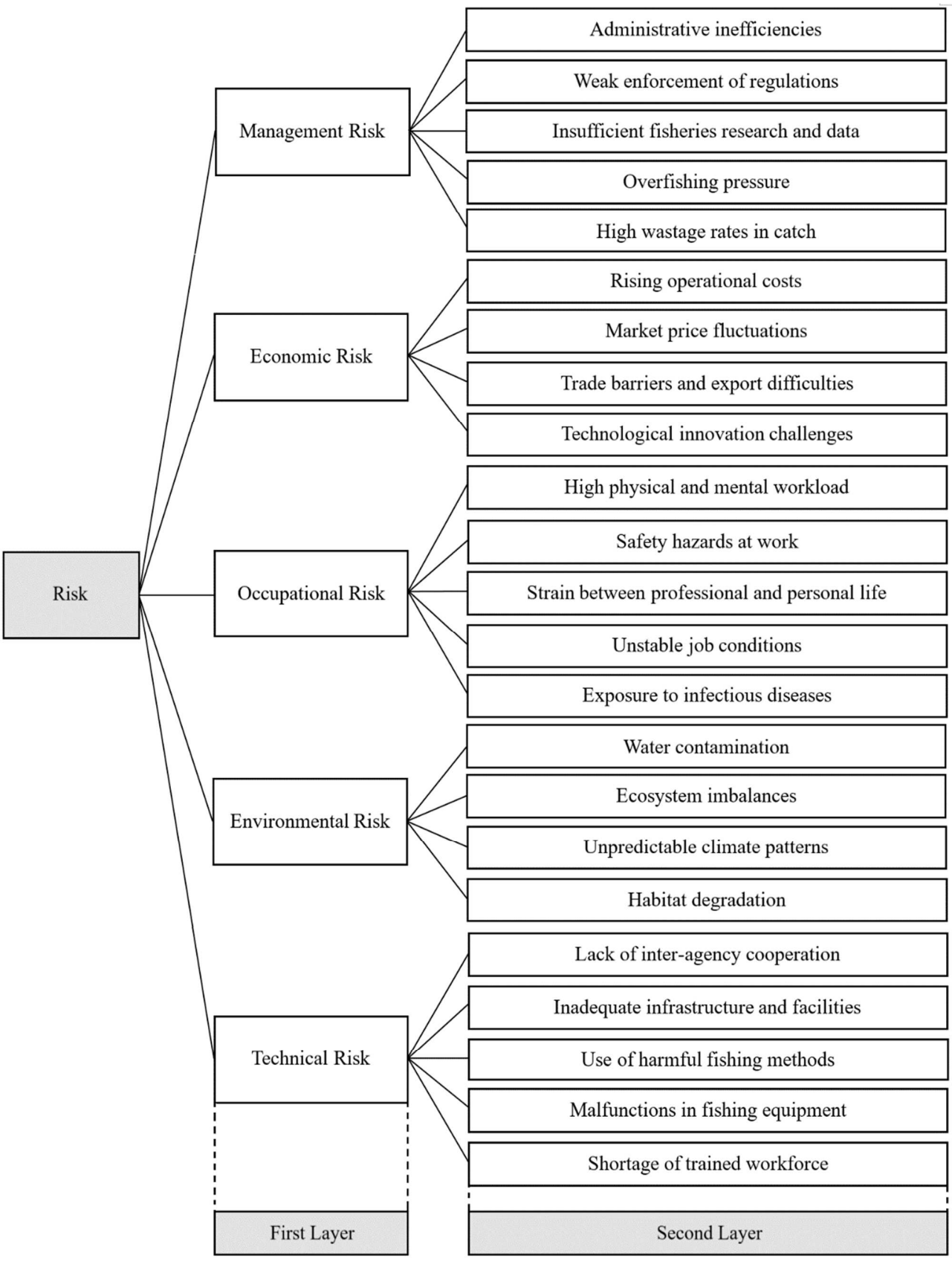

Figure 2. Risk classification.

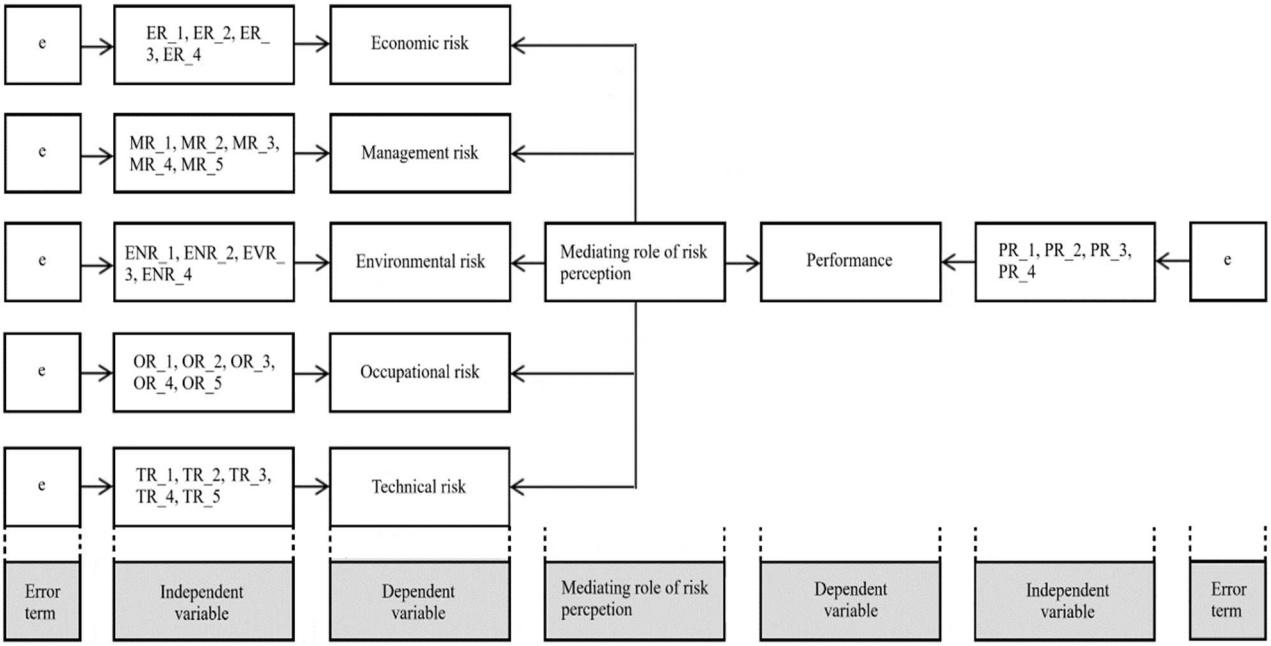

Figure 3. Research model.

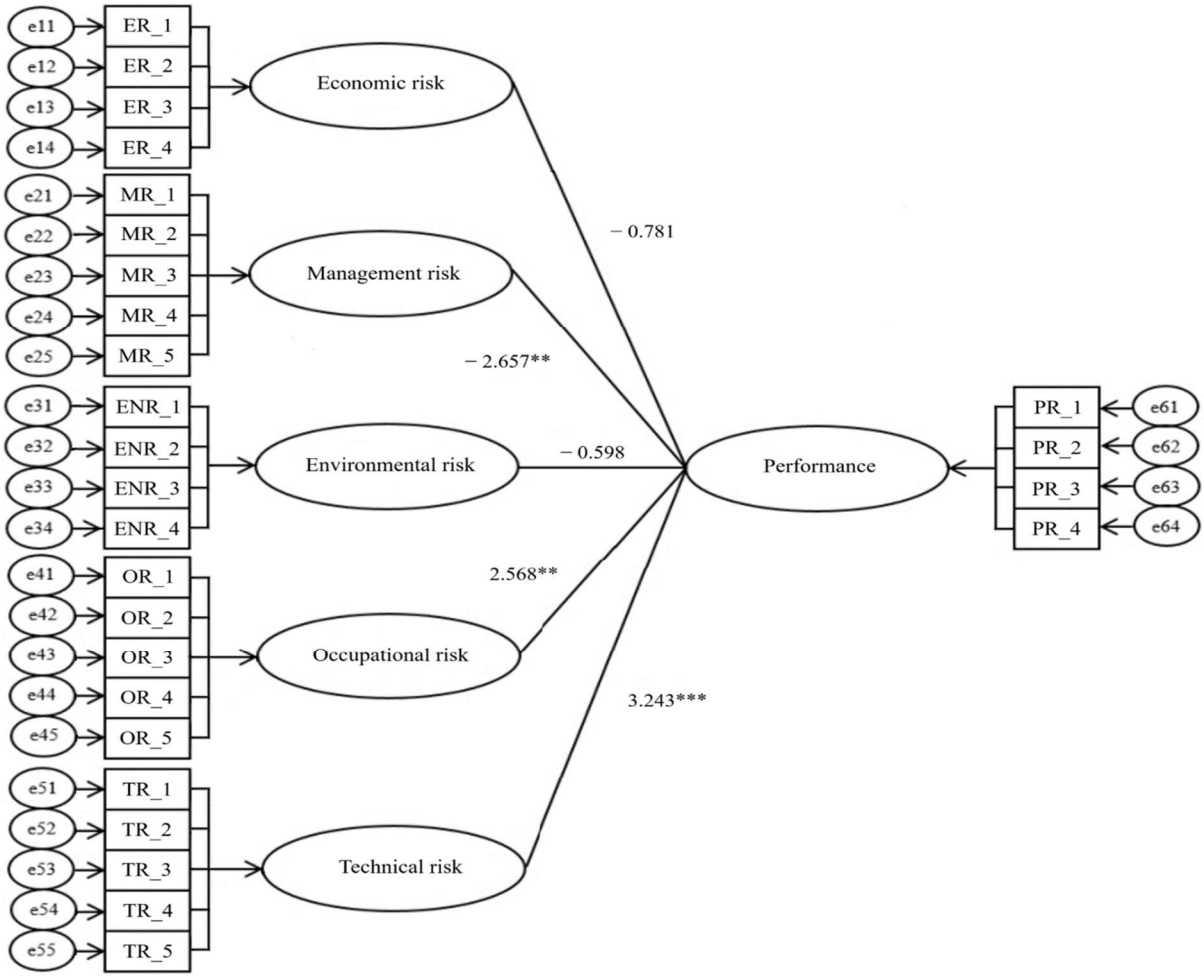

Figure 4. Path diagram for Karachi.

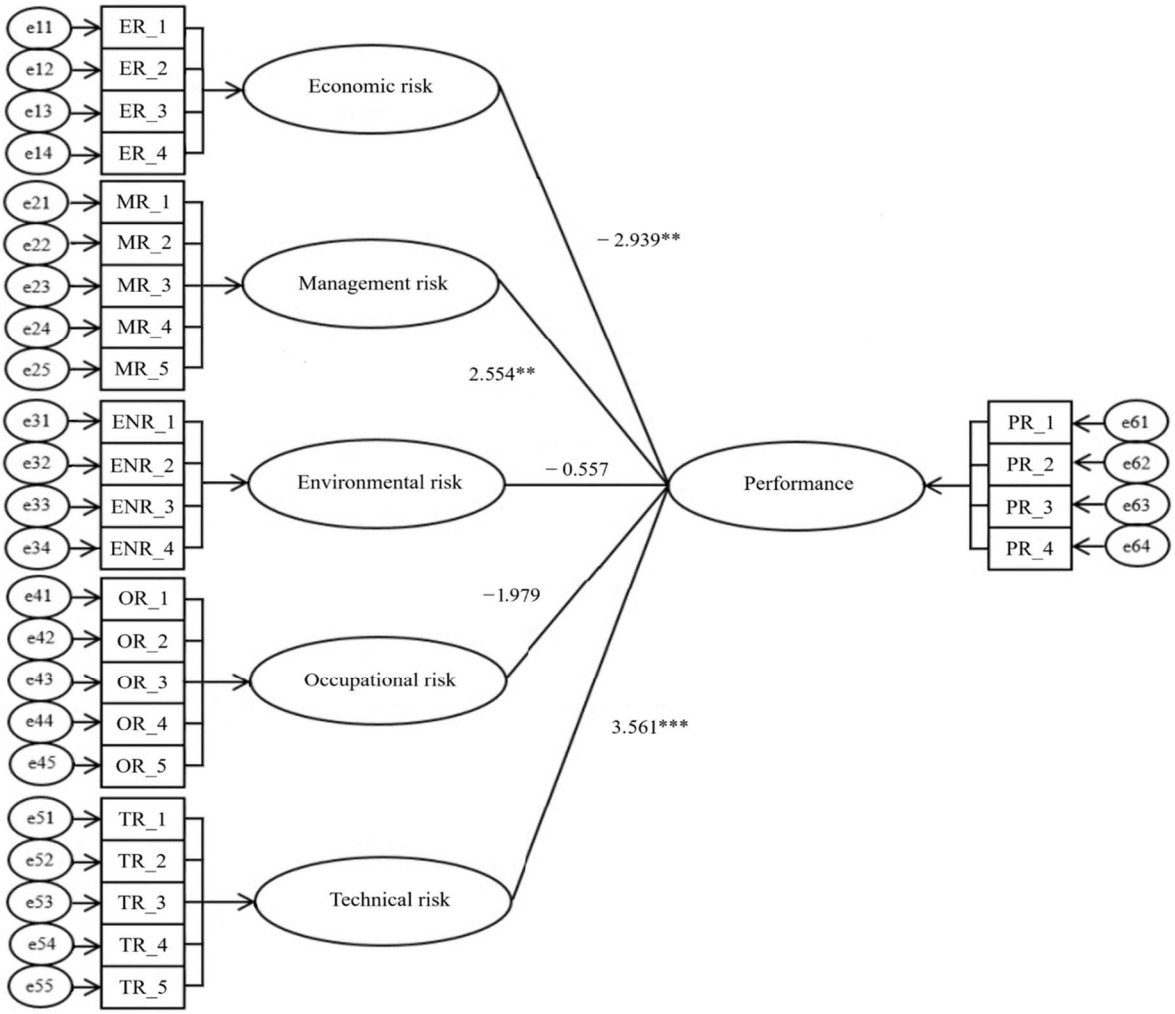

Figure 5. Path diagram for Thatta and Sujawal.

DISCUSSION

The goal of this study was to look at the relationship between risk management and performance in the fishing sector, as well as the mediating role of risk perception in this relationship. Using SEM, several key results are achieved that can give evidence-based targeted interventions to improve the fishing sector's contribution to Pakistan's economy. First, Pakistan's fisheries sector faces a variety of risks, which have been classified into five main types: management risk, economic risk, occupational risk, environmental risk, and technical risk. This result is consistent with previous research that has identified the fishing industry as vulnerable to a variety of risks (Noman *et al*., 2022; Mehak *et al*., 2023). Second, there is an inverse link between different types of risks and their effects on performance. However, the magnitude of the impact varies depending on the risk. Third, risk perception significantly determines risk-performance relationships. The accessible online literature evaluates the mediation effect of risk and supports the findings of this study (Joffre *et al*., 2018; Sugiardi *et al*., 2021). To estimate the mediating effect of risk perception, we employed a mediation analysis approach, where risk perception serves as the mediator in the relationship between the risk factors (e.g., management risk, economic risk, etc.) and performance. The CR values for each hypothesis reflect the significance and direction of the relationship for each region, which allows us to assess whether risk perception mediates the effect differently across regions. Specifically, a significant difference in CR values between Karachi, Thatta, and Sujawal indicates that the mediating role of risk perception varies in these regions, suggesting that its influence on the relationship between risk factors and performance is region-specific. We used standard bootstrapping techniques to confirm the significance of these indirect effects, and the values of CR indicate whether the mediation effect is statistically significant in each region.

Fisheries management is a step-by-step process, beginning with data collection and analysis and ending with the recommendation of various risk mitigation measures (Pita *et al*., 2010). The selection of stakeholders is an important step in this process because all management results will be determined by their recommendations. It is preferable to get feedback from multiple stakeholders. Data obtained from multiple stakeholders yields more trustworthy results since it better represents various sectors of the industry (Berghofer *et al*., 2008; Msomphora, 2015). This study analyzed data from numerous stakeholders and discovered that fisheries are vulnerable to a variety of threats. Data research found that all categories of risks reduce performance, with management risks having the greatest negative impact. This argument is supported by published research (Williams *et al*., 2011; Gourguet *et al*., 2014). Several studies have identified Pakistani fisheries as victims of overexploitation (Mohsin *et al*., 2017; Raza *et al*., 2022). Despite different catch regulations, practical control over overfishing is ineffective. The ineffective execution of fisheries law in Pakistan also impedes the achievement of needed management aims. This condition is exacerbated by operational challenges and a high waste rate (Noman *et al*.,2022). Furthermore, efficient fisheries management is impossible due to Pakistan's current data scarcity (Raza *et al*., 2023).

A variety of disciplines have investigated the impact of risk perception on the relationship between risk management and culminating risks (Brender and Markov, 2013; Wachinger *et al*., 2013; Jia *et al*., 2020). In this context, Pakistani fisheries are never assessed. Table 8 is a representation of the mediation effect, which is the distinction between the results of Karachi and Thatta and Sujawal. Online literature indicates that an increase in risk perception results in a positive correlation between risk and its management (Sethi, 2010; Joffre *et al*., 2018). Therefore, risk perception is the initial stage in mitigating risks, as it serves as the foundation for regulatory formulation and increases public awareness of potential hazards (Bergfjord, 2009). Low levels of risk perception associated with fisheries were reported by 83% of the survey respondents. They recommended the implementation of evaluation systems, reward systems, and training to improve performance. Numerous initiatives have been implemented by international organizations, including the Food and Agriculture Organization (FAO), to provide fishermen with training. Additionally, survey respondents indicated that they intended to enhance the effectiveness and efficiency of the training. An incentive-based system is a globally successful approach to enhancing organizational performance (Meirinhos *et al*., 2023). After conducting a comprehensive analysis of the advantages and disadvantages, it is feasible to implement such a system in Pakistan with appropriate modifications. The most significant obstacle is the successful execution of current management policies. This can be accomplished through the training of fishery officers. Furthermore, performance can be enhanced by improving coordination among various departments. This can be significantly facilitated by the implementation of specialized fishery police and tribunals (Fenichel *et al*., 2008; Johnson and Welch, 2009).

This study confers numerous implications as well as constraints. Such as risk management and risk communication strategies can be developed by gaining a more comprehensive understanding of risks and risk perceptions. By integrating a variety of extant risk theories that have been analyzed, it is anticipated that additional targeted efforts could offer a more comprehensive understanding of the definition of fisheries risk that individuals have. Surveys were conducted among a variety of stakeholders in the fisheries sector to investigate their perceptions of disparities in perception. This type of analysis is frequently restricted by the fact that it only offers a sampling of the perspectives of various individuals or sectors regarding their fisheries. Furthermore, this study lacks multi-group analysis which can be included in the future studies. Moreover, the SEM approach in fisheries research may oversimplify complex, dynamic interactions between various risks and their impacts, as it assumes a linear relationship between variables. It also requires large sample sizes for accurate estimation, which can be difficult to achieve in small or geographically limited populations, such as specific fishing communities. Additionally, the model's reliance on self-reported data can introduce biases, as participants' perceptions of risk may not always align with actual conditions, affecting the reliability of the results.

Conclusion: This study examined the relationship between risk management and performance in Pakistan's fisheries sector, with a focus on the mediating role of risk perception. The findings highlight that the sector encounters various risks, including management, economic, occupational, environmental, and technical, with each affecting performance to different extents. Notably, management risks were found to have the most significant negative effect on performance, a result consistent with prior research indicating the vulnerability of Pakistan’s fisheries to mismanagement and overexploitation. Risk perception was identified as a key mediator in the relationship between risk factors and performance, with significant regional differences observed between Karachi, Thatta, and Sujawal. This suggests that interventions to mitigate risks should be tailored to the specific context of each region. Furthermore, improving risk perception through awareness and training programs was identified as a crucial step in enhancing performance. The study

underscores the need for targeted risk management strategies, better enforcement of existing policies, and improved coordination among stakeholders.

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Fisheries Questionnaire Survey
(Karachi, Thatta and Sujawal)

Part I
Personal Information

Instructions: Please fill out this form truthfully.

1. Name: _____
2. Relationship status: Married: ☐ Unmarried: ☐
3. Gender: Male: ☐ Female: ☐
4. Age: 21~40 years: ☐ 41~60 years: ☐
5. Qualification: Primary school: ☐ From secondary school to masters: ☐
6. Area: Karachi: ☐ Thatta: ☐ Sujawal: ☐
7. Professional experience: 11~15 years: ☐ 15 years or more: ☐
8. Stakeholder group: Fishermen: ☐ Researchers: ☐
Public or private bodies: Consumers: ☐ ☐

Part II
Relationship between Risks and Performance

Instructions: Does risk sub-factors affect performance? Tick only one box.

1. Management Risk

Question	Not at all certain	Somewhat certain	Moderately certain	Very certain	Completely certain
1.1 Administrative inefficiencies					
1.2 Weak enforcement of regulations					
1.3 Insufficient fisheries research and data					
1.4 Overfishing pressure					
1.5 High wastage rates in catch					

2. Economic Risk

Question	Not at all certain	Somewhat certain	Moderately certain	Very certain	Completely certain
2.1 Rising operational costs					
2.2 Market price fluctuations					
2.3 Trade barriers and export difficulties					
2.4 Technological innovation challenges					

3. Occupational Risk

Question	Not at all certain	Somewhat certain	Moderatel y certain	Very certain	Completel y certain
3.1 High physical and mental workload					
3.2 Safety hazards at work					
3.3 Strain between professional and personal life					
3.4 Unstable job conditions					
3.5 Exposure to infectious diseases					

4. Environmental Risk

Question	Not at all certain	Somewhat certain	Moderately certain	Very certain	Completely certain
4.1 Water contamination					
4.2 Ecosystem imbalances					
4.3 Unpredictable climate patterns					
4.4 Habitat degradation					

5. Technical Risk

Question	Not at all certain	Somewhat certain	Moderately certain	Very certain	Completely certain
5.1 Lack of inter-agency cooperation					
5.2 Inadequate infrastructure and facilities					
5.3 Use of harmful fishing methods					
5.4 Malfunctions in fishing equipment					
5.5 Shortage of trained workforce					

Part III
Risk Perception and Performance

Instructions: Tick only one box.

6. Performance

Question	Very dissatisfied	dissatisfied	OK	Satisfied	Very satisfied
6.1 Fisheries sector overall performance					
6.2 Initiatives to boost performance					
6.3 Level of risk perception among people					
6.4 Polices strengthening risk perception					