

PRIORITIZING RISKS IN PAKISTAN'S FISHERIES SECTOR: A STRATEGIC ANALYSIS UTILIZING FUZZY AHP AND IPA METHODOLOGIES

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ABSTRACT

In Pakistan, the fisheries sector plays a vital role in providing livelihood to millions of people and contributing to the national GDP. However, this sector's contribution is far less than its potential. Published literature blames various risks faced by this sector to be responsible for this occurring. However, it does not compare, and rank risks based on their importance for directional management, which can help improve this prevailing situation. In this regard, the present study represents a pioneering and comprehensive investigation. Primary data was acquired from 317 survey respondents representing various fisheries stakeholders from Balochistan between 13 November 2023 and 9 February 2024. Fuzzy Analytic Hierarchy Process (fuzzy AHP) and Importance Performance Analysis (IPA) were utilized as statistical analysis tools. According to this study, the main risks confronted by the fisheries sector in Balochistan revolve around management risk (0.431), economic risk (0.212), and occupational risk (4.861). The most significant sub-risks affecting this sector are intense fishing (0.114), problems related to trade (0.088), and excessive discard rate (0.068). There is a dire need to focus on significant risks to improve the fisheries sector performance. Moreover, survey respondents also reported low levels of risk perception and suggested improving the prevailing situation by implementing rewards systems and performance evaluation programs.

Keywords: Fisheries, Management, Performance, Fuzzy AHP, IPA, Pakistan

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INTRODUCTION

The term "risk" is frequently employed to describe various potential threats associated with the fisheries sector (Sethi, 2010). Risk is fundamentally an instinctive judgment of some unexpected future event (Shrestha *et al.*, 2022). The fisheries sector is prone to diverse risks related to its inherited uncertain and changing nature (Chen *et al.*, 2021). This phenomenon is prevalent within the Pakistani fisheries sector. Pakistan's fishing industry is crucial to strengthening coastal communities' economies by providing business opportunities for thousands of fishermen's families. Exports from the fishing industry also constitute a significant part of the national GDP. Unfortunately, the fisheries sector's economic role is much less than its potential (Mehmood *et al.*, 2020; Rehman *et al.*, 2019). Moreover, studies suggest various risks as a fundamental reason for this sector's diminishing contribution to the national economy (Noman *et al.*, 2022).

In particular, the risk of overexploitation, it is frequently discussed in the published literature. Due to the risk of overexploitation, many fish stocks have

considerably decreased their production quantities (Mohsin *et al.*, 2017) resulting in lower export earnings. The uncontrolled operation of trawlers at the bottom has severely ruined the bottom aquatic ecosystem necessary for many fish species to thrive (Ul-Hassan *et al.*, 2021). Pakistan's fisheries sector is also plagued by a high discard rate and poor transportation facilities (Mehak *et al.*, 2023). Pollution is a significant issue in Pakistan's coastal waters. Several commercially significant types of fish such as shrimp cannot flourish well in polluted waters resulting in reduced production quantities. Pollution also causes various diseases in aquatic animals, making them unsuitable for consumption (Jilani, 2018; Elgendy *et al.*, 2023). Lack of product and market diversification are significant hurdles in promoting the fisheries trade. Thus, this sector is exposed to diverse risk factors that should be addressed in order to revive it in Pakistan.

To deal with fisheries risks, a precautionary approach is suggested (Sadik-Zada *et al.*, 2023). This approach targets avoiding risks and forms a fundamental fisheries risk management strategy. Fisheries risk management comprises two primary stages. The first

stage involves risk reporting and characterization, whereas the second stage proposes mitigation strategies (Sethi, 2010). In Pakistan, several national and provincial fisheries laws are in place (Noman *et al.*, 2022). However, the continuous existence of certain types of risks such as overexploitation makes the current management regime questionable. The problem of fisheries management failure is deeply rooted in policymaking that fails to compare and identify the most significant challenges in terms of their management and performance aspects (Mohsin *et al.*, 2021). Several risk mitigation policies have been implemented in Pakistan to encounter risks. Controlling overexploitation through mesh size restriction, closure seasons, catch quantity, effort control, and restriction of destructive fishing are in practice. Various other aspects of the fisheries, such as licensing and punishment systems, have also been developed to mitigate different risks. However, despite these initiatives and controlling measures, desired results have yet to be achieved, raising questions about policy implementations (Nisar *et al.*, 2021; Mohsin *et al.*, 2021; Noman *et al.*, 2022).

Decision analysis is a renowned and dependable way to make management decisions. When dealing with multiple risks according to stakeholder's perceptions decision analysis is the best choice (Rossetto *et al.*, 2015). Multi-criteria decision analysis (MCDA) is usually used to analyze several possibilities by taking into account a number of criteria or risk management goals. Rather than suggesting strict decision choices, MCDA makes it possible to identify an acceptable option (Estevez and Gelcich, 2015; Vergara-Solana *et al.*, 2019). In MCDA reasoning, the first phase involves identifying the criteria to be considered during the decision process. These criteria serve as the metrics employed to assess the various options. Following this, significance levels are assigned to the identified criteria through weighting, which denotes how critical they are. Alternative efficiency is then objectively evaluated using stated criteria. The last step in selecting the optimal choice is to rank all alternatives according to their aggregate performance (Diaz-Balteiro *et al.*, 2020; Sousa *et al.*, 2021).

Applications of MCDA are in several fields, such as governance, enterprise, sustainability, and medical care (Abdullah *et al.*, 2021; Basilio *et al.*, 2022). The MCDA framework offers a variety of tools and procedures, such as the Analytic Hierarchy Process (AHP), Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), and Preference Ranking Organization Method for Enrichment Evaluation (PROMETHEE). Particular methods are chosen based on the characteristics of a particular problem. MCDA offers a structured and methodical strategy that enables stakeholders to weigh different criteria and goals (Rossetto *et al.*, 2015).

AHP is an extraordinary tool that helps rank options quantitatively by involving tangible and intangible aspects of the decision problem (Subramanian and Ramanathan, 2012). It breaks complex problems into simpler elements and makes decision choices easy (Chang, 1996; Chan and Kumar, 2007). To evaluate performance management, Importance Performance Analysis (IPA) is the most reliable choice. However, IPA develops a relationship between management and performance according to various attributes. With its peculiar type of analysis called "Quadrant Analysis," it identifies areas of improvement and suggests better resource allocation, thereby improving performance. It is necessary to mention that AHP and IPA are used for different purposes (Jiang *et al.*, 2023). AHP helps to make decisions about management aspects, whereas IPA focuses on improving ongoing management performance. Due to these advantages and the relevance of AHP and IPA to this study, both are utilized.

Online literature documents various risks associated with the fisheries sector in Pakistan (Mohsin *et al.*, 2021). However, it has three major flaws. First, it does not comprehensively study all types of risks within the context of the Balochistan fisheries sector. Instead, it mostly discusses selected risk types individually. Furthermore, it needs to conduct a comparative analysis of different risks and rank them according to their importance. This prevents management from effectively addressing the most critical risks and resorting to uninformed decision-making. Third, by using large dependable samples of data to suggest reliable management solutions, it is not necessary to use specialized management statistics. Thus, this study is the first-time attempt in this regard. This study strives to answer the following three research questions:

- 1) Are risks confronting the development of the fisheries sector in Balochistan?
- 2) Which risks should be targeted to improve management?
- 3) How can the performance of the existing management be increased?

MATERIALS AND METHODS

Data collection: A desk study was done to gather relevant published online literature. This literature review helped to form a list of risks confronted by the fisheries sector. This list was discussed later with the stakeholders and edited. Thus, the risks presented in this study are practically associated with the fisheries sector of Balochistan. Risk classification was done by following the descriptions of Tingley *et al.* (2010) and Gray *et al.* (2010). This risk classification is presented in Figure 1. To fetch statistical data, a questionnaire survey was prepared incorporating fuzzy AHP and IPA elements. Stakeholders reviewed this questionnaire to check its

consistency and relevancy to this planned study. Data was collected between 13 November 2023 and 9 February 2024. In total 317 questionnaires, CR less than 0.1, were suitable for analysis. The survey response rate was higher in Lasbela (78%) than Gwadar (67%). Survey response rates were estimated by dividing the number of completed surveys by the total number of sent surveys and multiplying by 100.

Data analysis: Data was analyzed by using fuzzy AHP and IPA statistical routines. Saaty created the AHP approach, which is based on a hierarchical arrangement of complex risk factors acknowledged by experts (Sipahi and Timor, 2010). This attribute distinguishes this technique since it can aid in analyzing complex topics through logical evaluation based on expert judgments. AHP breaks down intricate issues into smaller, simpler, comparable components, allowing experts to understand risk's linked nature of risks. However, the traditional AHP technique does not account for human reasoning's non-numerical uncertainty. To overcome this problem and strengthen the decision-making process, fuzzy AHP provides a holistic and reliable assessment of the issue. Fuzzy AHP compares pairs of risks using a 9-point distinct preference scale (Liberatore and Nydick, 2008; Sipahi and Timor, 2010; Ho and Ma, 2018). The 9-point scale offers more detailed choices of options for the survey participants as compared to the 5-point scale. Therefore, a 9-point scale was adopted in this study. In this scale, weights are assigned to each risk factor to indicate its relative importance. Fuzzy AHP evaluations reflect and match human risk perceptions. Statistically speaking, fuzzy AHP consists of multiple steps. The initial stage is to compare risk pairs, denoted linguistically by i and j . Experts ranked these pairings during the survey. The second step is to ensure the survey data's reliability, also known as consistency. For this, consistency ratio (CR) was calculated. The threshold value of CR was set as 0.1 which meant surveys having CR greater than 0.1 could not be included in the analysis. CR estimation was represented as follows:

$$CR = \frac{\frac{\lambda_{max} - n}{n - 1}}{RI} \quad (1)$$

Here, n represents the number of risk pairs, whereas λ_{max} represents the eigenvalue (maximum). On the other hand, RI is a random index, and its value depends on the matrix. In the third step, the triangular fuzzy function was employed to calculate the fuzzy equivalents. This process was expressed as follows:

$$l_{ij} = \frac{K}{\prod_{k=1}^l l_{ijk}^{\frac{1}{K}}}; \quad m_{ij} = \frac{K}{\prod_{k=1}^m m_{ijk}^{\frac{1}{K}}}; \quad u_{ij} = \frac{K}{\prod_{k=1}^u u_{ijk}^{\frac{1}{K}}} \quad (2)$$

In the above equations, l_{ij} (upper), m_{ij} (middle), and u_{ij} (lower) indicate widths of pairwise comparisons. K denotes the survey participants number. In the fourth

step, an extent analysis was performed. This analysis dealt with the issue of vagueness in the judgments of survey participants. For this analysis, two sets, viz., object (X) and goal sets (U) were estimated using the two following equations correspondingly:

$$X = \{x_1, x_2, x_3, \dots, x_n\} \quad (3)$$

$$U = \{u_1, u_2, u_3, \dots, u_n\} \quad (4)$$

The following equation represents the overall process of the extent analysis:

$$l_{ij} = \left(\prod_{k=1}^K l_{ijk} \right)^{1/K}; \quad m_{ij} = \left(\prod_{k=1}^K m_{ijk} \right)^{1/K}; \quad u_{ij} = \left(\prod_{k=1}^K u_{ijk} \right)^{1/K} \quad (5)$$

Later on, M value addition was done by involving a triangular number (fuzzy). This process was illustrated as follows:

$$\sum_{j=1}^m M_{gi}^j = \left(\sum_{j=1}^m l_j, \sum_{j=1}^m m_j, \sum_{j=1}^m u_j \right) \quad (6)$$

In above equation, i varied between 1 to n . Furthermore, sum of the entire fuzzy number was calculated as follows:

$$\left[\sum_{j=1}^n \sum_{j=1}^m M_{gi}^j \right] = \left[\sum_{j=1}^n \sum_{j=1}^m l_j, \sum_{j=1}^n \sum_{j=1}^m m_j, \sum_{j=1}^n \sum_{j=1}^m u_j \right] \quad (7)$$

The inverse of the above function was also used and was described as follows:

$$\left[\sum_{j=1}^n \sum_{j=1}^m M_{gi}^j \right]^{-1} = \left(\frac{1}{\sum_{i=1}^n u_1}, \frac{1}{\sum_{i=1}^n m_1}, \frac{1}{\sum_{i=1}^n l_1} \right) \quad (8)$$

A comparison was conducted between pairs of fuzzy numbers. Each pair was represented as follows:

$$M_1 = (l_1, m_1, u_1) \quad (9)$$

$$M_2 = (l_2, m_2, u_2) \quad (10)$$

After comparing triangular numbers (fuzzy), their minimum value was determined using the following equation:

$$D'(A_i) = \min V(S_i \geq S_k) \quad (11)$$

In this equation, S represents probability and A_i denotes risk factors number from 1 to n . Ultimately, the weight factor was estimated by using the following equation:

$$W' = [d'(A_1), d'(A_2), \dots, d'(A_n)]^T \quad (12)$$

In this equation, $d'(A_i)$ indicates the score given to each decision option. Normalization of the weights was done to ensure no non-fuzzy numbers in the estimated weights. This normalization process was represented as follows:

$$d(A_i) = \frac{d'(A_i)}{\sum_{i=1}^n d'(A_i)} \quad (13)$$

Finally, to ensure accuracy in the estimated importance values, a sensitivity analysis was conducted. For this, the initial degree of fuzziness was set to zero (Mouhoumed *et al.*, 2023).

Besides fuzzy AHP, IPA was also utilized in this study. IPA is a specialized statistical tool to evaluate performance aspects of ongoing management (Eggert *et al.*, 2021). This technique helps managers identify potential improvement areas. A more efficient use of management resources is also suggested. Various fields employ this method because of its reliable results (Phadermrod *et al.*, 2019; Lin, 2020). IPA comprises a particular type of analysis known as Quadrant Analysis (Figure 2). This analysis distributes the study's risk factors into four quadrants specified by their estimated performance and importance attributes. Performance attributes are generally plotted on the x-axis. On the other hand, importance is placed on the y-axis. Thus, a grid is formed between performance and importance with four quadrants, i.e., quadrant 1 representing low performance and high importance attributes of the risk factors. On the other hand, quadrant 2 indicates high performance and high importance. In contrast, quadrant 3 encompasses low performance and low importance attributes. The last quadrant, 4, represents low performance and high importance. Quadrant 1, "concentrate here", comprises those risk factors that need serious managerial attention. Thus, management should input more resources to improve management performance when encountering these risk factors. Quadrant 2, "keep up with the good work" highlights those risk factors for which the current management regime works well, and there is no need to change management strategy for them. Quadrant 3, "low priority" represents those risks that can be neglected due to their low performance and importance attributes. On the other hand, quadrant 4, "possible overkill" comprises risk factors for which management resources are just a waste. Using these resources to manage risks in quadrant 1 would be more effective (Deng, 2008).

RESULTS

Salient Features of Survey Respondents: Statistical data were collected in sufficient quantities for reliable results to be obtained. A total of 317 questionnaire participants completed the survey. A detailed breakdown of survey participants is displayed in Table 1. There were 56 unmarried participants (17.6%) and 261 married participants (82.4%) in the survey population. The majority of the research sample comprised of 290 male participants (91.5%), followed by 27 female participants (8.5%). Participant's age demographics revealed that 34 of them (10.7%) were between 25 and 34 years old, 263 (82.9%) were aged between 35 and 54, and 20 (6.4%) were between the 55 and 65 age group. Participant age demographics revealed that 34 individuals (10.7%) were

between 25 and 34 years old, 263 participants (82.9%) were aged 35-54, and 20 individuals (6.4%) were in the 55-65 age group. Regarding geographical distribution, 146 participants (46.1%) hailed from Lasbela, while 171 (53.9%) originated from Gwadar. In terms of professional experience, participants were classified as follows: 76 (23.9%) with 5 to 9 years, 83 (26.2%) with 10 to 14 years, and 158 (49.9%) with 15 years or more. About the stakeholder group, 67 participants (21.1%) identified themselves as fishermen, 71 (22.4%) were affiliated with fishing companies, 52 (16.4%) were associated with public or private organizations, 48 (15.2%) were involved in research, and 79 (24.9%) were categorized as well-aware consumers.

Fuzzy AHP Ranking of Main Risk Factors for Balochistan: Table 2 analyzes the estimated prioritization of fuzzy AHP scores for the main risk factors, as determined by their assigned weights (local). The hierarchy places management risk (MR) (0.431) at the top, succeeded by economic risk (ER) (0.212), with technical risk (TR) (0.176) taking third place, and occupational risk (OR) (0.123) and environmental risk (ENR) (0.058) following suit at fourth and fifth places, respectively.

Fuzzy AHP Ranking of Risk Sub-Factors: In Figure 3, the rankings of risk sub-factors for Balochistan, computed through fuzzy AHP and considering their local weights, are showcased. The hierarchy of ER sub-factors, arranged from most to least important, included trade-related issues (TRI) (0.401), escalating fishing costs (IFC) (0.258), technological advancements (TA) (0.194), and price volatility (PV) (0.147). Furthermore, MR sub-factors were arranged in descending order of significance, with intense fishing (IF) (0.421), inadequate legislative implementation (ILI) (0.286), excessive discard ratio (EDR) (0.139), operational issues (OI) (0.103), and scientific knowledge about fisheries (SKF) (0.051) following in that sequence. Moreover, ENR sub-factors were arranged in descending order of significance, with habitat damage (HD) (0.411), pollution (PO) (0.321), environmental disruption (ED) (0.207), and erratic temperature (ET) (0.151) following in that sequence. Moreover, TR sub-factors were categorized by importance, with the lack of skilled and educated workers (LSEW) (0.386), lack of coordination between agencies (LCA) (0.242), destructive fishing techniques (DFT) (0.211), infrastructure shortage (IS) (0.085), and equipment failure (EF) (0.076) correspondingly. Similarly, OR sub-factors were prioritized from highest to lowest importance, including high job demands (HJD) (0.331), issues related to personal safety (IPS) (0.305), job insecurity (JI) (0.201), contagious disease (CD) (0.089), and work-life imbalance (WLI) (0.074) in that order.

Overall Ranking of All Risk Sub-Factors: The rankings of Balochistan's risk sub-factors, determined through fuzzy AHP and applying global weights, can be found in Table 3. The top three sub-factors, along with their corresponding importance, were IF (0.114), TRI (0.088), and EDR (0.068). In addition, the last three sub-factors, along with their respective importance, were EF (0.011), CD (0.009), and SKF (0.008), in that order.

IPA Ranking of Main Risk Factors for Balochistan:

Table 4 shows the calculated IPA rankings of the main risk factors for Balochistan. OR (4.861) secured the top rank, followed by MR (4.116), while ER (4.022) held the third position, with ENR (3.536) and TR (3.377) following suit in the fourth and fifth places, respectively.

IPA Ranking of Risk Sub-Factors for Balochistan:

Calculated IPA rankings of risk sub-factors for Balochistan are given in Figure 4. ER sub-factors were categorized by importance, with TRI (4.717), TA (4.309), ICF (4.253), and PV (4.154) being categorized from highest to lowest significance. Furthermore, management risk sub-factors were arranged in descending order of priority, highlighting EDR (4.851), IF (4.781), SKF (4.561), ILI (4.501), and OI (4.151) accordingly. Additionally, ENR sub-factors were arranged in decreasing order of significance, featuring ET (4.834),

DH (4.779), PO (4.491), and ED (3.817) in that sequence. Furthermore, TR sub-factors were arranged in descending order of priority, highlighting DTF (3.201), LCA (4.713), LSEW (4.101), IS (3.756), and EF (3.551) accordingly. Moreover, sub-factors were ranked from most to least critical, including JI (4.639), IPS (4.011), HJD (3.872), CD (3.547), and WLI (3.119), correspondingly.

Risk Management: An Improvement Assessment:

Table 5 depicts the IPA breakdown of risk sub-factors into four quadrants, according to their performance ratings. Sub-factors in quadrant 1 demonstrated significant importance but were associated with suboptimal performance levels, prompting improvement. These comprise EFC, TRI, OI, ILI, IF, EDR, PO, HD, IS, DFI, and IPS. Quadrant 2 accommodated sub-factors with substantial importance and performance, indicating their continued management. These include SKF, LCA, LSEW, JI, and CD. In quadrant 3, sub-factors exhibiting low importance and performance were identified, underscoring their low priority. These factors include PV, EF, and HJD. Sub-factors with exceptional performance but marginal importance were designated to quadrant 4, prompting a reevaluation of resource allocation towards addressing the critical sub-factors in Area 1. This group includes TA, ET, and WLI (Figure 5).

Table 1. Salient features of the survey respondents from Balochistan.

	Features	Number	Percentage
Relationship status	Unmarried	56	17.6
	Married	261	82.4
Gender	Male	290	91.5
	Female	27	8.5
Age	25~34 years	34	10.7
	35~54 years	263	82.9
	55~65 years	20	6.4
Qualification	Primary school	51	16.1
	From secondary school to masters	244	76.8
	Ph.D.	22	7.1
Area	Lasbela	146	46.1
	Gwadar	171	53.9
Professional experience	5~9 years	76	23.9
	10~14 years	83	26.2
	15 years or more	158	49.9
Stakeholder group	Fishermen	67	21.1
	Fishing companies	71	22.4
	Public or private organizations	52	16.4
	Researchers	48	15.2
	Consumers (well-aware)	79	24.9
	Total	317	100

Table 2. Fuzzy AHP ranking of main risk factors for Balochistan.

Risk	Importance	Rank
Management Risk	0.431	1
Economic Risk	0.212	2
Technical Risk	0.176	3
Occupational Risk	0.123	4
Environmental Risk	0.058	5

Table 3. Overall fuzzy AHP ranking of risk sub-factors for Balochistan.

Risk	Global weights	Rank
Intense fishing	0.114	1
Problems related to trade	0.088	2
Excessive discard ratio	0.068	3
Inadequate legislative implementation	0.066	4
Pollution	0.062	5
Damage to habitats	0.061	6
High job demands	0.057	7
Lack of coordination between agencies	0.055	8
Lack of skilled and educated manpower	0.054	9
Operational issues	0.053	10
Destructive techniques of fishing	0.048	11
Environmental disruption	0.046	12
Work-life imbalance	0.035	13
Erratic temperature	0.031	14
Issues related to personal safety	0.029	15
Increasing costs of fishing	0.028	16
Technological advancements	0.024	17
Infrastructure shortage	0.022	18
Price volatility	0.019	19
Job insecurity	0.012	20
Equipment failure	0.011	21
Contagious disease	0.009	22
Scientific knowledge about fisheries	0.008	23

Table 4. IPA ranking of main risk factors for Balochistan using estimated local weights.

Risk	Performance	Rank
Occupational Risk	4.861	1
Management Risk	4.116	2
Economic Risk	4.022	3
Environmental Risk	3.536	4
Technical Risk	3.377	5

Table 5. IPA estimates of importance and performance for Balochistan.

Code	Risk	Importance	Performance
1	Scientific knowledge about fisheries	4.561	3.112
2	Increasing costs of fishing	4.253	3.681
3	Problems related to trade	4.717	3.819
4	Issues related to personal safety	4.011	3.951
5	Operational issues	4.151	3.332
6	Inadequate legislative implementation	4.501	3.594
7	Intense fishing	4.781	3.312

8	Excessive discard ratio	4.851	3.931
9	Lack of coordination between agencies	4.713	3.491
10	Pollution	4.491	3.773
11	Price volatility	4.154	3.511
12	Damage to habitats	4.779	4.213
13	Lack of skilled and educated manpower	4.101	4.331
14	Technological advancements	4.309	4.542
15	Job insecurity	4.639	4.517
16	Erratic temperature	4.834	4.813
17	Environmental disruption	3.817	3.954
18	Infrastructure shortage	3.756	3.641
19	Equipment failure	3.551	3.875
20	Work-life imbalance	3.119	3.321
21	Destructive techniques of fishing	3.201	4.257
22	Contagious disease	3.547	4.491
23	High job demands	3.872	4.165

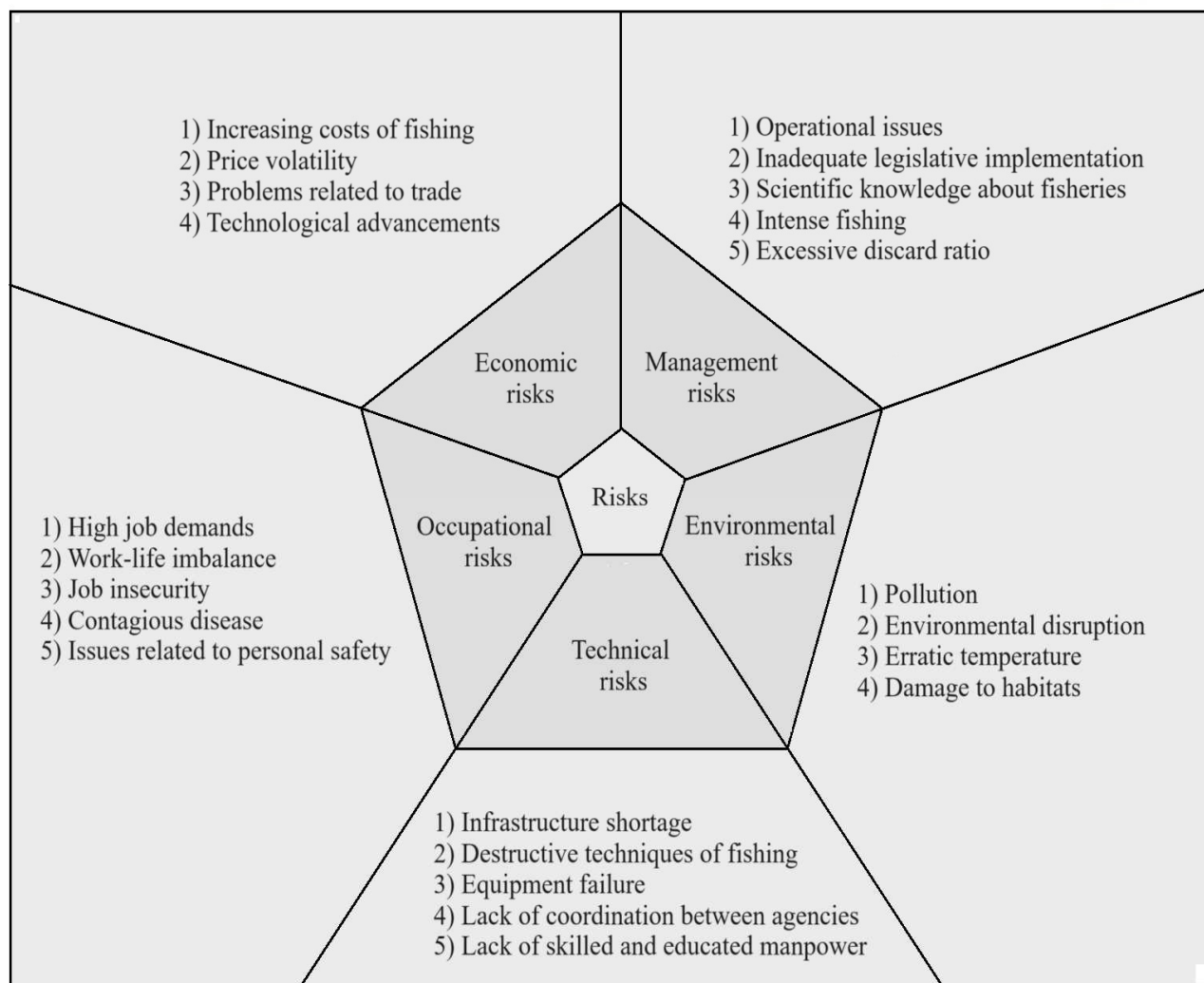


Figure 1. Hierarchical classification of risks.

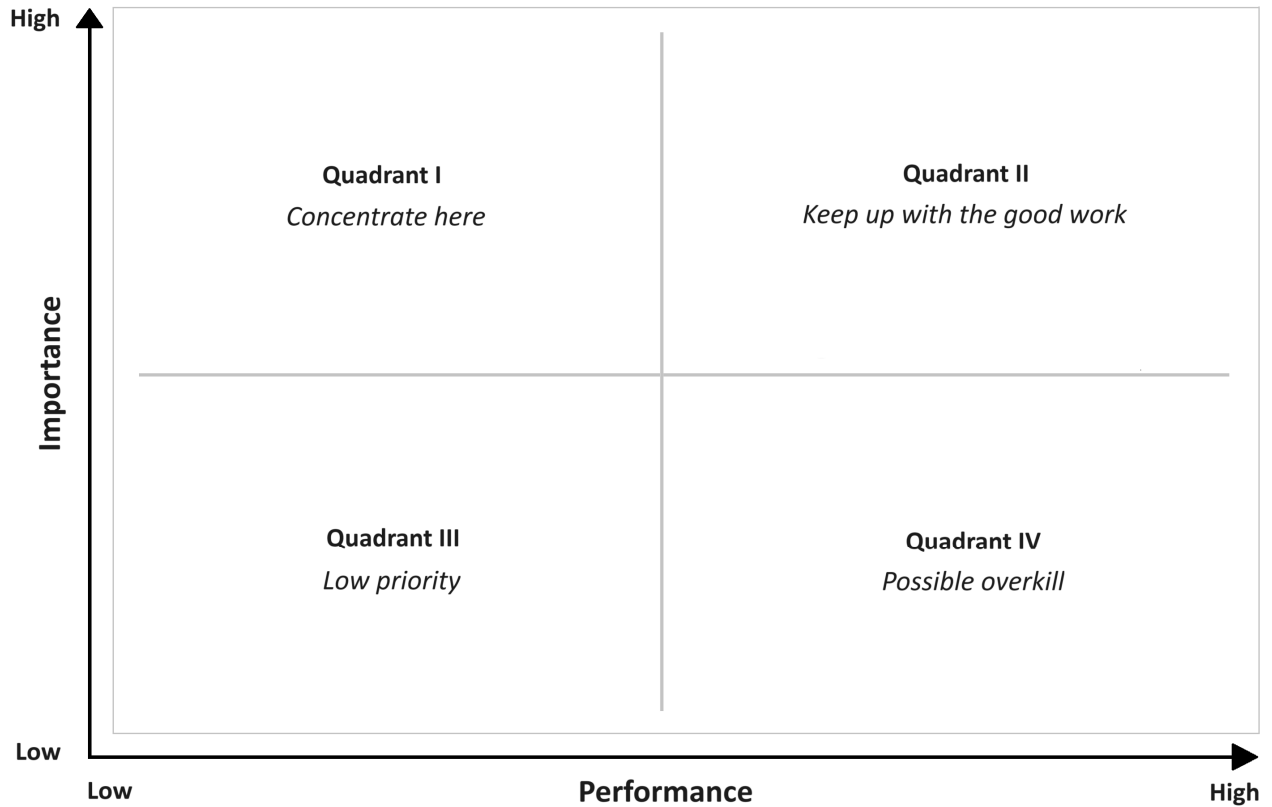


Figure 2. Graphical representation of IPA quadrant analysis.

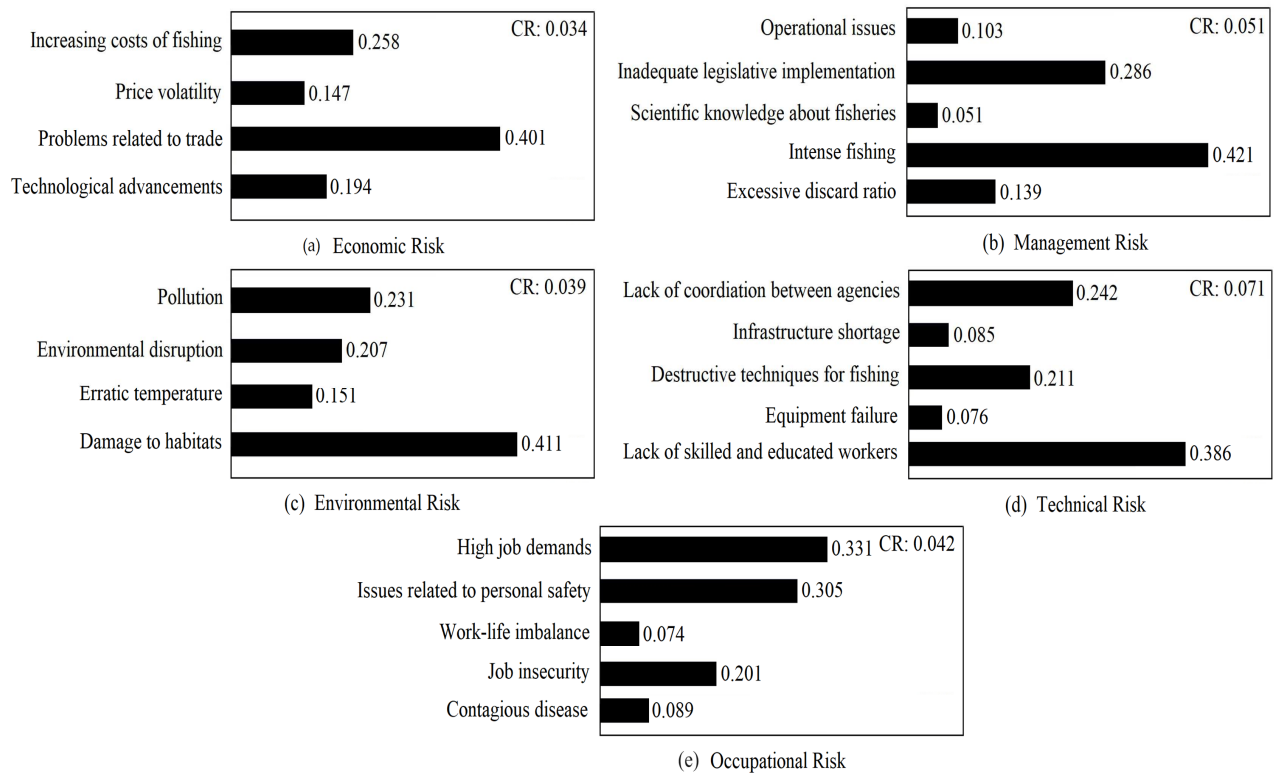


Figure 3. Fuzzy AHP ranking of sub-risks based on their local weights.

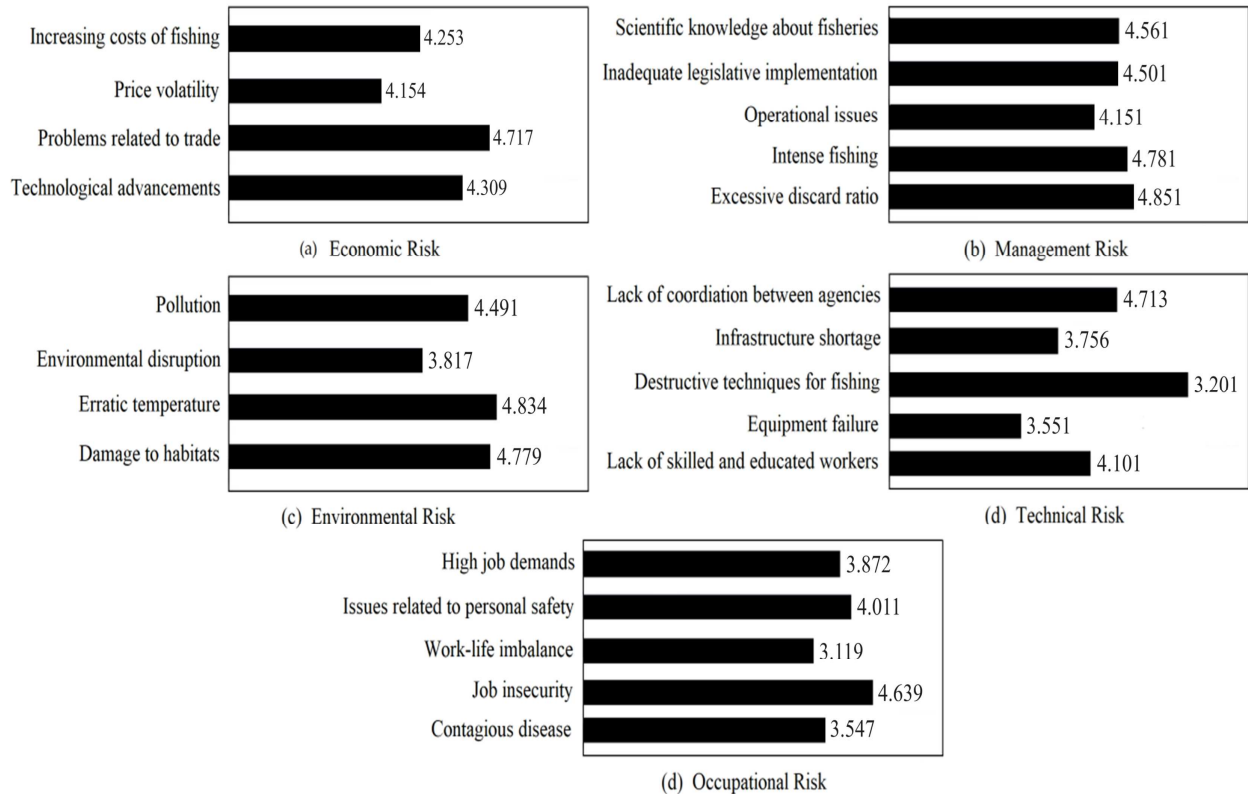


Figure 4. IPA ranking of sub-risks.

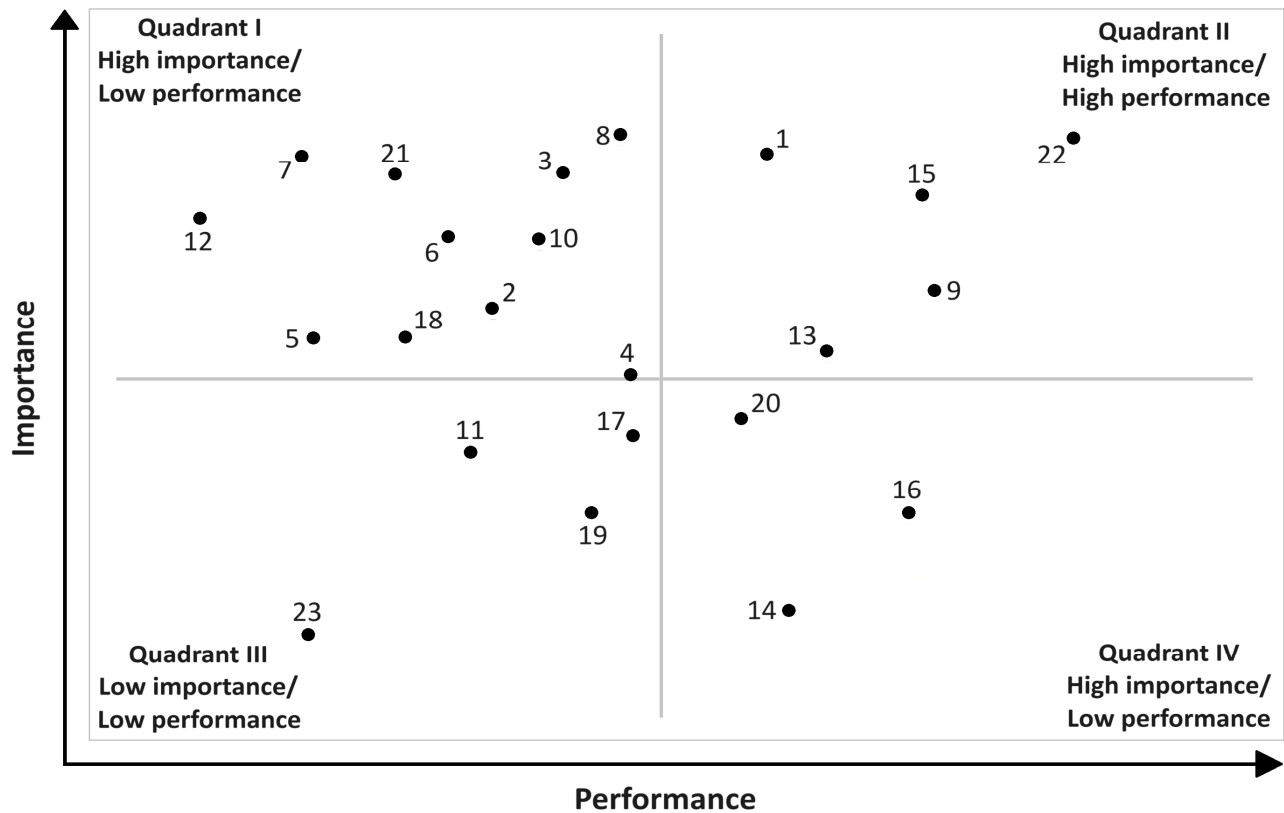


Figure 5. Quadrant analysis of IPA.

DISCUSSION

According to this study, the main fishing risks in Balochistan revolve around management risk, economic risk, and occupational risk. The most significant sub-risks affecting this sector are intense fishing, problems related to trade, and an excessive discard rate. Published literature supports the findings of this study (Mohsin *et al.*, 2021; Noman *et al.*, 2022). One of the biggest challenges facing Pakistan's fisheries is overexploitation due to the open access regime. This risk is addressed by the National Fisheries Policy (NFP) and provincial fisheries policy. However, this risk is still prevalent (Raza *et al.*, 2022; Kalhoro *et al.*, 2024). Unfortunately, Pakistan lacks the necessary policies and regulations that could assist and promote the fish trade. One of the objectives of strategic axis 3.5 of the NFP is facilitating fish trade by gaining access to international fisheries markets (Noman *et al.*, 2022). However, the situation in this regard is not encouraging at present. Pakistan attained the 116th spot among 132 countries in 'The Global Enabling Trade Index' (GETI) of 2012. Furthermore, Pakistani exports require more time and documentation than exports from other countries in this region because the process is slower. Pakistan's export efficiency (EE) is reported to be below that of other countries, such as Thailand, India, etc., based on the data. There are seven documents required for export to Pakistan in total. These documents are processed in Pakistan in 21 days. The number of documents needed is very high, and the timeframe is long. Various problems associated with legislation and regulations pertaining to fisheries are addressed under strategy axis B.5 of NFP (GoP, 2015; Naseer *et al.*, 2019; Sajid and Rahman, 2021). Despite this, many of these problems are still present in the fisheries sector. These problems can be seen through Pakistan's GETI and EE, as aforementioned.

Most of survey respondents, 77%, believed Pakistan had a low perception of fisheries risks. On the other hand, 56% of survey participants mentioned that most governance methods do not adequately deal with risks. In addition, 66% of respondents mentioned the ineffective execution of existing administrative measures. Moreover, 86% had no idea about improving the existing management regime. Participants' responses reflect the prevailing situation in Pakistan regarding risk management and human behavior. Poor seafood quality is a major hurdle in booming exports from Pakistan. Fish exports can only be increased if Pakistan complies with 'Sanitary and Phytosanitary' (SPS) and 'Technical Barriers to Trade' (TBT) requirements. Historically, Pakistan's fish exports have been banned since they failed to comply with these SPS and TBT standards in the past (Nisar *et al.*, 2021; Mustafa *et al.*, 2020; Mustafa *et al.*, 2022). Pakistan has two governmental entities involved in standardization, namely, 'The Pakistan

Standards and Quality Control Authority' and 'The Pakistan National Accreditation Council', both independent agencies (Mehak, 2019). They are responsible for adopting TBT guidelines in Pakistan in cooperation with the Ministry of Commerce. In addition, they provide advise on a variety of standardization measures. Pakistan Standards and Quality Control Authority registration is required for all exporters and importers who wish to trade in fish. The system does provide for the certificate issuance, but the system is not fully developed or efficient (GoP, 2015; Masakure *et al.*, 2009; Geng *et al.*, 2024). Exports of seafood require two kinds of certificates. First, MFD issues a certificate called 'The Certificate of Quality and Origin', and the second, a certificate called 'The Certificate of Health'.

Export products from Pakistan are struggling due to the lack of diversified markets and a limited export product range. Only 17% of all country exports come from food and agro products (GoP, 2015). Pakistani exports are homogenized and lack diversification. Additionally, Pakistan produces very few fisheries products. Fisheries products are often shipped out frozen. Frozen products account for about 80% of all fish exports every year (Ali *et al.*, 2022). Aside from that, the target export markets are limited. Historically, fisheries products from Pakistan were primarily sold to Japan, the United States, and Japan (Bahmani-Oskooee *et al.*, 2016; Khan and Abbas, 2023). In 2007, however, due to a ban imposed by the EU and the United States on imports of Pakistani fish products, the market composition gradually changed. This ban has resulted in a lot of economic loss for Pakistan, which amounts to more than 80 million USD, as a result of these sanctions. Roughly 75% of shrimp are shipped to China. Consequently, Pakistani fisheries have minimal product ranges and market diversification (Dey *et al.*, 2005; Mehak, 2019). In NFP, strategy axes 3.4 and 3.5 relate to problems about post-harvest processes and procedures. In addition to facilitating commercialization, this policy also suggests that Pakistani fisheries products can access diverse markets to expand their market reach (GoP, 2015). Fishing boats mostly lack adequate cooling equipment. Therefore, most of the catch brought to the dock station is spoiled or infested due to this process. An extremely unhealthy and filthy environment is present when the catch is handled. Fisheries do not comply with international standards when handling catch (Mehak, 2019).

In order to improve the performance of the fishing industry, survey participants suggested training, performance evaluation, and rewards. In Pakistan, there is a growing trend to train employees working in the fisheries sector. However, Balochistan needs frequent training. In 2010, through Trade Related Technical Assistance Program II training was carried out along the entire industry chain. This covered all the fisheries

industry employees related to best practices in operations, manufacturing procedures, and assurance of production standards. Trainings were delivered in Urdu to increase their effectiveness. In 2020, 280 fishermen were given training regarding increasing knowledge about safe fishing, operations, control of post-harvest losses, and collecting reliable data. This project, worth 20 million Pak Rupees, was funded by 'The World Wildlife Fund' (Mehak, 2019). Fishing knowledge and competence can be improved by participating in various FAO training programs. In one survey participant's experience, no internet connection was available during the fishery data entry, recording, and analysis training session. In addition, there were very few computers available for participants. Thus, performance evaluation of existing management is indispensable.

Performance evaluation is of paramount importance in managing fisheries in Pakistan. There are several ways to evaluate fishery managers' performance and other segments of the fishery's system through various assessment surveys. It is necessary to perform manager performance evaluations to obtain an accurate picture of how team members view their supervisors (Haas *et al.*, 2019). Rewards encourage employees to work efficiently thus positively impacting their performance. Financial compensation is one of the most popular forms of employee rewards. It is often justified to give an employee an additional financial reward when they exceed company goals and propel the company forward (Salah, 2016; Malik and Butt, 2017). Commissions and bonuses are commonly used as financial rewards (Kishore *et al.*, 2013). It is essential to measure and reward the performance of employees by implementing a system in which they are given a certain percentage of sales completed, or new clients sign a contract as a reward for their dedication to the organization (Chenhall and Langfield-Smith, 2013).

This study has several practical implications. Such as, this study's findings can help mitigate risks confronted by the fisheries sector comprehensively. Risk hierarchy highlights major risks that can be focused on for better management. This directional management can facilitate to formulate effective policies and can result in inclusive management. Furthermore, this study also advocates the diversion of management of resources from quadrant 4 to quadrant 1 for their optimized utilization. Another significant finding of this study is the importance of strengthening risk awareness. Increasing risk awareness has a positive effect on boosting performance management. Thus, future research can focus on researching which strategies can be used efficiently to improve risk awareness. In addition, more data spanning a large geographical region can be utilized to conduct further research on this topic. Individual risk types can be studied for detailed mitigation strategies. Moreover, data

can be collected from a single stakeholder group to understand fisheries management issues better.

Conclusions: This study comprehensively investigated various risks confronted by the fisheries sector in Pakistan by employing fuzzy AHP and IPA. Results indicate that the main risks confronted by the fisheries sector in Balochistan revolve around management risk, economic risk, and occupational risk. The most significant sub-risks affecting this sector are intense fishing, problems related to trade, and excessive discard rate. To better manage these risks and boost the fisheries sector's performance more comprehensive efforts are needed from public and private organizations through joint ventures. Moreover, management resources should be directed from quadrant 4 to quadrant 1. In addition, risk unawareness is the critical factor leading to ineffective management of this sector. Thus, target-oriented steps should be taken to increase risk awareness.

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