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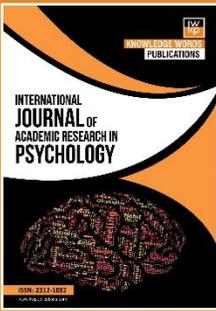
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From Comparative Risk Assessment to Multi-Criteria Decision Analysis and Adaptive Management: A Review

Sidra Ghor¹, Rafi Ahmed Ghor²⁺⁺, Mohsin Ali Shaikh³, Muhammad Kashan Surahio⁴, Ehsan Ali⁵

¹Lecturer of Department of Physiology, Indus Medical College, The University of Modern Sciences, Tando Muhammad Khan, Sindh, Pakistan, ²⁺⁺Professor of Medicine dean Medical and Health Sciences, Indus Medical College, The University of Modern Sciences, Tando Muhammad Khan, Sindh, Pakistan, ³PhD Student, University of Science and technology of china, Hefei, Anhui, 230026, ⁴Department and faculty of economy and management, Tashkent University of information technologies, Tashkent, Uzbekistan, ⁵Manager Production & Planning, Pakitex Boards private limited, Karachi, Sindh, Pakistan

Abstract

In recent years, procedures for assessing and making decisions about environmental risks have evolved to include techniques such as toxicological risk assessment, cost-benefit analysis, and expert judgment and have become exceedingly sophisticated, data-intensive, and intricate. The main reason is that social, economic, ecological, and environmental concerns have inherent trade-offs. Comparative Risk Assessment (CRA) and Multi-criteria Decision Analysis (MCDA) are the most commonly used strategies to improve environmental decision-making. CRA doesn't have a systematic way of determining the best project option. In contrast, MCDA offers more well-supported methodologies for comparing project alternatives using decision matrices and systematic ways for incorporating project stakeholders' perspectives in solution ranking. According to this research, forecasting the evolution of the ecosystem and responding to varied management techniques necessitates a change from optimal to adaptive management. The study conducts advanced research in CRA, MCDA, and adaptive management strategies employed in environmental restoration and rehabilitation projects, as well as a comprehensive assessment of existing decision-making methodologies. This study presents a framework for decision-making to combine MCDA and adaptive management and methods for eliciting stakeholder value and public participation. The study also demonstrates the framework's applications.

Keywords: Comparative risk assessment, multi-criteria Decision analysis, Adaptive management

Introduction to Comparative Risk Assessment and evolving Decision Analysis approaches

Environmental decisions are frequently complicated and nuanced, involving a diverse range of parties with varying goals and aims — presenting the same category of dilemma that rational action studies suggest people are ignorant to tackle without assistance (Linkov, Ferguson, et al., 2006). When challenged with situations like this, most people try to reduce the problem using intuitive or heuristic ways until it appears more manageable. The crucial data may be lost, points of view opposed to one another may be dismissed, and uncertainty components may be overlooked during the process. To summarize, there are numerous grounds to believe that, in a high-stakes decision-making situation with ambiguity and valued constraints, individuals frequently struggle to make informed, mindful decisions (McDaniels, 1999). Sidra *et al.* (2025) highlight how textile workers in Hyderabad often perceive their physiological risk—exposure to dust, noise, and chemicals—quite differently from measured hazard levels, emphasizing a disconnect between objective data and worker awareness. Their findings underscore the necessity of integrating both actual exposure metrics and human perception when applying CRA, MCDA, and adaptive management frameworks to occupational risk.

In addition to reviewing the evolution from Comparative Risk Assessment (CRA) to Multi-Criteria Decision Analysis (MCDA) integrated with Adaptive Management—as outlined in the foundational review Ghori *et al.* (2025) offer a complementary perspective on the foundations of modern risk frameworks in physiological and biomedical contexts. Their paper, *“Risk Management and Risk Assessment in Physiology: Analysis of Modern Developments on Their Foundation”*, spans analyses of current trends in risk identification, evaluation, and mitigation within physiology and human systems (Ghori *et al.*, 2025).

Furthermore, environmental decisions are frequently based on broad knowledge bases, including social, physical, and natural sciences, ethics, politics, and medicine. This reality, combined with the fact that environmental challenges frequently entail shared resources and large constituencies, necessitates group decision-making methods. Individual processes may have certain advantages; for example, more viewpoints may be offered for discussion, natural systematic thinkers are more likely to profit from their presence, and organizations trust and rely on more thoughtful, well-informed individuals. Conversely, groups are prone to establishing firm viewpoints or prematurely adopting a shared vision that suppresses unreliable data. Some have dubbed this propensity "groupthink" (Kiker *et al.*, 2005).

Ghori *et al.* (2025) evaluate the impact of case-based learning in physiology at Indus Medical College, demonstrating enhanced student engagement, deeper comprehension, and superior academic performance compared to traditional teaching. Their findings affirm the pedagogical value of case-based approaches, reinforcing the need for decision-making frameworks like CRA and MCDA to consider educational strategies and learner perception within adaptive management systems. Recent studies from the healthcare and occupational sectors in Pakistan have shown the real-world implications of poor risk communication and fragmented decision-making. For example, Ghori *et al.* (2025) investigated physiological risk perceptions among textile workers and highlighted the lack of structured frameworks for risk mitigation in industrial environments. In another study, Ghori *et al.* (2025) explored the role of Clinical Exercise Physiologists (CEPs) in managing chronic diseases and emphasized the importance of preventive, system-wide strategies that align closely with adaptive

and evidence-based planning models. These studies underscore the need for decision-making approaches that incorporate both technical data and stakeholder insights.

Ghori *et al.* (2017) conducted a one-year cross-sectional study of 30 patients at a Pakistani tertiary hospital, documenting the demographic and clinical prevalence of hematological disorders—finding high rates of pallor (83%), weight loss (70%), and infections (63%), and identifying megaloblastic anemia, aplastic anemia, acute leukemia, and lymphoproliferative disorders as most common. This study provides real-world clinical profiles that underscore the value of anchoring abstract CRA/MCDA frameworks in concrete health-risk data to enhance decision relevance and adaptive management. Decision-makers in environmental management projects frequently obtain 4 forms of specialized knowledge: simulation and evaluation results, risk assessment, cost estimation, and stakeholder choices. The present and changing judgment strategies aimed at managing filthy sediments are depicted in figure 1. On the other hand, current decision-making methods often provide no instruction about incorporating or evaluating the relative value of data from various sources. In addition, information arrives in a variety of formats. While the findings of simulation and observation are normally given as quantifiable figures, risk evaluation and cost-benefit assessments might require the project team to make more performance appraisals. It's possible that organized data regarding sponsor likings will never remain offered towards a decision-maker and might be controlled haphazardly or subjectively, making it more difficult to portray the decision-making process as trustworthy and reasonable. Furthermore, structured approaches might be regarded as missing the tractability to adjust to specific problems or accurately characterize smaller opinions where they are used. For environmental decision-making, a systematic technique to incorporate quantifiable and qualitative feedback derived from technical or engineering assessments of threat, rate, profit, and investor viewpoints and principles, is still to be thoroughly developed. Consequently, decision-makers cannot recognize all viable options and fully utilize all accessible and relevant data while deciding between potential projects.

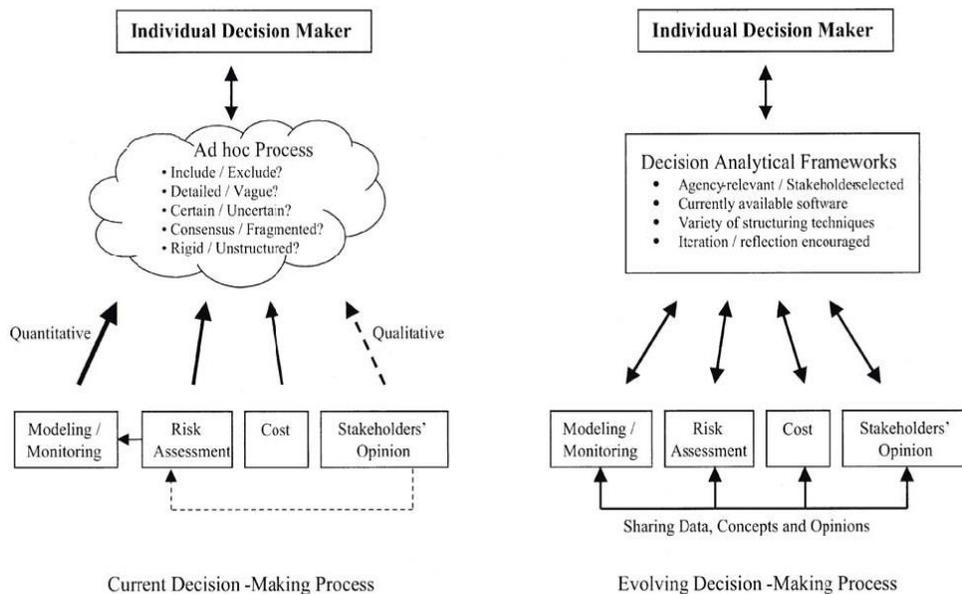


Fig 1. Existing and progressing decision-making strategies for managing polluted sediments

This study examines efforts to apply novel notions in decision analysis and process exploration to complicated ecological initiatives in response to contemporary decision-making issues and analyses decision-making methods such as CRA and MCDA. These techniques are intended to improve understanding of the trade-offs that can only be established among odd objectives of the project, assist in comparing alternatives with significantly different possible consequences or results, and synthesize a broader range of data.

When it comes to sediment management issues, CRA can be considered in the context of a decision-making method (Andrews et al., 2004) that is based on the assessed potential impacts of each management option under discussion (Linkov, Seager et al., 2006); its disadvantage is the ambiguous manner in which it integrates effectiveness across criterion to come up with effective project option (Tal et al., 2004). (Andrews et al., 2004) differentiates between the macro and micro scales of CRA application. Programmatic CRA has helped identify provincial and global environmental goals at the macro level by assessing the multi-dimensional hazards associated with practical solutions. Micro-CRA research has evaluated associated risks concerning particular policy decisions, like the hazard of chemical vs microbiological illness in drinkable water (Bridges et al., 2005).

On the other hand, MCDA offers a method for systematically incorporating associated risks, ambiguity, and asset value (Adem et al., 2018; Topuz et al., 2011). MCDA uses systematic analysis to help decision-makers analyze and choose solutions based on various factors, overcoming the limits of unstructured decision-making. There are various MCDA approaches, each of which creates the matrix data and rates the possibilities differently (Yoe et al., 2002).

An adaptive management paradigm can be effectively related to MCDA technologies. The ambiguity in managers' understanding of a system is acknowledged in adaptive management. MCDA framework compares different decision-makers perspectives and guides personal decisions through situations with no single optimum answer (Yatsalo et al., 2012). Individuals can use the MCDA process to quantify assumptions, rank project choices based on their interest criterion, and choose their desired operation mechanism. The methodology for determining sponsor opinions for groups may be more sophisticated, and it may include components of collective judgment. One benefit of using an MCDA strategy in group decision-making is the ability to draw consideration to commonalities or possible encounter zones among participants, leading to improved awareness of others' values.

This paper explores using MCDA and adaptive management in various projects and applications. According to our findings, should combine adaptive management with decision-making technologies that would enable this to deal with the following optimization-based administration systems. As the best way to cope with uncertainty while choosing a management alternative, this paper incorporates an adaptive management framework with multi-criteria decision analysis. The two approaches work together to form a comprehensive risk management framework. Figure 2 shows the decision scenario of contaminated sediment management.

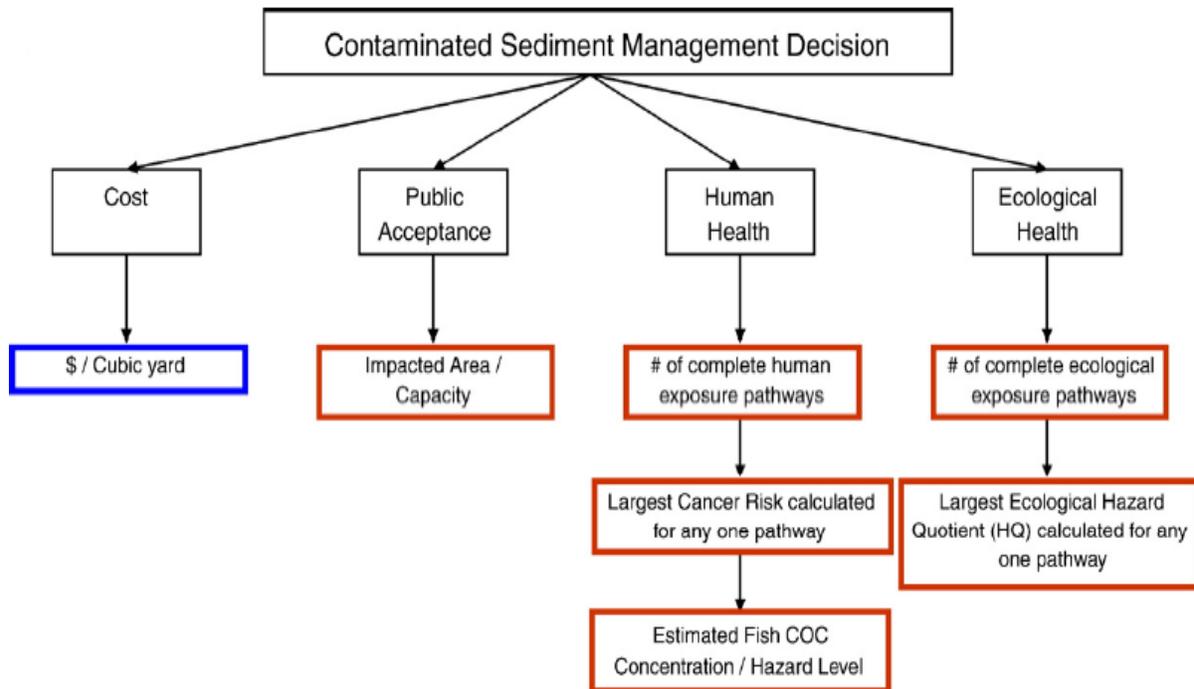


Fig 2. Decision scenario of Contaminated Sediment Management

MCDA methods and tools

Table 1 shows that MCDA, in comparison to CRA, offers a more comprehensive environmental management approach. In CRA, a decision matrix is a final product; in MCDA, it is simply an intermediary product. Here are various complex MCDA approaches (Belton et al., 2002; Huang et al., 2011). The analytical hierarchy process (AHP) and multi-attribute utility theory (MAUT) are more advanced methodologies that involve optimization techniques, while Outranking utilizes a dominance strategy.

MAUT aims to find a succinct term for a decision's net benefits. The MAUT technique combines multiple criteria with solitary utility by utilizing utility or value functions. MAUT is premised on the notion that the decision-maker is sensible, possesses complete information, and makes appropriate decisions. The decision-maker's purpose would be to substantially increase this process's usefulness. MAUT is included in compensating approaches because some criteria have poor scores that positive outcomes in other areas could counterbalance.

Using the objective function, AHP combines different aspects of the decision problem (Chen et al., 2011). AHP chooses the option with the highest goal function value. AHP uses a method of quantitative evaluation that compares two criteria at a time. The user compares the options using a numerical scale, AHP works through all of the pair-wise requirements in an organized manner and alternative contrasts, and the findings are produced in matrix form. As a result, AHP assumes that humans are better at making relative judgments. As a result, AHP's rationality assumption is more flexible than MAUT's (Barzilai et al., 2004).

Outranking evaluates the performance of all alternatives simultaneously to determine the extent to which one is preferred over the other (Kangas et al., 2001). The data is then compiled among all

necessary attributes to determine the evidence strength supporting one option over another (ODPM, 2004). As a result, outranking compensates for poor performance on some criteria with better performance on others. Partially compensatory models outrank outranking models. When aggregating criteria metrics are problematic, measurement rules differ widely, and units are incomparable, outranking strategies are the best option (Seager, 2004).

Table 1

Comparison of ad hoc decision-making, comparative risk assessment, and multi-criteria decision analysis

Decision-making Elements	Ad hoc Decision-making	Comparative Risk Assessment	Multi-criteria Decision Analysis
Define the issues	Stakeholder input is either limited or absent. Alternatives may not be able to satisfy stakeholder concerns as a result.	Stakeholder feedback is gathered after decision-makers and experts have defined the problem. Stakeholder involvement may help to refine the problem definition.	Stakeholder feedback is taken into account right from the start of the problem-solving process. Stakeholder agreement on problem definition is frequently higher. As a result, proposed solutions are more likely to please all stakeholders.
Consider other options	The decision-maker generally uses an equivalent from a list of pre-existing possibilities after consulting with an expert.	Changes are settled by a more site-specific formal involvement of specialists.	All stakeholders, including professionals, are involved in the development of alternatives.
Create a set of criteria to use when evaluating alternatives.	Alternatives are frequently judged using criteria that aren't expressly considered or articulated.	Defining criteria and sub-criteria is a common practice.	The possibility of a unique alternative generation increases when all stakeholders are involved. Expert and stakeholder judgment are used to building criterion and sub-criteria hierarchies.
Compile a list of subjective opinions on the comparative significance of certain factors.	The judgment maker's non-quantitative criterion assessment	The decision-maker may formulate quantitative criteria weights, although they are frequently ill-founded.	Decision-makers and stakeholders provide quantitative criteria weights.
Finalize your choices and rank them.	Alternatives are frequently selected based on unstated implicit weights.	Alternatives are chosen based on a weight of evidence discussion or qualitative evaluations of criteria scores.	Using criteria scores and weights, a set of scientific, well-defined algorithms selects an option.

Environmental Management Applications for MCDA

MCDA approaches have been used to improve policy selection in contaminated land cleanup, reduce contamination in marine environments, optimize water and coastal resources, and manage various resources (Linkov et al., 2004).

Many reviewed publications conclude that using the MCDA method improves the decision-making procedure and communal approval of the proposed curative or diminution strategy.

Restoration of Freshwater Environments and Poisoned Deposits

MCDA has been used for sediment and aquatic system cleanup (Cinelli et al., 2021; Linkov, Kiker, et al., 2004; Sparrevik et al., 2012). MAUT has been employed in radioactive sites' management (Arvai et al., 2003; Gallego et al., 2004; Ríos-Insua et al., 2002) and the Superfund cleanup process (Grelk, 1997; Grelk B et al., 1998; Parnell et al., 2001). (Wakeman, 2003) Analyzes alternatives for dredging polluted sediments using a basic multi-attribute assessment technique. (Pavlou et al., 1998) Examined the trade-off of ecological threat removal and rate in dirty deposit dumping, and (Stansbury et al., 1999) combined trade-off exploration between risk and cost by composite programming and fuzzy set theory. (Rogers et al., 2004) uses outranking techniques in factoring sponsor principles into the decision-making procedure for unique technology options for sedimentation control. (Apostolakis, 2001; Bonano et al., 2000; Accorsi et al., 1999a, b) Established a methodology that integrates the consequences of sophisticated influence assessment methodologies with investor predilections using AHP, influence diagrams, MAUT, and risk assessment tools. Risk–cost trade-off analysis, composite programming risk–cost trade-off analysis, and fuzzy set theory have been used by (Pavlou et al., 1998; Stansbury et al., 1999). (Gallego et al., 2004; Ríos-Insua et al., 2002; Grelk B et al., 1998; Parnell et al., 2001; Wakeman, 2003; Rogers et al., 2004; Apostolakis, 2001; Bonano et al., 2000; Accorsi et al., 1999a) used SMART, MAUT, AHP, and Outranking.

Reduction of Pollutants Released into Aquatic Habitats

In an attempt to prevent pollution from entering aquatic habitats, MCDA approaches have been applied. (Doley et al., 2001) Determined the best strategy to decrease nitrogen flow into the Potomac River through models and cost-effectiveness analysis. (Wladis et al., 1999) Studied how NO_x, SO₂, and NH₃ influenced groundwater and compared several emission control scenarios. In North America and the Mediterranean, (Kholghi, 2001; Ganoulis, 2003) used MCDA to determine how to regulate wastewater. Outranking has been used to determine an effective wastewater treatment system (van Damme et al., 2003) and to promote wastewater projects (Al-Rashdan et al., 1999). (Van Moeffaert, 2002) used Fuzzy outranking for eco-friendly wastewater treatment systems. The implications of a suggested 30% decrease in nitrogen intake in the Neuse Estuary in North Carolina are being studied (Borsuk et al., 2001). Shaikh *et al.* (2017) report that among 50 sepsis patients in Pakistan, infection sources were most frequently urethral catheterization (18 %), intravenous catheters (16 %), urinary tract infections (16 %), and respiratory tract infections (16 %). This real-world clinical data underscores the value of anchoring decision-analysis frameworks like CRA and MCDA in concrete risk exposure profiles when designing adaptive management interventions.

Water and Coastal Resource Allocation

Regarding water allocation and seashore development, MCDA procedures are widely utilized to reconcile the competing needs of environment protection and business expansion. In the Missouri River, MAUT-based approaches were used to analyze current and alternative water control schemes

(Prato, 2003), while (Ni et al., 2002; Qin et al., 2002) employed AHP to figure out the best length and placement for a shoreline rehabilitation project. Distance approaches that include game theory and programming are also employed (Mimi et al., 2003). Water utilization, regeneration, preservation, and electricity production have all been studied in studies of water bodies in the US (Bella et al., 1996), Europe (Özelkan et al., 1996), and South Africa (Joubert et al., 1997). Other studies (McDaniels, 1999; Gregory and Failing, 2002; Hämäläinen et al., 2001; Marttunen et al., 1995; Gregory and Wellman, 2001; Whitaker et al., 2001) used MAUT, AHP, and other MCDA approaches for governing substitutes, standards, and principles. (Ning et al., 2002) developed a river system's water quality monitoring network. In a section of the Elbe River in Germany, (Klauer et al., 2002) evaluated the amount of groundwater preservation against growth in the economy.

Other Resource Management

Wetlands, coral reefs, and fisheries have all been managed using MCDA. (Herath, 2004) AHP is used to determine how many wetlands should be built in Australia to boost nature-based tourism. (Fernandes et al., 1999) Used AHP approaches to decide whether to boost tourism to coral reefs, whereas (Brown et al., 2001) employed sponsor workspaces to collect investor viewpoints with a reduced quantifiable trade-off exploration to choose a managing strategy for Tobago's Buccoo Reef Marine Park. Fishery management has also used AHP analysis with stakeholder input (Mardle et al., 2004; Soma et al., 2003). (McDaniels, 1999) Employed a MAUT technique to choose between commercial fisheries alternatives when competing for long-term salmon management goals.

Similarly, (Mardle et al., 2002) employed MAUT in fishery management, whereas (Gurocak et al., 1998) combined if-then rules with fuzzy set theory. (Merritt et al., 2001) Employs AHP for determining the best allocation of expenditures for fish stock research.

(Mendoza et al., 2002) Assessed land conditions to designate military training zones. Limits for a national park are being chosen by (Sharifi et al., 2002). (Vaillancourt et al., 2002) carried out waste management actions in Canada. (Joerin et al., 2000) Created a house-land suitability map in Switzerland. (Schmoltdt et al., 1994; Schmoltdt et al., 2001) Used AHP for managing natural parks. The spruce budworm was managed in Canadian woods using MAUT (Levy et al., 2000). Environmental vulnerability in the Mid-Atlantic Region was assessed by (Tran et al., 2002). (Gomez-Limon et al.) Investigated farmers' risk attitudes in Spain. (Kwak et al., 2001) assessed Korea's air quality. (Georgopoulou et al., 1998) used renewable energy sources.

Adaptive Management and Environmental Decision-Making

Traditional managing strategies use MCDA methods and tools to consider environmental decisions, but we show their power when combined with adaptive management (Satterstrom et al., 2006). Goals were created, and various management tactics were explored in traditional management. One best management approach is carefully chosen and time adopted; its effectiveness is not constantly checked. The plan will almost certainly be evaluated at some time, and if it is seen to have failed, it will implement a new one in its stead. The goals are rarely revisited, and any shift in management approach or acknowledgement of doubt about the arrangement under control is likely to be seen as a letdown in this context. Adaptive management recognizes that ambiguity is a part of all ecological ecosystems and aims to reduce it by knowing much more about the system in operation under management. Its core procedure is simple: whenever maintaining a system, someone elects a

managing act, observes the act's impacts, and modifies the activities based on the monitoring consequences. Adaptive management can be passive or active. Active adaptive management examines comprehensive experimental alternative solutions compared to a regulation to separate variables that impact the system, whilst passive adaptive management decides to implement one strategic plan at a time. At that time, the achieved biome was perceived to gather data on the management strategy's impacts on the system. The monitoring results should, in theory, influence model development and parameters, and the managing approach should be assessed and altered accordingly. Adaptive management is recommended by regulatory bodies worldwide; however, agencies often only apply or stress certain aspects of the process. The review examined Adaptive management in fisheries (McDaniels et al., 2004; Pinkerton et al., 1999; Hilborn et al., 1988; Bearlin et al., 2002; Bundy et al., 2004; Nudds et al., 2003), coastal and marine ecosystems (Weinstein et al., 1997; Weishar et al., 1998; Duda et al., 2002), forest and terrestrial ecosystems (Allison et al., 2004; van Staden et al., 2004; Norton et al., 2001; Haney et al., 1996; McGinley et al., 2003), the Florida Everglades (Voss Michael, 2000; Gentile et al., 2001), rivers, freshwater areas, estuaries (Habron et al., 2003; Hillman et al., 2002; Lowry et al., 2003; Marmorek et al., 2001), wildlife management (Johnson, 1999; Johnson et al., 1999; Dallmeier et al., 2002; Wilhere, 2002; Salafsky et al., 2002), and rehabilitation (JBunch et al., 2004).

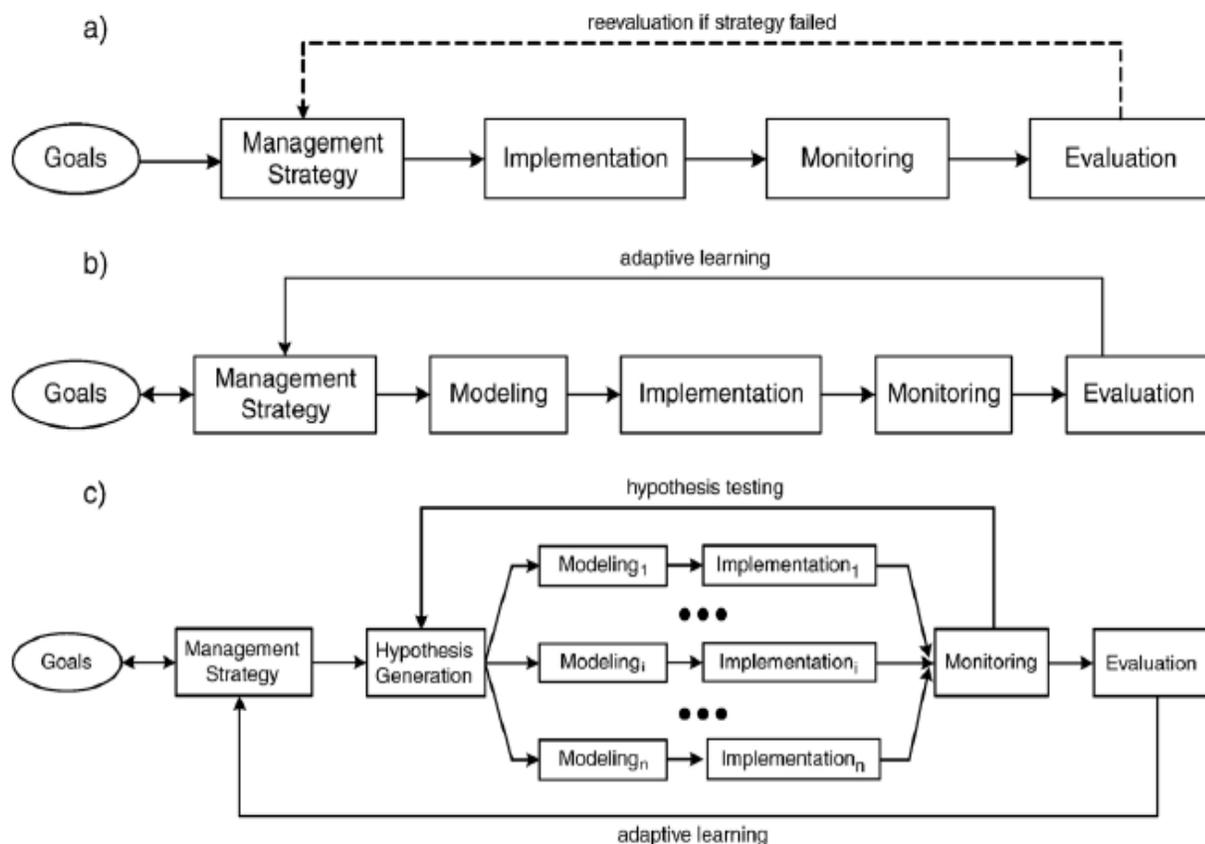


Fig 3. (a) Traditional management (b) passive adaptive management (c) active adaptive management

Management Objectives that are Evaluated and Altered Regularly

A consistent evaluation of a scheme's purposes is the fundamental component of adaptive management. Stakeholders should concur on the program's core goals, which should revisit as new information comes to light. Surprisingly, many adaptive management publications address the

upgrading and modification of goals when new information becomes available. Many people, in reality, assume that their aims are set in stone.

A Representation of the System Under Management

Many adaptive management approaches need the use of modelling tools. They serve as a foundation for comprehending how change happens in a controlled environment and are often used to forecast the impacts of various tactics. Although quantitative mathematical models are favoured, conceptual models are nevertheless useful since adaptive managers frequently deal with very uncertain scenarios. Modelling appears to be one of the most often employed components of the adaptive.

Management process, according to this study. Nonetheless, models frequently focus solely on ecological processes; integrated models, which include available options, charges, and societal factors, are still uncommon.

A Variety of Managing Options

The production of various management options is part of an active adaptive management process. Using many techniques simultaneously, coupled with control, is theoretically comparable to doing a scientific experiment. However, the outcomes are less obvious.

Outcomes Monitoring and Assessment

After an administrator has developed and applied a variety of choices, they must monitor and evaluate them to see which one works best. This is the part of adaptive management that receives the greatest attention. Numerous monitoring systems have been established, from basic data gathering to advanced numerical methodologies, covering vast international oceanic ecologies and protected areas (Sit et al., 2001).

A Method for Applying what has been Learned to Future Decisions

Learning is a crucial aim for any project because the primary principle of adaptive management is to mitigate risk about the arrangement under control. (Kiker et al., 2001). They highlight that existing information is inadequate for Everglades' rehabilitation, and they suggest adaptive management as a strategy to build a comprehensive consideration that decision-makers and politicians can employ. Some other authors advocate for learning as an objective in managing decision-making.

A Participatory and Learning Configuration for Stakeholders

The inclusion of stakeholders is a crucial component of adaptive management. The general community, businesses, researchers, and administration organizations want to feel heard and informed throughout the process. Active adaptive management might be construed as ecological experimental research, so decision-makers must retain investors – particularly the general community – up to date on not only the organization's goals but also the problems it's dealing with and the solutions it's coming up with. When management fails to include stakeholders in decision-making, it leads to mistrust and political strife.

Combining Multi-Criteria Decision Analysis and Adaptive Management

The incapability to forecast the evolution of the system based on evolving atmospheres and socioeconomic aspects is acknowledged by adaptive management. Many publications recognize that efficient environmental decision-making necessitates taking into account the eco-friendly, natural, technical, profitable, and socio-political elements that must be considered when determining and choosing options available, these elements are rarely taken into account in tandem. Judgments are frequently based on a single facet of the situation. There is no framework for integrating and organizing the individuals, procedures, and technologies necessary to make organized and logical ecological strategic choices. The quantifiable outfits and procedures for applying adaptive management techniques are not structured.

A robust platform for various environmental management challenges exists when adaptive management and MCDA are combined. It enables the creation of structured, explicit decisions and the modification of such decisions based on their outcomes. In many publications, the MCDA framework includes feedback loops among all procedure phases, which chooses an alternative. Adopting adaptive management perspectives enables the iterative application of the MCDA context, and incorporating a feedback loop enables the re-ranking of alternatives, and goal and criteria weightings, after an alternative is chosen.

A broad decision framework meant to serve as a guide for making environmental decisions. The decision-making procedure's first and most important step is the ability to put together the right team. There are two steps to the decision-making process: 1) producing management options, success factors, and subjective opinions, and 2) prioritizing the choices using value weights.

Decision analysis tools are a significant portion of the completely decision-making procedure. These tools assist in the generation and mapping of stakeholder group preferences and individual value judgments into structured processes that may connect to other technological tools like risk evaluation, modelling and observing, and rate projections. Decision analysis software can give valuable graphical methods and techniques for expressing the acquired data in understandable forms. Decision analysis outfits can quickly react to changes in the decision process by reprocessing and iterating with new inputs. This combination of choice tools and technical and engineering techniques enables all to play a distinct and important part in deciding the procedure despite seeking to use any resource outside its intended scope.

Fig 4. Framework for adaptive decision-making. Solid lines represent people's direct involvement or tool use; dashed lines represent less direct involvement or tool use. Each phase of the framework is iterative and can be repeated several times during the intricate decision-making process. A first-pass attempt can proficiently identify potential difficulties, essential parties to include, and model investigations that should initiate. Since these problems are becoming more obvious, someone uses an iterative process through the structure once more to examine and alter the approach to handle the more nuanced components of the decision. Every repetition suggests additional information that would help enhance the decision process.

Conclusion

The proposed technique recommends decision analysis to aid in making organized, logical decisions on management possibilities, and it utilizes adaptive management as an entire planned and operational structure. Our approach has shown to be extremely effective, and we assume that our current evaluation presents the most comprehensive and justified framework for effectively implementing the network structure for the environmental sustainability of wide-ranging projects. Multi-criteria decision analysis and adaptive management focus on the decision-making process by allowing the management to understand the method and adopt the strategic plan as new information becomes available. Managers may benefit greatly from such a framework, which would save their resources and time by assisting them in understanding the trade-offs involved in various management approaches and making reasonable, well-informed judgments.

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