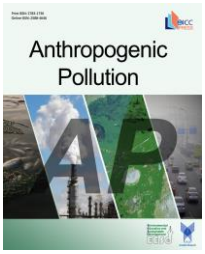

J. Anthropog Pollut. 2025; 9(2): Article 25

Anthropogenic Pollution (AP)

https://doi.org/10.57647/J.AP.2025.0902.25

Research Article

Designing an Implementation Model for Realizing Environmental Policies Based on Sustainable Development in Iran through the Application of Knowledge Management

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Article History:

Received:
04 September 2025

Revised:
22 September 2025

Accepted:
08 November 2025

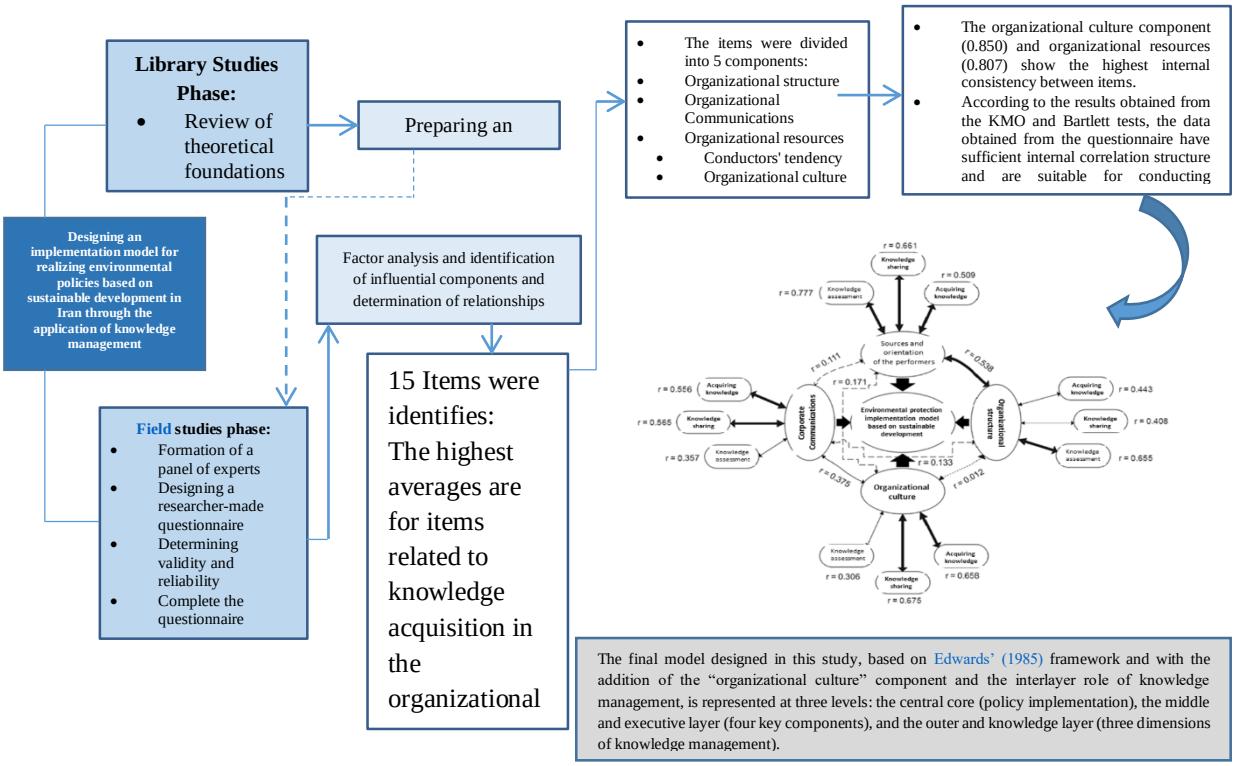
Published in Issue:
31 December 2025

Abstract

This study was conducted with the aim of designing an implementation model based on the application of knowledge management to improve the implementation of environmental policies in government institutions of the country. The present study is considered to be applied in terms of purpose and strategic in terms of approach. The research population consisted of 50 experts, managers, and specialists from government organizations active in the field of the environment who were selected purposefully. The data collection tool was a researcher-made questionnaire based on a five-point Likert scale that was designed with a focus on three dimensions of knowledge management (acquiring, sharing, and evaluating knowledge) and five key factors of policy implementation (organizational structure, resources, communications, executives' orientation, and organizational culture). Descriptive statistics, exploratory factor analysis (EFA) and Pearson correlation test were used to analyze the data using SPSS software. Also, to strengthen the analysis, the country's upstream environmental documents were also examined using qualitative analysis. The first component, which includes the resources and orientation of the implementers, had the highest explanatory power among the identified components with an eigenvalue of 3.377 and a share of 22.514% of the total variance. After that, the organizational culture component with an eigenvalue of 2.629 and a share of 17.527% is located, which indicates the importance of the values, beliefs, and norms governing the organization in accepting and implementing environmental policies. The final designed model consists of three layers, which are: the central layer: implementation of environmental policies; the middle layer: four rearranged executive components; and the outer layer: three dimensions of knowledge management. By providing a systematic, localized, and data-driven approach, this model has the ability to explain inter-organizational interactions, evaluate organizational learning, and policy coherence in the executive structure of the Islamic Republic of Iran government, and is considered a scientific response to the challenge of the lack of an effective executive model in this area.

Keywords: Environmental Policymaking; Knowledge Management; Edwards's Model; Organizational Culture; Iranian Government Organizations

Cite this article: Shiranzaei, Sh., Bahmanpour, H. & Alvani, S.M., (2025). Designing an implementation model for realizing environmental policies based on sustainable development in Iran through the application of knowledge management, *Anthropogenic Pollution*, 9*(2),* Article 25. https://doi.org/10.57647/J.AP.2025.0902.25



1. Introduction

The environment, as one of the most important intergenerational assets of humanity, has faced increasing pressures from industrial development, population growth, and institutional inefficiencies in recent decades. This situation is accompanied by more serious challenges in developing countries such as Iran, because despite the adoption of numerous development policies and programs, there is a significant gap in practice between the design of policies and the realization of their goals (Attarpour et al., 2025). Society expects the government to use public resources and facilities in an optimal and effective manner in line with the public interest. In other words, people expect the executive structure of a country to pave the way for the realization of the society's macro goals by adopting the most efficient methods. However, what happens in practice is that a significant part of the approved policies face serious challenges in the implementation stage and fail to achieve the expected results (Alvani and Shalviri, 2016). In the public policy-making process, the implementation stage is the most important and decisive stage. Because it is at this stage that the policy moves from the decision and plan level to the action and realization level. Any weakness, ambiguity, or inconsistency in implementation can lead even a sound and scientific policy to failure (Alvani & Shalviri, 2016 , Hosseini et al., 2024). Policy implementation, as one of the main stages of the policy-making process, has a key position in achieving the goals of policymakers. This stage is not only a bridge between decision and action, but also a test of the validity and efficiency of the previous stages (i.e., policy formulation and approval) (Bayati et al., 2023).

The study of public policy design approaches in the policy literature plays an important role in understanding the methods of formulating, effectively implementing, and evaluating policies. These approaches are mainly classified based on the type of view on the relationship between policymakers and implementers, as well as the level of focus on formal structure or field-oriented behavior. Within this framework, three major approaches can be identified:

a) Top-down approach: This approach, which is mainly based on the tradition of authoritarianism and hierarchical structures, emphasizes that the policy-making process should begin at the highest level of decision-making and be transferred to lower levels in the form of a formal hierarchy. In this model, political leaders or high-ranking officials first determine the preferences and goals of the policy, and then, through bureaucratic mechanisms, these goals are transferred to implementers to implement it according to instructions (Givrian and Rabiei, 2015). In this view, implementers appear as unquestioning subjects of policymakers' decisions and what has been formulated must be implemented without interference.

b) Bottom-up approach: With criticisms of the shortcomings of top-down models, the bottom-up approach emerged as an alternative perspective. This approach, emphasizing executive realism, begins the

policymaking process from the operational level and the place of service provision. In this approach, policy implementers play a key role in defining, interpreting, and effectively implementing the policy due to their closer proximity to the problem and field experience (Givrian and Rabiei, 2015). This approach emphasizes participation, flexibility, and understanding local requirements and considers the mere implementation of orders from above to be ineffective.

c) Hybrid approach: This approach, with the aim of resolving the theoretical and practical conflicts between the two above-mentioned perspectives, is located in the middle of the top-down and bottom-up spectrum. Although its history dates back two years before the official introduction of the bottom-up approach, its central role in the implementation literature is known as a "middle ground solution."

In the hybrid approach, an attempt is made to combine the strengths of both approaches and provide more flexible and realistic models for diverse situations. In this way, both planning considerations from high levels of governance are taken into account and the experiences and requirements of field implementers are taken into account in designing and modifying policies. Each of these approaches has strengths and limitations, depending on the political context, administrative structure, and level of knowledge maturity of countries. However, in the field of environmental policies in developing countries, models that can cover a combination of hardware dimensions (such as organizational structure and resources), software dimensions (such as organizational orientation and culture), and knowledge dimensions (acquiring, sharing, and evaluating knowledge) in an integrated manner are rare. A review of the executive structure of the government in Iran and an analysis of past experiences show that the main challenges of environmental policymaking occur not at the level of legislation or policy formulation, but at the implementation stage. Government institutions have not been very successful in implementing policies effectively due to weak organizational structures, interdisciplinary incoherence, and lack of resources, ineffective knowledge mechanisms, and ineffective organizational culture. One of the most important reasons for this failure is the lack of comprehensive, local, and adapted implementation models to the country's institutional context (Shaora et al., 2024).

Theoretical Background and Conceptual Framework

The effective design and implementation of public policies has always been a major concern in the field of public policy and executive management. In this regard, the environment, as one of the most important areas of governance, requires frameworks that can reduce the gap between policy design and implementation. Environmental policymaking in the present era is facing increasing complexities that cannot be solved by formulating appropriate policies alone, but also requires the design of effective and adaptable implementation mec9hanisms. In the classical literature of public policy, numerous models have been presented to explain the implementation process, each of which has tried to represent the complexities of policy implementation by emphasizing specific dimensions. The Edwards model (Edwards, 1985) is considered one of the most important and classic analytical models in the field of public policy implementation, which uses a systematic approach to explain the dimensions affecting the implementation process. This model considers implementation as a dynamic and multidimensional process whose realization depends on the effective interaction of four key factors: organizational structure, organizational resources, organizational communications, and the orientation of the implementers.

The organizational structure in this model is recognized as a formal platform for organization, direction, and accountability, and its role in determining the limits of authority, hierarchy, and patterns of organizational action is vital. Resources include all human, financial, informational, and technical capacities, the absence or inefficiency of which is considered one of the main obstacles to the successful implementation of policies. The communication component, emphasizing the appropriate flow of information between different levels of decision-making and implementation, is recognized as the lifeblood of the model. Finally, the orientation and motivation of the implementers include the degree of their belief, willingness, and commitment to the approved policies, which, if ignored, will present the implementation process with fundamental challenges. Unlike purely structural models, Edwards' model emphasizes the role of human actors and the system of organizational interactions, and therefore is in line with behavioral analyses in public policymaking. This model also has high conceptual flexibility and is adaptable to different implementation conditions, especially in complex, multi-level and institutional contexts such as Iranian government organizations. In the present study, the Edwards model has been developed to respond to the complexity and specific characteristics of the Iranian environmental field. First, by adding the organizational culture component, the software and value-based dimension of the administrative system has been considered. Because empirical evidence from the research shows that organizational culture plays a decisive role in facilitating or obstructing knowledge processes in the implementation of environmental policies. Second, by

analyzing the exploratory factor, integrating the organizational resources component and the executives' tendency due to conceptual overlap in the field of allocation and utilization of human and attitudinal resources, the coherence of the model has been enhanced. Finally, knowledge management has been added to the model as a facilitating and intermediate layer and is located around the four main implementation components. The three dimensions of knowledge management, including knowledge acquisition, knowledge sharing, and knowledge evaluation, not only support the implementation process, but also provide the basis for organizational reinvention and learning for government institutions. Therefore, the Edwards model developed in this study is a combination of a solid theoretical foundation, executive realism, and a knowledge-cultural approach that can be the basis for designing effective environmental policies in the Iranian government structure.

Also, a review of Iran's development documents from the first to the seventh plan shows that in most cases, failure to achieve environmental goals has been due not to the lack of policies, but to weaknesses in their implementation, the lack of a learning system, and ineffective organizational communication. Environmental policymaking in Iran, as part of public policymaking, has always been a response to growing challenges in areas such as pollution, destruction of natural resources, and climate change. The evolution of these programs reflects a gradual transition from symbolic and holistic approaches to structural and institutional orientations towards the environment (Talebi et al., 2023). Designing an effective implementation model for environmental protection requires the use of previous theoretical and empirical evidence and experiences. In this regard, numerous domestic and foreign studies in the fields of knowledge management, environmental policymaking, and policy implementation have been used. Although previous studies have made valuable efforts to explain the dimensions of green management, public policy-making, or the role of knowledge in government organizations, they have clearly lacked an integrated approach that simultaneously addresses the role of knowledge management in implementing environmental policies in Iranian government organizations. The most important reliable studies, in terms of alignment with the objectives of the present study, are as follows: For example, Mazaheri et al. (2022) presented a three-dimensional model of green management in the country's executive agencies, focusing more on the structural, content, and contextual levels, without delving deeply into the knowledge infrastructure or the link with environmental policy-making. In this regard, Ahmadvand et al. (2022) analyzed the energy policy-making network, although they attributed an important role to knowledge components such as knowledge sharing, acquisition, and maintenance, their focus was on energy and not the environment.

On the other hand, Ahmadi Tonekaboni et al. (2022) used qualitative content analysis to identify key dimensions of environmental policymaking in the form of six main dimensions, including organizational structure, upstream documents, decision-making, culture, information technology, and key processes. This study, by providing a relatively comprehensive framework for understanding the dimensions of policymaking, is an important step in understanding the contexts affecting the formulation of environmental policies. However, from an implementation perspective, no specific model has been presented to link these components with the implementation process or knowledge management in the government structure. In the implementation dimension, studies such as Jamshidi et al. (2021) and Kazemi-Nejad et al. (2019), focusing on implementation in the oil and gas sector, identified causal, intervening, and contextual variables, but the knowledge approach is absent in these models and they are not grounded in environmental issues. On the other hand, the research of Keshavarz et al. (2021) in designing a knowledge management maturity model in Iranian government agencies, although it emphasizes components such as human resource empowerment, systematic knowledge sharing, and support structure, this model has not been generalized to the level of environmental policymaking. The only study by Sohrabi and Bagherian (2015) directly addresses the link between knowledge management and environmental protection, but it lacks an executive modeling framework and institutional analysis.

At the international level, there has also been considerable research in recent years. For example, Norkadia et al. (2024), focusing on the development of Indonesia's new capital, examined the challenges of implementing environmental policies in the context of institutional structures, local participation, and policy coherence. This research highlights the importance of environmental governance and the need to redesign government institutions to respond to local conditions, although it lacks an organized knowledge approach. In this regard, Kassa and Ning (2023), in a systematic review of studies on knowledge management in the public sector, identified three key axes: improving organizational performance, increasing citizen satisfaction, and fostering innovation, but had little focus on the environment and developing governments. Song et al. (2022) and Weina and Yanling (2022) also focused more on private organizations and innovation culture than on government

structures, emphasizing the role of green knowledge management processes in innovation and environmental sustainability. Hejnowicz and Thorne (2022) also concluded, with a comparative approach, that successful implementation of environmental policies depends on multilevel governance, active stakeholder participation, inter-organizational coherence, and culturally and gender-sensitive policies. They distanced themselves from authoritarian approaches and emphasized flexible and hybrid models in policy implementation. Although this research focuses on policy implementation, it does not provide an in-depth analysis of knowledge flows.

In another study, Dekens et al. (2025) examined the integration of indigenous and formal knowledge through participatory network governance among government institutions, the private sector, and local organizations. Their findings show that continuous interaction between researchers and local stakeholders leads to the synergy of community-based and scientific knowledge and increases the capacity to respond to sustainable policies. Also, Hoan et al. (2024) focused on Vietnam and showed that the maturity of knowledge management, together with a green organizational culture and transformational leadership, paves the way for environmental innovation and effective governance. This study suggests that institutionalizing a green culture in organizations and enhancing knowledge capabilities significantly increases the effectiveness of environmental policies. In their study, Wenyao Zhang et al. (2021) examined the effect of environmental knowledge sharing and application on employees' green behavior, relying on the theory of planned behavior. They also showed that the perception of organizational green support and green behavioral intention strengthen the relationship between knowledge management and environmental behavior. Although this study was conducted at the micro-organizational level, its importance lies in emphasizing the role of knowledge and cultural capital in the formation of environmental organizational behaviors. Finally, Taiwo et al. (2021) focused on East Asian countries and showed that the maturity of knowledge management and knowledge governance is a critical component in the success of environmental policies. They introduced indicators such as open access to environmental data, policy learning, and management of past experiences as requirements for effective governance. This study is one of the few that systematically examines the linkages between knowledge management and environmental governance at the macro-governmental level. In summary, the review and comparative analysis of these studies shows that no study has yet presented a local, comprehensive, and operational model for implementing environmental policies based on knowledge management dimensions in the context of government agencies. The present study seeks to respond to this gap, and by developing Edwards' theoretical framework and adding a layer of knowledge based on the views of knowledge management theorists such as Wiig (2000) and Nonaka & Takeuchi (1995), it considers a conceptual framework with three dimensions of "knowledge acquisition", "knowledge sharing", and "knowledge evaluation" in a comprehensive and effective way on all components and organizational culture, and presents a proposed model for improving the quality of environmental policy implementation in the Iranian government, which includes the capacity for institutional analysis, organizational learning, and reform of executive structures in an integrated manner.

The present study is trying to design, validate, and present a model that is simultaneously data-driven and executable, utilizing structural, behavioral, and knowledge layers. It is also a native and specific model for Iran, so that objective solutions can be provided for the effective implementation of environmental policies in Iranian government institutions.

2. Materials and methods

The present study is considered to be applied in terms of purpose and developmental in nature, because it attempts to help improve the effectiveness of environmental policy implementation in Iranian government organizations by providing a conceptual-executive model. From a methodological perspective, this study was conducted with a quantitative approach and a multiple case study strategy. The statistical population of the study consisted of 50 experts, managers, and senior experts from government organizations active in the field of the environment, who were selected using a purposive sampling method. Diversity at the managerial and institutional levels was one of the key criteria in selecting participants. The data collection tool was a researcher-made questionnaire based on a five-point Likert scale that was designed based on the conceptual framework of the study. This questionnaire included 15 items in five main executive components (organizational structure, organizational communications, organizational resources, executives' orientation, and organizational culture) and three dimensions of knowledge management (knowledge acquisition, sharing, and evaluation). The collected data were analyzed using indicators such as mean, standard deviation, and range of responses in each of the components of the executive model, and finally inferential analyses were performed with two complementary approaches. First, exploratory factor analysis was performed to identify the internal structure of the data and empirical validation of the components extracted from the

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theoretical literature and conceptual framework. This analysis helps to discover hidden relationships between items and their empirical clustering and provides the basis for rearranging the initial conceptual model. Then, in order to empirically examine the relationships between executive components and knowledge management dimensions, Pearson correlation test was used to enable simultaneous and non-causal analysis of relationships with appropriate statistical accuracy. This level of analysis deals with the empirical test of the alignment of the components of the executive model and the facilitating role of knowledge management in it. Using a combined approach of exploratory factor analysis and Pearson correlation is a scientifically valid and recommended approach in organizational and management research, especially in situations where the goal is to develop conceptual models and validate their structure (Hair et al., 2022). The face validity of the questionnaire was confirmed by a group of professors in the fields of public policy and knowledge management. It is emphasized that this article is based on expert opinion and that local aspects as well as sustainable development indicators have been considered in the design of the questions.

3. Results and discussion

3.1. Questionnaire Content Analysis

In this section, Table 1 shows the frequency distribution of responses along with the mean and standard deviation for each question:

Table 1. Descriptive statistics of questionnaire items

Question	Item (summary)	Very high	High	Medium	Low	Very low	Average	Standard deviation
1	Knowledge acquisition and organizational structure	33	14	3	0	0	4.60	0.61
2	Knowledge sharing and organizational structure	18	25	6	1	0	4.20	0.73
3	Knowledge assessment and organizational structure	12	29	8	1	0	4.04	0.70
4	Knowledge acquisition and communication	19	17	13	1	0	4.08	0.85
5	Knowledge sharing and communication	11	28	7	4	0	3.94	0.79
6	Knowledge and communication assessment	8	31	7	4	0	3.88	0.75
7	Acquisition of organizational knowledge and resources	29	18	2	1	0	4.50	0.68
8	Sharing organizational knowledge and resources	21	25	4	0	0	4.34	0.63
9	Evaluation of organizational knowledge and resources	22	18	9	1	0	4.22	0.82
10	Acquiring knowledge and orientation of executives	28	19	3	0	0	4.50	0.61
11	Sharing knowledge and orientation of executives	21	24	4	1	0	4.30	0.71
12	Assessing the knowledge and attitude of the performers	16	22	12	0	0	4.08	0.75
13	Acquiring knowledge and organizational culture	14	16	14	6	0	3.78	1.02
14	Knowledge sharing and organizational culture	12	15	11	12	0	3.54	1.11
15	Assessment of organizational knowledge and culture	3	19	21	7	0	3.36	0.80
Total	268	319	126	37	0			

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3.2. Descriptive Findings Analysis

• The highest averages are related to items related to knowledge acquisition in organizational structure (4.60) and organizational resources and executives' orientation (4.50), which shows that respondents have confirmed the strong impact of this component on the success of environmental policy implementation and indicates the high importance of the knowledge dimension in strengthening the structure and behavioral attitude. The low standard deviation in these items indicates a high consensus among experts.
• The lowest averages are related to items related to organizational culture; especially in knowledge assessment with a mean of (3.36) and standard deviation of (0.80). These data may indicate deep challenges in institutionalizing knowledge assessment and transfer in cultural layers or weaknesses in the knowledge assessment system of government organizations.
• The average score of more than 4.0 in most components indicates a high level of agreement among experts with the role of knowledge management in implementing environmental policies, and the standard deviation is in most cases less than 1, indicating acceptable convergence and coherence in the opinions of the participants.

3.3. Measuring the reliability of the data collection tool (Cronbach's alpha)

To calculate Cronbach's alpha, the items were entered into SPSS software based on the following categories, and alpha was calculated for each category (Table 2).

3.4. Analysis and interpretation

• All five components of the questionnaire have acceptable reliability (above 0.7) and there is no need to delete or modify items.
• The coefficient for the entire questionnaire is (0.810), which indicates good consistency in the entire measurement tool and, according to standard criteria, indicates good reliability of the entire measurement tool. This result is reassuring, because it shows that the questionnaire design has acceptable conceptual consistency and the data obtained from it can be the basis for subsequent inferential analyses.
• The organizational culture component (0.850) and organizational resources (0.807) show the highest internal consistency between items. Meanwhile, the highest internal consistency is related to organizational culture, which, despite the fact that the average of the items in this component is relatively low, indicates a high agreement among participants in identifying cultural challenges and shortcomings in the environmental field, and the existence of weakness or inefficiency in this component, which can be very helpful for the analyses of Chapter 5.
• Even the lowest organizational structure coefficient (0.732) is within the appropriate reliability range and there is no need to remove any of the items. This indicates that the items have been designed with sufficient scientific accuracy and conceptual coherence is at a satisfactory level.

3.5. Checking the adequacy of data for factor analysis (KMO and Bartlett's Test)

Before conducting exploratory factor analysis, it is necessary to check the appropriateness of the correlation matrix between items (Table 3).

3.6. Analysis and interpretation of findings

• The KMO value = 0.643 indicates the adequacy of the sample to perform an acceptable exploratory factor analysis; because according to the criterion, values between 0.6 and 0.7 indicate acceptable adequacy and data reliability for latent component analysis (Hair et al., 2022).
• The results of the Bartlett's Test also show, with a significant chi-square value ($\chi^2 = 389.270$, $p < 0.001$), that there is a significant correlation matrix between the items and that factor analysis can be performed, and the null hypothesis (no correlation) is rejected. Therefore, the data are suitable for factor analysis (Field, 2018).

According to the results obtained from the KMO and Bartlett tests, the data obtained from the questionnaire have adequacy and an appropriate internal correlation structure for performing an exploratory factor analysis. Therefore, we can confidently enter the exploratory factor analysis stage and empirically validate the conceptual structure of the proposed model.

3.7. Identifying the components of the knowledge management-based environmental conservation implementation model using exploratory factor analysis (EFA)

Exploratory factor analysis is used to discover the underlying structure of a set of observed variables and determines which items are correlated with each other and can be interpreted as a component (Field, 2018; Hair et al., 2022). Also, to strengthen the theoretical inference, a qualitative analysis of the country's upstream documents in the field of environment and knowledge management was used (Table 4).

Table 2. Cronbach's alpha coefficients for questionnaire components

Components	Number of items	Related items	Cronbach's alpha	Final commentary
Organizational structure	3	Questions 1, 2, 3	0.732	Acceptable
Organizational Communications	3	Questions 4, 5, 6	0.769	Acceptable
Organizational resources	3	Questions 7, 8, 9	0.807	Good
Conductors' tendency	3	Questions 10, 11, 12	0.760	Acceptable
Organizational culture	3	Questions 13, 14, 15	0.850	Good
The entire questionnaire	15	Questions 1 to 15	0.810	Good

Table 3. Test results for research data

Index	Calculation amount	Scientific interpretation
KMO index	0.643	Sample adequacy within acceptable limits (Hair et al., 2022)
Bartlett's Test	$\chi^2 = 389.270$	($p < 0.001$)
df	105	
Sig.	0.001	The suitability of the correlation matrix for factor analysis

Table 4. Extracted components and factor loadings after Varimax rotation

Extraction components	Loaded items (with factor weighting)
Sources and orientation of the performers	Question 7 (0.625), Question 8 (0.547), Question 9 (0.648), Question 10 (0.522), Question 11 (0.794), Question 12 (0.623)
Organizational culture	Question 13 (0.856), Question 14 (0.802), Question 15 (0.702)
Organizational structure	Question 1 (0.712), Question 2 (0.706), Question 3 (0.738)
Organizational Communications	Question 4 (0.650), Question 5 (0.764), Question 6 (0.721)

Table 5. Eigenvalues and explained variance of the components

Component	Special amount	Percentage of variance explained	Cumulative percentage
Sources and orientation of the performers	3.377	22.514	22.514
Organizational culture	2.629	17.527	40.040
Organizational structure	2.261	15.074	55.115
Organizational Communications	2.143	14.288	69.402

The components of "organizational resources" and "executive orientation," although distinct from a conceptual and factor analysis perspective, were extracted simultaneously in the output of the Varimax rotation. For this reason, they are presented in a combined table to maintain explanatory coherence and continuity. The statistical analysis of each component was conducted independently. In addition, in the field of environmental policymaking, these two constructs (resources and executive orientation) are often interdependent. This is because when resources are sufficient, the attitude and orientation of executives is more positive, and when resources are insufficient, the orientation becomes negative.

3.8. Analysis and interpretation of results

• The results indicate that success in implementing environmental policies requires simultaneous attention to structural and cultural-relational factors.

• The first component (resources and orientation of implementers) this component, with an eigenvalue of 3.377 and a share of 22.514% of the total variance, had the highest explanatory power among the identified components. The factor loadings of the items related to "organizational resources" and "orientation of implementers" on this component were very high, indicating a conceptual overlap of these two dimensions. The finding emphasizes that providing financial,

equipment, and human resources, along with a positive attitude of implementers towards implementing policies, is one of the key prerequisites for success in environmental policymaking. This overlap indicates that the lack of resources weakens the orientation of implementers and, conversely, enhanced resources cause motivation and commitment in implementing the policy.

• The second component (organizational culture) this component, with an eigenvalue of 2.629 and a variance share of 17.527% reflects the importance of the values, beliefs, and norms governing the organization in the adoption and implementation of environmental policies. The very high factor loadings of the items in this dimension indicate that organizational culture plays an important software role in strengthening or weakening implementation efforts and clearly emphasizes that even in the presence of sufficient resources, weaknesses in organizational culture can make policy implementation challenging.

• The third component (organizational structure) this component had an eigenvalue of 2.261 after varimax rotation and explained 15.074% of the total variance. Three items related to organizational structure had high loadings on this component, indicating the necessity of a transparent structure, clear decision-making processes, and precise assignment of tasks in the implementation of environmental policies. The findings show that organizational structure, as the backbone of policy implementation, plays a fundamental role in its success.

• The fourth component (organizational communications) this component, with an eigenvalue of 2.143 and a share of 14.288% of the variance, emphasizes the importance of a smooth and effective flow of intra-organizational and inter-departmental information. The quality of communication,

coordination of units, and clarity of messages are known as key factors in the success of environmental policies. The data indicate that even with appropriate resources and structure, effective policy implementation is not possible without effective and transparent communication.

• Items related to knowledge management are not distributed among these components, because knowledge management in this study is seen as a dimension outside the implementation model and its position among the components will be examined through Pearson correlation analysis.

• Factor loading ≥ 0.50 for acceptance of items in the components: In the table, the extracted values for all items are higher than 0.5 (between 0.522 and 0.856), which indicates that each variable has a significant share of the variance in the extracted components.

• Eigenvalue ≥ 1 for component selection: Four principal components were extracted, explaining a total of 69.402% of the total variance of the data, and the factor loadings of most items were above 0.60 and no items were eliminated.

3.9. Analysis of relationships between components of the knowledge management-based environmental protection implementation model using Pearson correlation

Pearson correlation analysis was conducted with the aim of examining and measuring the relationships between the extracted components and evaluating the relationship of these components with the three dimensions of knowledge management, including knowledge acquisition, sharing, and evaluation (Table 6).

3.10. Relationships between executive components and knowledge management dimensions

• Executive resources and orientation have a strong relationship with knowledge management dimensions and show the highest correlation with knowledge assessment.

• Organizational culture showed a strong and significant relationship with knowledge sharing (r = 0.675) and knowledge acquisition (r = 0.658);

• Organizational structure has a strong relationship with knowledge evaluation (r = 0.655) and a moderate relationship with knowledge acquisition (r = 0.443) and knowledge sharing (r = 0.408); • Organizational communication has a strong and significant correlation with both knowledge management dimensions (acquisition and sharing). These relationships indicate the complementary role of knowledge management in improving the executive capacity of government institutions in the field of environment. Based on the correlation matrix data, the interrelationships between the components are also significant. For example:

• Executive resources and orientation have a strong to weak correlation with organizational structure (r = 0.538) and organizational communication (r = 0.111);

• Organizational culture has a moderate relationship with communication (r = 0.375) and the lowest correlation with other components, for example with structure (r = 0.012), which can indicate the relative independence of this factor in the organizational value system

The proposed final model;

Based on the above findings, the final designed model consists of three layers:

• The central layer: implementation of environmental policies;

• The middle layer: four rearranged executive components;

• The outer layer: three dimensions of knowledge management.

Table 6. Comparison of component matrix results

Components	Sources and orientation of the erformers	Organizational culture	Organizational structure	Organizational Communications	Acquiring knowledge	Knowledge sharing	Knowledge assessment
Sources and orientation of the performers	1	0.171	0.538	0.111	0.509	0.661	0.777
Organizational culture	0.171	1	0.012	0.375	0.658	0.675	0.306
Organizational structure	0.538	0.012	1	0.133	0.443	0.408	0.655
Organizational Communications	0.111	0.375	0.133	1	0.556	0.565	0.357
Acquiring knowledge	0.509	0.658	0.443	0.556	1	0.715	0.443
Knowledge sharing	0.661	0.675	0.408	0.565	0.715	1	0.635
Knowledge assessment	0.777	0.306	0.655	0.357	0.443	0.635	1

Relationship Level Guide Based On Cohen (1998):
Strong: $0.50 \leq r$ Moderate: $0.30 \leq r < 0.50$ Weak: $0.1 \leq r < 0.30$ Insignificant $r < 0.1$

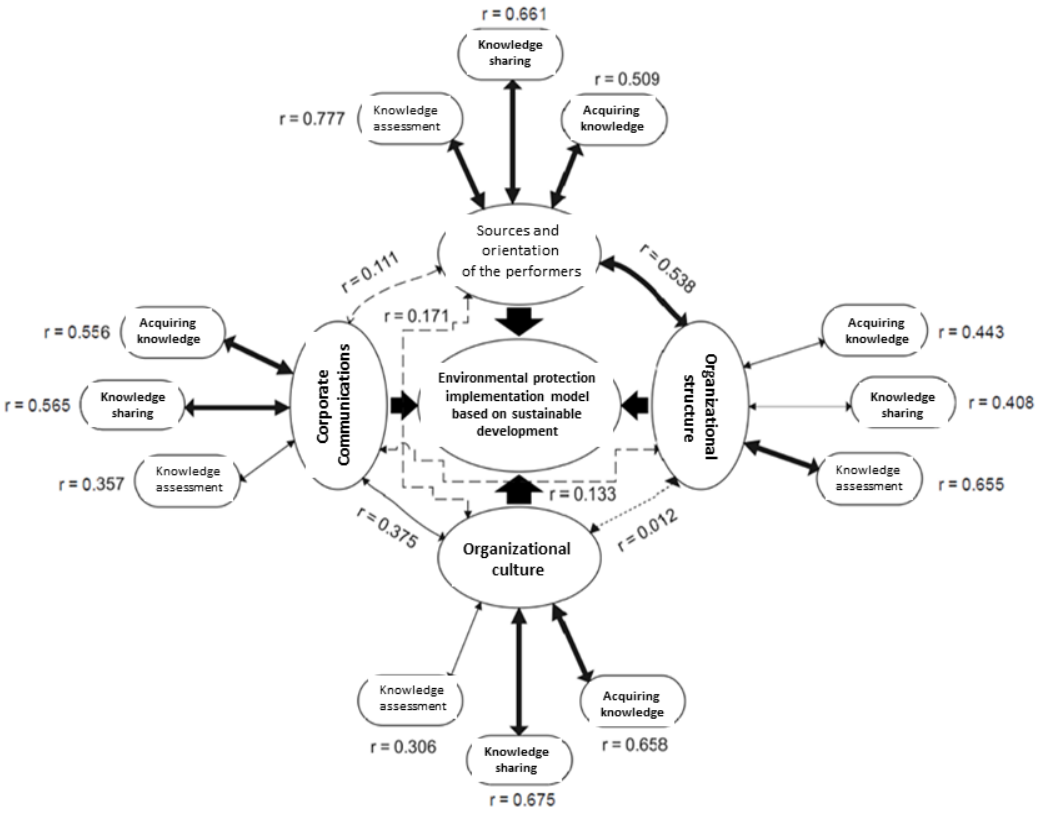

Figure 1. Final research model

In this model, reciprocal relationships between executive components are systematically established, and knowledge dimensions around each factor play a facilitating and supporting role.

4. Discussion

The results of this study indicate a complex but meaningful interaction between structural, cultural, resource and attitude, and communication components in the implementation of environmental policies in Iranian government organizations. Exploratory factor analysis led to the identification of four key components, each of which plays a role in achieving environmental goals: "organizational structure", "organizational culture", "resources and attitude of executives", and "organizational communication". These components are not only effective independently, but also affect the performance of the administrative system in their mutual interactions with each other. In the meantime, Pearson correlation findings indicate that the dimensions of knowledge management, especially knowledge assessment, play a key role in strengthening executive performance. For example, the component of "organizational resources and executives' orientation" had the highest correlation with "knowledge assessment", which indicates the importance of managers' capability, attitude and commitment in assessing and applying environmental data and experiences. Similarly, organizational culture also showed strong, meaningful and effective relationships with the dimensions of "knowledge acquisition" and "knowledge sharing", and organizational structure showed a strong correlation with "knowledge assessment". These findings imply that if government organizations have a more flexible structure, smoother communication, a learning-oriented culture and more capable human resources, they can implement environmental policies more effectively. The final model designed in this study, based on Edwards' (2008) framework and with the addition of the "organizational culture" component and the interlayer role of knowledge management, is represented at three levels: the central core (policy implementation), the middle and executive layer (four key components), and the outer and knowledge layer (three dimensions of knowledge management). Such an approach allows for a more comprehensive and systematic explanation of environmental policy implementation. A systematic review of domestic and foreign studies shows that despite the expansion of research in areas related to environmental policymaking, knowledge management, and executive structures, most of these studies have either focused on one of these dimensions or lacked a coherent link between the components in the form of an integrated and indigenous executive model. Meanwhile, the model designed in the present study has attempted to cover the conceptual and operational gap between knowledge and implementation by combining Edwards' theory, the organizational culture component, and the conceptual framework of knowledge management.

At the domestic level, studies such as Mazaheri et al. (2023) and Ahmadvand et al. (2023) have addressed green management and knowledge management in the energy sector, but they have lacked integration with environmental policymaking at the organizational level. Although the research of Ahmadi Tonekaboni et al. (2023) identified the components of policymaking, it lacked a specific implementation structure. Also, Jamshidi et al. (2022) focused on obstacles to policy implementation and did not propose an implementation structure. Keshavarz et al. (2022) only addressed knowledge management in government organizations and did not consider the environmental sector. While Kazemi-Nejad et al. (2018) took a structuralist view of policy implementation, without considering cultural and knowledge factors. Finally, Sohrabi and Bagherian (2015) proposed a conceptual relationship between knowledge management and the environment, but lacked a practical implementation framework. In the present model, these shortcomings are covered by combining empirical findings and an integrated conceptual framework.

At the foreign level, although studies such as Dekens et al. (2025), Norkadia et al. (2024), and Hejnowicz and Thorne (2022) have emphasized the necessity of coordinated governance, stakeholder participation, and knowledge integration in environmental policymaking, they have often remained at the strategic level and lacked implementation design at the level of government organizations. The study by Tarcoxa et al. (2023) highlighted the role of knowledge management in improving policies, but did not present an implementation conceptual model with a multi-layered approach. Also, articles such as Huan et al. (2024), Weina and Yanling (2022), Song et al. (2022), and Wenyao Zhang et al. (2021) have shown the impact of organizational culture, employee green behaviors, and knowledge innovation, which in the present research model has been explicitly operationalized as an independent component of organizational culture and its link to knowledge management. In this regard, Melati et al. (2021) have also emphasized the role of knowledge management in decision-making, which the present model strengthens with a data-driven and education-based approach. Finally, the findings of Taiwo et al. (2021) on the relationship

between the knowledge maturity of institutions and the success of environmental governance have also been included in this model theoretically and empirically. In summary, the present research model, with an integrated, data-based, localized, and networked approach, has attempted to create a structural, functional, and interactive link between the implementation components of policy, organizational culture, and knowledge management, and to respond coherently to the gaps observed in domestic and foreign literature. Finally, this model is not only applicable to the field of environmental policymaking in Iran, but can also be a model for applying knowledge management in other policymaking areas. The main condition for its success is institutionalizing a knowledge culture, redesigning structures, enhancing human resource capacities, and improving the flow of formal and informal communication in government agencies.

The innovation of this research is the design of a model for developing environmental policies in the country based on knowledge management, which has not been done in the country so far.

5. Conclusion

Based on the findings and the designed model, the following suggestions can be made to improve the implementation of environmental policies in government organizations:

1) Creating flexible and expertise-based structures:

The organizational structure should be designed in a way that facilitates the flow of information, participatory decision-making, and rapid response to environmental issues. Organizations should move away from rigid hierarchical structures and pay more attention to network and matrix models.

2) Institutionalizing an environmental organizational culture:

It is necessary to strengthen knowledge values, environmental attitudes, and responsible behaviors among employees through targeted training, non-material incentives, and exemplary leadership. The organizational culture should be formed in a way that supports “environmental learning.”

3) Systematic development of resources and motivation of implementers:

It is necessary to design promotion, reward and performance evaluation systems in government organizations based on knowledge competencies and environmental commitment. Also, attracting and retaining expert forces, strengthening information technology infrastructure, developing knowledge evaluation indicators and designing behavioral incentives are key requirements for improving the efficiency of implementers in implementing environmental policies based on knowledge management.

4) Improving the level of horizontal and vertical organizational communications:

Effective communications between different levels of the organization, executive units, supervisory bodies and even civil society organizations should be facilitated. These communications can be strengthened through integrated information systems, interactive meetings and knowledge networks.

5) Institutionalizing the knowledge management cycle in policy implementation:

Environmental policies should be designed and modified in a continuous and systematic process through "acquiring", "sharing" and "evaluating" knowledge. Establishing knowledge management systems and supporting organizational learning, using artificial intelligence, and data mining are key conditions for the success of this model.

Research Suggestions:

- Designing Comparative Implementation Models in Other Fields:
  Future research could focus on fields such as health, education, or energy to evaluate the applicability of this three-layer model (implementation factors + knowledge management + policy output).
- Adapting the model to non-governmental organizations and the private sector:
  Investigating the application of the model in non-profit institutions, policy consulting firms, and the private sector can contribute to theoretical enrichment.
- Analyzing causal paths between components using a structural equation modeling approach:
  By expanding the statistical population and using more advanced models, the causal effect paths between implementation components and knowledge management dimensions can be analyzed more accurately.
- Comparative study of the designed model with successful global models:
  Comparing this model with examples implemented in countries that have been more successful in implementing environmental policies (such as Finland or Germany) can increase the analytical richness of the research.

There were no specific limitations in this research. The only thing that can be mentioned is the lack of agreement and cooperation of two experts in the field of environmental policymaking in the country, who were

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unwilling to participate in this research for various reasons.

The comparative analysis reveals that the final model of this research introduces several significant innovations, both theoretically and practically, which can be outlined as follows:

According to the findings, organizational culture, as a key component and mediator, strengthens the structural link between formal mechanisms and organizational behavior.

Unlike static models, this model considers knowledge management as a dynamic process and interaction at the core of policy implementation.

The model is based not only on theoretical perspectives but also on analyses derived from 50 valid questionnaires across several government organizations in the country. This characteristic enhances the local validation of the model and increases its generalizability within the country's institutional environment.

Furthermore, by adopting such a multi-layered approach (hardware, software, and knowledge), the model analyzes and maps the relationships between components in a non-linear manner. This approach enhances the practical depth of the model and differentiates it from linear and single-layer patterns.

Authors Contribution
All authors have contributed equally to prepare the paper.

Availability of data and materials
The data that support the findings of this study are available from the corresponding author, upon reasonable request.

Conflict of interests
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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