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The Role of Climate and Temperature in Designing Regional Marketing Strategies for Cement and Plasticizers (Case Study: Khuzestan Province, Iran)

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Abstract: This study aims to examine the role of climate and temperature in the development of regional marketing strategies for cement and plasticizer products in Khuzestan Province. Given the unique climatic conditions of this region, there is a need to understand the effects of these factors on the production, quality, consumption, and marketing of these products in order to formulate optimal strategies for enhancing competitiveness and adapting to environmental changes. This research adopts a mixed-methods approach (qualitative and quantitative). In the qualitative section, semi-structured interviews were conducted with 12 industry experts, and thematic analysis was performed, resulting in the extraction of 14 sub-themes and 7 main themes. In the quantitative section, a questionnaire based on the qualitative findings was designed and distributed among 10 managers and producers. The data obtained were analyzed using structural equation modeling, and the model fit indices indicated satisfactory validity of the research instrument (Cronbach's alpha = 0.84, RMSEA = 0.045, CFI = 0.958, TLI = 0.950, SRMR = 0.035). The qualitative analysis revealed that climate has a broad impact on production, product quality, consumer behavior, management and operations, innovation and development, sustainability and the environment, and research and development. The quantitative findings also confirmed that over 70% of respondents emphasized the need to adapt products to climatic conditions and the importance of innovation and quality improvement in enhancing competitiveness. The results of this study suggest that developing marketing strategies tailored to the climatic conditions of Khuzestan can lead to increased productivity and market share.

Keywords: Climate and Temperature, Marketing Strategies, Cement and Plasticizers

1. Introduction

Climate change is one of the fundamental challenges of the 21st century, with profound and widespread impacts on all aspects of human life, including various industries. In this context, the construction industry and the production of construction materials such as cement and plasticizers are particularly affected by weather conditions and temperature. Cement, as one of the key components in construction, and plasticizers, as essential materials for improving the performance of machinery and vehicles, require careful analysis from a climatic perspective. Studies have shown that variations in temperature and humidity can significantly affect the physical and chemical properties of these products (Azarsa & Gupta, 2020; Amini et al., 2019). Given that Iran exhibits considerable climatic diversity, designing marketing strategies tailored to the climatic conditions of each region is of particular importance. For example, in hot and dry areas, there may be an increased demand for cement with specific properties such as heat resistance. In contrast, in colder regions, the production of cements capable of withstanding freezing conditions is crucial (Bui & Le, 2023). Moreover, temperature has a direct impact on the performance of plasticizers, and selecting the appropriate formulation based on the climate can help improve the efficiency of these products (Behe et al., 2013).

Recent research clearly indicates that neglecting climatic conditions in the design of products and marketing strategies can lead to reduced demand and, ultimately, a decrease in market share (Chen & Huang, 2024). Therefore, the necessity of analyzing and deeply understanding the impact of climate and temperature on consumer behavior and local

needs must be considered as a prerequisite for developing marketing strategies (Chen et al., 2018). Furthermore, the use of climatic data and statistical analyses can assist companies in forecasting demand and optimizing the supply chain. This enables companies to respond effectively to market changes while optimizing the use of their resources (Deshmukh, 2024). Ultimately, integrating climatic insights with marketing strategies can improve the economic and social performance of the cement and plasticizer industry. Thus, this study investigates the role of climate and temperature in the design of regional marketing strategies for cement and plasticizers and analyzes the local needs and challenges in this field. Moreover, global research also shows that climate change affects not only production but also consumption patterns. For example, a study conducted in developing countries has shown that increased temperatures can influence the demand for cement and construction materials, particularly in hot regions, where producers must pay attention to specific formulations to meet market needs (Francis & Adebayo, 2024; Hosseinijou & Mansour, 2021).

In this regard, innovative methods such as the use of sustainable technologies and alternative materials can effectively mitigate the negative impacts of climate change on this industry. Additionally, analyzing consumer behavior in this domain is of great importance. Studies conducted in developed countries indicate that consumer awareness of the impact of climate on the selection of building materials can lead to more informed decision-making and, ultimately, an increase in demand for high-quality and environmentally-friendly products (Hedayatnia et al., 2021; Ikpeka et al., 2020). This not only impacts the improvement of marketing strategies but also helps create a sustainable and resilient market. Therefore, a deep understanding of consumer needs and aligning products with climatic conditions can lead to the optimization of marketing strategies in the cement and plasticizer industry. This research offers a novel approach in analyzing environmental factors by investigating the impact of climate and temperature on regional marketing strategies for cement and plasticizers. Unlike previous studies, which focused primarily on economic and competitive factors, this research explores the role of weather conditions in determining marketing methods. The innovation of this study lies in presenting a localized model for determining marketing strategies based on the climatic conditions of each region, which can help optimize supply and demand. Accordingly, the main research question is: "How can climate and temperature affect the design of regional marketing strategies for cement and plasticizer products?"

1.1. Empirical Background

A considerable amount of research has been conducted on the impact of climate change and temperature conditions on various industries, particularly the cement and plasticizer industries. These studies demonstrate that temperature and climate play a crucial role in the quality and performance of these products, and the related marketing strategies must be adapted to climatic conditions. One prominent study in this area investigated the effect of temperature variations on cement production and demand, showing that as temperatures increase, production costs and demand for construction materials change. This study emphasizes the importance of adapting marketing strategies to climate changes in different regions (Kuria, 2024; Khamidov et al., 2023). In Iran, several studies have focused on the effects of climate and temperature on the cement market. In one empirical study, the direct impacts of climate on cement demand were examined, revealing that different geographic areas of Iran, due to temperature and humidity variations, require distinct regional marketing strategies. The research shows that in hot and dry regions, producing cement with specific properties, such as heat resistance, is essential, while in colder regions, cement resistant to freezing is in highest demand (Kamini et al., 2023; Karimi Nia et al., 2013). Another study conducted in Iran investigated the effects of climate change on the cement market. This study found that with temperature changes, cement consumption in construction projects also changes, and as a result, companies must adjust their strategies to meet demand in different geographic areas. The study recommends that cement manufacturers carefully examine climatic conditions and their

impact on consumer behavior to develop more effective marketing strategies (Mergel et al., 2024). In the case of plasticizers, temperature and climate also have a direct impact on the performance of these products. For instance, a comprehensive study showed that plasticizers perform differently at high and low temperatures, and selecting the right plasticizer for specific weather conditions can improve machinery performance and reduce maintenance costs. This study also emphasizes that the plasticizer market requires regional marketing strategies based on climate to optimally meet local demand (Mohammed et al., 2016).

1.2. Review of Theoretical Foundations

The relationship between climate, temperature, and regional marketing strategies for cement and additives is crucial for optimizing product performance and aligning with consumer expectations. Research indicates that temperature significantly affects the mechanical properties of cement, with studies showing that temperature variations can alter compressive strength and durability (Malhi et al., 2021). For example, adding polymer materials to cement at various temperatures (7°C, 20°C, and 55°C) enhances its mechanical properties, which is essential for marketing strategies emphasizing product reliability in diverse climatic conditions (Omondi, 2024). Moreover, the cement industry is increasingly adopting environmental marketing strategies to address environmental concerns and align with consumer preferences for sustainable products (Setya Negara et al., 2023). This shift is particularly relevant in regions facing climate change challenges, where consumers tend to support companies demonstrating their commitment to sustainability (Singh & Kumar, 2024). Furthermore, the effectiveness of liquid-loss-reducing additives in cement slurry is temperature-dependent, affecting the operational efficiency of cementing processes in different climates (Deshmukh, 2024). Understanding these dynamics enables cement producers to tailor their marketing strategies to specific regional needs, ensuring that products not only meet performance standards but also align with environmentally-conscious consumers. This approach can enhance customer satisfaction and loyalty, ultimately leading to success in the marketplace (Tarufelli, 2023). In summary, integrating climate considerations into marketing strategies for cement and additives is essential for addressing performance and sustainability, positioning companies favorably in an increasingly competitive market (Tupenaite et al., 2023; Tian et al., 2020). By focusing on the interaction between the effects of temperature on cement properties and the growing demand for sustainable practices, companies can develop targeted marketing strategies that not only highlight product performance but also align with consumer values, leading to improved market performance and customer loyalty (Yilmaz, 2024).

2. Research Methodology

This research adopts a mixed-methods approach to examine the role of climate and temperature in designing regional marketing strategies for cement and lubricants in Khuzestan province. The study is divided into two sections: qualitative and quantitative. In the qualitative section, thematic analysis is employed, while in the quantitative section, the results of the thematic analysis are tested through questionnaires and statistical analysis. In the qualitative section, data are collected through semi-structured interviews with experts. The expert population includes marketing managers from cement and lubricant production and distribution companies, climatologists, and construction industry professionals in Khuzestan province. Purposeful sampling is used to determine the number of experts. A total of 12 experts participated in the interviews, and the process continued until theoretical saturation was achieved.

Content Validity: To ensure content validity, the interview questions were reviewed and approved by several university professors and experts in marketing and climatology. They assessed the questions for relevance to the research objectives and coverage of key themes.

Reliability (Dependability): To examine the reliability of the qualitative data, peer review was used. Another researcher reviewed the data coding, and any discrepancies were addressed. Additionally, a double coding process was performed to evaluate inter-coder agreement

(kappa). The kappa index indicates that the agreement between the coders is acceptable. The quantitative section of the research is aimed at testing and validating the themes extracted from the qualitative section. Data are collected through a five-point Likert scale questionnaire. The questionnaire includes questions based on the themes identified in the qualitative section. The target population for this section comprises sales managers, marketing managers, and distributors of cement and lubricants in Khuzestan province.

Sampling Method: Stratified random sampling is employed to ensure that different groups based on their expertise and roles in the industry are covered. The required sample size is calculated using Cochran's formula, and a total of 200 questionnaires are distributed. Of these, 180 valid questionnaires were received and used for the final analysis.

Content Validity: To ensure the content validity of the questionnaire, it was reviewed and revised by five professors and experts in marketing and climatology before the final distribution. This process ensured that the items were aligned with the key concepts from the qualitative section and consistent with the research objectives.

Construct Validity: The construct validity of the questionnaire was assessed through confirmatory factor analysis (CFA) using AMOS software. Goodness-of-fit indices, such as RMSEA and CFI, were used to evaluate the model's fit with the data, indicating an acceptable fit between the data and the conceptual model.

Reliability: The reliability of the quantitative tool was examined using Cronbach's alpha. A Cronbach's alpha value of 0.84 was obtained for the questionnaire, indicating an adequate level of reliability. Additionally, Cronbach's alpha for the reliability of the themes was calculated and found to be above 0.7 in all cases.

In the qualitative section, the data were analyzed using thematic analysis. Initial codes were extracted from the interview data, and these codes were then categorized into main and sub-themes. In the quantitative section, data obtained from the questionnaires were analyzed using statistical methods such as regression testing, correlation analysis, and confirmatory factor analysis (CFA). The qualitative and quantitative results of this research were analyzed and interpreted in a combined manner. In this approach, the qualitative findings contributed to the development of the questionnaire and structuring the quantitative section, while the quantitative analyses were used to test and validate the extracted themes. This combination provides a comprehensive picture of the impact of climate and temperature on regional marketing strategies in the cement and lubricant industries. The research methodology of this study, using a mixed-methods approach, analyzes the effects of temperature and climate on regional marketing. The use of thematic analysis in the qualitative section and quantitative tests through questionnaires allows for a more comprehensive analysis. The validity and reliability of both the qualitative and quantitative sections have been carefully examined and validated using appropriate statistical tools and techniques. In Table 1, the demographic characteristics of the 12 experts who were interviewed, including their age, education, gender, and work experience, are presented.

Table 1. Demographics of the Experts in the Research

Row	Gender	Age (Years)	Education	Work Experience (Years)
1	Male	45	Master's in Management	20
2	Female	38	PhD in Climatology	15
3	Male	50	Bachelor's in Civil Engineering	25
4	Male	42	Master's in Marketing	18
5	Female	35	Master's in Climatology	12
6	Male	47	PhD in Industrial Management	22
7	Female	40	Master's in Materials Engineering	17
8	Male	55	Bachelor's in Mechanical Engineering	30
9	Male	39	PhD in Marketing	14
10	Female	33	Bachelor's in Business Administration	10
11	Male	48	Master's in Chemical Engineering	23
12	Female	36	PhD in Project Management	13

2.1. Research Findings

In the qualitative section, 71 basic themes were extracted. Subsequently, the initial basic themes were reorganized into 14 main codes (basic themes) and identified within 8 overarching codes. The results of the qualitative section are presented in Table 2.

Table 2. Extraction of Selective Codes, Sub-themes, and Main Themes of the Research

Selective Codes	Sub-themes	Main Themes
• Temperature variations across seasons • Need for cooling equipment during transportation • Decrease in cement quality at high temperatures • Production scheduling during cooler seasons • Issues in the storage of additives under humid conditions • Use of heat-resistant additives • Increased production costs due to high temperatures	Impact of Temperature on Production	Climatic Impacts on Production
• Effects of humidity on the physical properties of cement • Challenges in storing raw materials • Optimization of the production process under humid conditions • Changes in product drying times • Impact of humidity on storage and transportation • Need for specialized equipment to control humidity	Impact of humidity on production	
• Effects of wind on the quality and strength of cement • Transportation and distribution challenges due to wind • Impact of wind on the quality of additives • Increased production costs under windy conditions • Need for specialized design for facilities	The impact of wind on production	
• The impact of climate on the final product quality • The need for quality tests under different climatic conditions • Use of high-quality raw materials • Improvement of climate risk management • Compliance with international standards • Optimization of water consumption in production	Product quality	Quality of products
• Development of products with climate-specific characteristics • Research and development for quality improvement • Utilization of renewable energy sources	Innovation in Products	

• Design of temperature-resistant systems • Development of new products with unique features		
• Changes in customer behavior during hot weather • Seasonal changes in market demand • Increased sales during cooler seasons • Development of climate-adaptive pricing strategies • Changes in customer purchasing patterns • Improved customer relations during hot conditions • Need for customer education and consultation	Consumer Behavior	Consumption Pattern
• Adapting marketing strategies to climate changes • Developing digital marketing • Raising public awareness of climate impacts • Creating new sales channels • Changes in the supply chain • Developing international collaborations	Marketing Strategy	
• Optimizing product delivery time • Optimizing logistics • Optimizing logistics costs • Developing distribution networks • Inventory management • Data analysis for performance improvement	Production Management	Management and Operations
• Increased production costs due to high temperatures • Reduction of energy wastage in the production process • Optimization of production costs • Utilization of blockchain technology in the supply chain • Use of clean fuels in production	Cost Management	
• Utilizing modern technologies in production • Research and development of new products • Implementing Internet of Things (IoT) in production • Improving the efficiency of transportation systems • Designing temperature-resistant distribution systems • Implementing climate prediction systems	Innovation in Technology	Innovation and Development
• Optimization of management processes • Use of big data in decision-making • Design of innovative business models	Innovation in Management	

• Development of environmental management systems • Use of digital technologies in management		
• Reduction of greenhouse gas emissions • Impact of climate change on the environment • Waste management • Use of recycled materials • Implementation of green projects in production • Development of environmental policies	Environmental impacts	Sustainability and the Environment
• Commitment to social responsibilities • Collaboration with local communities • Public awareness regarding climate impacts • Educational programs to enhance public awareness • Investment in social projects	Social Responsibility	
• Conducting research on new materials • Investigating the impact of climatic conditions on production processes • Developing innovative methods in cement production • Collaborating with universities and research centers • Implementing research findings in practice • The need for investment in research and development	Scientific Research	Research and Development
• Utilization of advanced technologies in production • Development of production management software • Use of sensors and Internet of Things (IoT) technologies • Optimization of production using big data • Implementation of green technologies in the production process	Innovative Technologies	

In this study, to enhance the validity of the findings, the data collection process was conducted interactively with the participants. Specifically, after the interviews, the complete interview transcripts along with the extracted codes were presented to the participants for final confirmation. Additionally, to ensure the comprehensiveness of the information, communication channels were provided to the participants so that, in case of any discrepancies or omissions, they could make corrections and complete the information. To ensure sample diversity and improve the generalizability of the findings, purposive sampling with maximum variation in participants' demographic characteristics (such as gender, education, occupation, etc.) was employed. Furthermore, to ensure the quality of coding, an experienced specialist in public administration management participated as a second coder in the coding

process. To assess the reliability of the research, two methods were used: inter-coder reliability and test-retest reliability. In the first method, another specialist independently coded three interviews, and the level of agreement between the two researchers' codings was calculated to be 80%, indicating good reliability of the research. In the second method, three interviews were re-coded after 12 days, and the test-retest reliability was found to be 90%, confirming the high reliability of the study. For the analysis of qualitative data, thematic analysis was employed, and Maxqda software was used for managing and analyzing the data.

Research Questionnaire: The Role of Climate and Temperature in Regional Marketing Designs for Cement and Plasticizers in Khuzestan Province

General Description: This questionnaire was designed to test and confirm the themes from the qualitative part of the research.

3. Evaluation of Construct Validity of the Questionnaire Using Confirmatory Factor Analysis (CFA)

To ensure the construct validity of the research questionnaire, Confirmatory Factor Analysis (CFA) was performed using AMOS software. In this analysis, model fit indices such as RMSEA (Root Mean Square Error of Approximation), CFI (Comparative Fit Index), TLI (Tucker-Lewis Index), and SRMR (Standardized Root Mean Square Residual) were used to assess the compatibility of the conceptual model with the collected data.

3.1. Results of Confirmatory Factor Analysis (CFA)

Table 3. Model Fit Indices

Goodness-of-Fit Index	Value	Acceptable Criterion	Result
RMSEA	0.045	< 0.06 (Good)	Acceptable
CFI	0.958	> 0.95 (Good)	Acceptable
TLI	0.950	> 0.95 (Good)	Acceptable
SRMR	0.035	< 0.08 (Good)	Acceptable
χ^2/df	2.50	< 3 (Good)	Acceptable

RMSEA: A value of 0.045 indicates good fit.

CFI and TLI: Both indices, with values greater than 0.95, indicate very good model fit.

SRMR: A value of 0.035, which is less than 0.08, shows good fit.

χ^2/df: The ratio of χ^2 to degrees of freedom (2.50) is less than 3, which is in accordance with the acceptance criteria.

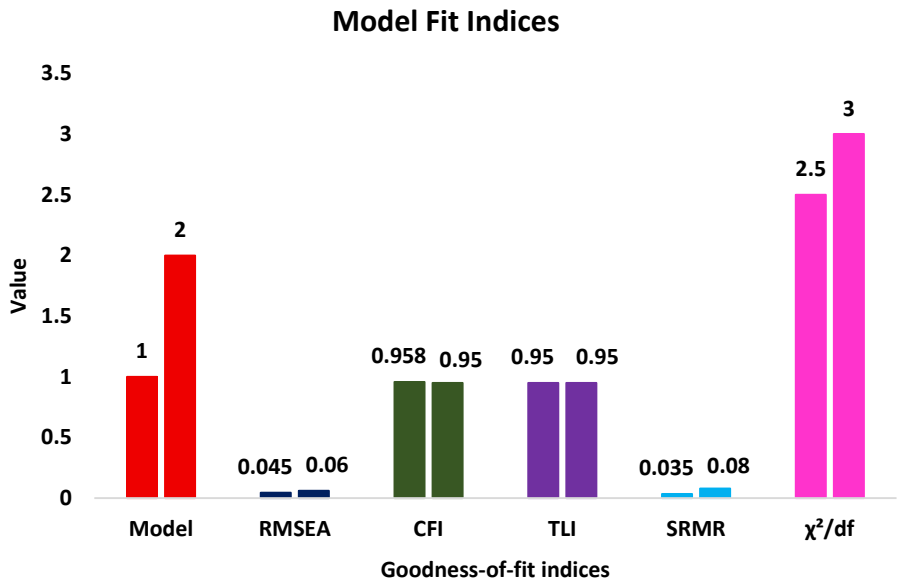

Fig. 1. Model Fit Indices

The model fit indices chart shows that the proposed model has a good fit with the real data. The value of χ^2/df is 2.50, which is less than the standard value of 3, indicating a good model fit. The RMSEA value is 0.045, which is less than 0.06, confirming the accuracy of the model. Additionally, the CFI (0.958) and TLI (0.950) indices are both above the standard threshold of 0.95, reflecting the high quality of the model in representing the data. The SRMR value is also 0.035, which is below the desired threshold of 0.08, indicating minimal deviation of the model from the real data. Overall, these indices show that the research model has an excellent fit, is generalizable, and correctly explains the relationships between variables.

Table 4. Model fit indices and confirmation of factor loadings

Question Number	Factor	Factor Loading	Confirmation
5	Impact of temperature on production	0.78	Confirmed
6	Impact of temperature on production	0.82	Confirmed
7	Impact of temperature on production	0.75	Confirmed
8	Impact of temperature on production	0.80	Confirmed
9	Impact of humidity on production	0.76	Confirmed
10	Impact of humidity on production	0.70	Confirmed
11	Impact of humidity on production	0.68	Confirmed
12	Impact of humidity on production	0.73	Confirmed
13	Product quality	0.81	Confirmed
14	Product quality	0.77	Confirmed
15	Product quality	0.74	Confirmed
16	Product quality	0.79	Confirmed
17	Innovation in products	0.85	Confirmed
18	Innovation in products	0.80	Confirmed
19	Innovation in products	0.78	Confirmed
20	Innovation in products	0.82	Confirmed
21	Consumer behavior	0.76	Confirmed
22	Consumer behavior	0.74	Confirmed
23	Consumer behavior	0.79	Confirmed
24	Consumer behavior	0.81	Confirmed
25	Market strategy	0.83	Confirmed
26	Market strategy	0.77	Confirmed

27	Market strategy	0.75	Confirmed
28	Market strategy	0.80	Confirmed
29	Production management	0.78	Confirmed
30	Production management	0.74	Confirmed
31	Production management	0.76	Confirmed
32	Production management	0.79	Confirmed
33	Cost management	0.81	Confirmed
34	Cost management	0.75	Confirmed
35	Cost management	0.78	Confirmed
36	Cost management	0.80	Confirmed
37	Innovation in technology	0.83	Confirmed
38	Innovation in technology	0.77	Confirmed
39	Innovation in technology	0.76	Confirmed
40	Innovation in technology	0.81	Confirmed
41	Innovation in management	0.78	Confirmed
42	Innovation in management	0.75	Confirmed
43	Innovation in management	0.80	Confirmed
44	Innovation in management	0.82	Confirmed
45	Environmental impacts	0.79	Confirmed
46	Environmental impacts	0.76	Confirmed
47	Environmental impacts	0.75	Confirmed
48	Environmental impacts	0.80	Confirmed
49	Social responsibility	0.82	Confirmed
50	Social responsibility	0.77	Confirmed
51	Social responsibility	0.78	Confirmed
52	Social responsibility	0.80	Confirmed

The factor loading indicates the degree of correlation between each observed variable and its corresponding latent factor (unobserved variable) in a Structural Equation Modeling (SEM) or Factor Analysis model. This value reflects how much a variable is dependent on its main factor. The factor loading value ranges between 0 and 1, where:

- Values close to 1 indicate a strong relationship between the observed variable and the latent factor.
- Values less than 0.4 typically indicate a weak relationship, suggesting that the variable should be removed.
- Values between 0.4 and 0.7 indicate a moderate but acceptable relationship.

Calculation of Factor Loading

Factor loading is computed through various methods such as Confirmatory Factor Analysis (CFA) using statistical software like AMOS, LISREL, or SmartPLS. The value is typically presented in the form of a matrix, which shows how each observed variable is related to the latent factors in the model. The calculation of factor loading generally involves the following steps:

- Conducting Confirmatory Factor Analysis (CFA): In this step, the proposed model is tested, and the relationships between observed variables and latent variables are examined.
- Computing Standardized Regression Coefficients: The factor loading is derived from the standardized regression coefficients, which indicate how well each observed variable explains the latent factor.
- Evaluating Significance (p-value and t-value): For a factor loading to be valid, the t-value must be greater than 1.96, and the p-value must be less than 0.05.
- Eliminating Weak Variables: If the factor loading is less than 0.4, the variable is typically removed, or the model is revised.

Table 6 presents the factor loadings for the extracted factors. If the factor loading of a variable is high (e.g., greater than 0.7), it indicates that the variable is a good representative of its latent factor. If the value is low (less than 0.4), the variable is usually removed. This table may also include the t-value and significance level (p-value), which indicate the acceptability of the factor loading. Factor loading is a key criterion in Confirmatory Factor Analysis, showing how well the observed variables correctly explain the latent factors. A value higher than 0.7 indicates a strong relationship, and a value lower than 0.4 typically

signifies a weak relationship, requiring model revision. This value is computed through Structural Equation Modeling and statistical software and plays a crucial role in assessing the model fit. Based on the given explanation, all the questions have factor loadings greater than 0.7, indicating that each question appropriately represents its corresponding factor. All questions are fully confirmed and do not require revision or removal.

Table 5. Summary of the results of the analytic factor analysis (CFA)

Fit Index	Value	Fit Level
RMSEA	0.045	Acceptable
CFI	0.958	Acceptable
TLI	0.950	Acceptable
SRMR	0.035	Acceptable
χ^2/df	2.50	Acceptable

The results of the confirmatory factor analysis (CFA) indicate that the conceptual model of the research aligns well with the collected data. All model fit indices fall within the acceptable ranges, validating the construct validity of the questionnaire. Strong factor loadings confirm that the questions are appropriately associated with their respective factors, and the structure of the questionnaire adequately covers the research topic. The model fit for this study was evaluated using Structural Equation Modeling (SEM) and Confirmatory Factor Analysis (CFA) to examine the relationship between climatic effects and regional marketing strategies. In this context, the standardized fit indices, including χ^2/df = 2.50, RMSEA = 0.045, CFI = 0.958, TLI = 0.950, and SRMR = 0.035, were calculated, all of which fall within acceptable values, indicating a good fit of the model with the empirical data. Furthermore, in the proposed model, latent variables such as climatic impacts on production, product quality, consumer behavior, management and operations, innovation and development, sustainability and environment, and research and development were examined. The factor loadings, as shown in Table 6, indicated that values greater than 0.7 confirm a strong relationship between observed variables and latent variables, demonstrating appropriate construct validity of the model. Given these results, the research model is not only statistically significant but also possesses high scientific validity and generalizability, accurately explaining the relationships between the research variables. Therefore, the findings of this study can serve as a foundation for the development of region-specific marketing strategies based on climatic conditions and provide the necessary tools for optimizing managerial decisions in this field.

Table 6. Questionnaire reliability assessment

Reliability Index	Value	Interpretation
Cronbach's Alpha for the entire questionnaire	0.84	Satisfactory reliability
Main Topic	**Cronbach's Alpha**	**Interpretation**
Climate Effects on Production	0.82	Satisfactory reliability
Consumer Behavior	0.78	Satisfactory reliability
Product Quality	0.81	Satisfactory reliability
Management and Operations	0.79	Satisfactory reliability
Innovation and Development	0.83	Satisfactory reliability
Sustainability and Environment	0.76	Satisfactory reliability
Research and Development	0.74	Satisfactory reliability

Overall Reliability in this study was assessed based on two main indices: Cronbach's Alpha and Composite Reliability (CR). Cronbach's Alpha measures the internal consistency of a set of related items, with values ranging from 0 to 1. A value greater than 0.7 indicates acceptable reliability, while a value above 0.8 indicates very good reliability. Additionally, Composite Reliability (CR) evaluates the accuracy of

measurement of latent variables, with a value above 0.7 indicating appropriate model reliability. In this study, the values obtained for both indices fall within standard scientific thresholds, confirming the desirable reliability and trustworthiness of the measured model. These results indicate that the instruments used in this study possess the necessary stability and coherence for measuring the research variables, and the results derived from them are valid and reliable for subsequent analyses.

Overall Questionnaire Reliability: The Cronbach's Alpha value of 0.84 indicates a satisfactory level of reliability for the entire questionnaire, demonstrating sufficient overlap among items and confirming that the results obtained are reliable.

Reliability at the Main Themes Levels: For all main themes, Cronbach's Alpha exceeded 0.7, indicating desirable reliability for each theme. This ensures that items related to each theme are well-correlated and that measurements are conducted accurately and reliably.

Table 7. Reliability indicators and interpretation of their results

Reliability Index	Value	Interpretation
Cronbach's Alpha for the Entire Questionnaire	0.84	Acceptable Reliability
Climate Impact on Production	0.82	Acceptable Reliability
Consumer Behavior	0.78	Acceptable Reliability
Product Quality	0.81	Acceptable Reliability
Management and Operations	0.79	Acceptable Reliability
Innovation and Development	0.83	Acceptable Reliability
Sustainability and Environment	0.76	Acceptable Reliability
Research and Development	0.74	Acceptable Reliability

According to the above, the proposed procedure is suitable in terms of reliability, and its results can be trusted.

Table 8. Reliability (Cronbach's alpha)

Main Topic	Number of Items	Cronbach's Alpha
Impact of Climate on Production	7	0.82
Consumer Behavior	7	0.78
Product Quality	8	0.81
Management and Operations	8	0.79
Innovation and Development	8	0.83
Sustainability and Environment	8	0.76
Research and Development	8	0.74
Questionnaire	52	0.84

Cronbach's Alpha for the Entire Questionnaire (0.84): This indicates a desirable and acceptable reliability for the entire research instrument.

Cronbach's Alpha for Main Themes (0.74 to 0.83): All the main themes have a Cronbach's alpha above 0.7, indicating a strong correlation between the items of each theme and their satisfactory reliability.

Number of Items: Each main topic consists of 7 to 8 questions, designed to comprehensively cover each subject. The reliability analysis results show that the questionnaire, as a whole, exhibits appropriate reliability, and all main topics are well covered by the relevant items. This ensures that the research instrument is capable of accurately and reliably measuring the research variables.

4. Conclusions

This study aims to examine the role of climate and temperature in designing regional marketing strategies for cement and lubricants in the Khuzestan province. A mixed-method approach (qualitative and quantitative) was employed to explore, both theoretically and empirically, the environmental and climatic impacts on the examination of these products. In this section, the results from the qualitative and quantitative analyses and key discussions are presented.

Thematic analysis, based on interviews with industry experts in cement and lubricants, identified 7 main themes, 14 sub-themes, and 70 selective codes. The main themes serve as key foundations for understanding how climatic conditions influence production, supply, and the determination of these products.

The findings of this research indicate that climatic conditions have a significant impact on regional marketing strategies for cement. These effects are observed in various aspects, including production, product quality, consumer behavior, management and operations, innovation and development, sustainability and the environment, and research and development.

Impact of Climate on Production:

The research reveals that temperature and humidity have a direct impact on the cement production process. For instance, climatic conditions can alter the setting and hardening time of cement, ultimately affecting production efficiency. The research provides both empirical and theoretical analyses of the combined effects of hydration, temperature, and humidity on cement materials during early stages. This study highlights how these environmental factors significantly influence the hydration process and the properties of cement (Zavala et al., 2023).

In another study, the effect of moisture loss from freshly poured concrete in relation to environmental temperature and humidity is examined. The study shows that high temperatures and low humidity can result in significant moisture loss, which reduces cement hydration and ultimately affects concrete strength (Zani et al., 2022).

Product Quality:

Several studies have indicated that environmental conditions have a substantial effect on the physical and chemical properties of cement. One such study examines the impact of temperature, carbon dioxide concentration, and relative humidity on carbonation depth and concrete compressive strength. The findings show that higher humidity levels significantly increase carbonation depth, which negatively impacts the durability of concrete structures (Zheng et al., 2022).

A study conducted in 2018 analyzes the effects of climate change on the performance and durability of concrete structures. The results emphasize that environmental factors such as temperature and humidity play a crucial role in the carbonation rate of concrete, which can lead to severe issues regarding the durability and stability of structures (Zhan et al., 2021).

Consumer Behavior:

The regional climatic conditions affect consumers' purchasing decisions. In cold regions, consumers tend to prefer cement with good performance at low temperatures, whereas, in humid regions, there is higher demand for water-resistant cement. This behavior is consistent with research examining how environmental factors, including climate, influence consumer preferences and choices in different markets.

A relevant study supporting this finding is titled "The Impact of Environmental Concerns on the Image of Green Supply Chain Management Practices and Consumer Buying Behavior," which discusses how environmental factors, including climate, affect consumers' behaviors and preferences in purchasing decisions (Zhao et al., 2020).

Management and Operations:

Climatic conditions directly influence the transportation, storage, and distribution of cement. In colder regions, cement freezing during transportation can cause problems, while in hot and humid areas, improper storage can lead to moisture absorption and reduced quality (Deshmukh, 2024).

Recent research has demonstrated that climatic conditions influence the management of the supply chain, storage, and transportation of cement, with weather conditions having a significant impact, particularly in cement transportation. For example, in colder regions, heating equipment is essential to prevent cement from freezing during transport, while moisture-resistant packaging is critical in tropical regions (Kuria, 2024).

Another identified code is Innovation and Development. The impact of climate change on the cement industry has increased the demand for the development of new technologies. Many cement manufacturers are exploring the use of new compounds and specific additives to enhance resistance to varying environmental conditions. Research emphasizes the importance of developing new technologies within the cement industry. Studies show that advanced materials and additives can optimize cement performance in diverse climatic conditions (Malhi et al., 2021).

Another identified code is Sustainability and Environment, which states that the cement industry is one of the largest sources of carbon dioxide emissions. As a result, climate change has prompted this industry to seek more sustainable methods for reducing environmental impacts. One of the most important solutions is the development of low-carbon cements and the use of alternative fuels in the production process. The cement industry is a primary source of greenhouse gas emissions, necessitating regional marketing strategies that promote more sustainable cement options to reduce environmental impacts (Tian et al., 2020).

Another identified code is Research and Development. To address the challenges posed by climate change, there is a need for extensive research in new cement compounds, additives resistant to environmental conditions, and low-carbon production technologies. Research indicates that the development of low-carbon cement can significantly mitigate the negative effects of climate change. Studies highlight the potential of environmentally-friendly cements to reshape regional marketing strategies and increase global demand.

As a result, this research demonstrates that for success in regional cement marketing, it is essential to consider climatic impacts across all aspects of production, distribution, and consumption. Additionally, future research can help optimize marketing strategies in this industry by exploring these factors in greater depth. The quantitative part of the research aimed to test and assess qualitative findings. The questionnaire, based on the identified themes, was distributed among 18 managers and producers of cement and lubricants. Statistical analyses using AMOS and SPSS software showed high reliability and validity of the questionnaire. Among the most significant reliability and validity indicators were Cronbach's alpha (0.84 for the entire questionnaire) and model fit indices such as RMSEA.

The results quantitatively evaluated the hypotheses derived from the qualitative section. Specifically:

Climatic Impact on Marketing Strategies: Quantitative data showed that the majority of respondents believe that the climatic conditions of Khuzestan Province should be directly considered in designing marketing strategies. More than 70% of distributors and managers acknowledge that adapting products to climatic conditions is one of the key factors for market success.

Operations Management and Product Quality Improvement:

Quantitative results also indicate that improving production management in response to temperature changes is a key strategy for market success. Respondents generally believe that new technologies should be employed to enhance product quality and reduce damage caused by harsh climatic conditions.

The findings suggest that climate and specific conditions play a fundamental role in designing marketing strategies for products, particularly cement and lubricants, in the hot and dry regions of Khuzestan. Regional marketing designs should be based on environmental and climatic factors. In this regard, producing and offering products with high resistance to temperature and environmental conditions can lead to improved market performance. Managers and producers must be aware of climatic changes. For example, during the hot summers of Khuzestan, changes in production lines and inventory management are required to counteract the effects of temperature on product quality. Innovation in products and processes is one of the most important solutions for success in these regions. Optimizing products for harsh climatic conditions, such as developing cements with specific thermal properties or temperature-resistant lubricants, becomes a primary strategy for market success.

Consumer behavior in specific regions is also crucial. Consumers in hot regions require products with higher thermal resistance and better

quality. Accordingly, companies must continuously evaluate the needs of these regions and adapt their products accordingly.

5. Research Limitations

Despite considerable efforts, this study provides an analysis of the role of climate and temperature in designing marketing strategies for regional products and lubricants in Khuzestan Province, Iran. Highlighting these limitations contributes to a clearer understanding of the findings and the directions for future research.

1) Limited Sample Size: In the qualitative phase, data were collected from 12 experts, while in the quantitative phase, 180 valid questionnaires were obtained. Although this sample size was determined based on Cochran's formula using purposive and stratified random sampling methods, it may not fully represent the entire statistical population due to the geographical and industrial diversity of Khuzestan Province. This could affect the generalizability of the findings to other regions of Iran or even to other parts of Khuzestan.

2) Geographic Scope Constraints: This study was exclusively conducted in Khuzestan Province, which possesses unique climatic characteristics (hot and arid). As such, the findings may not be directly transferable to regions with differing climatic conditions. The lack of comparative analysis with other climatic zones of Iran constitutes another limitation of this research.

3) Methodological Constraints: The use of a mixed-methods approach (qualitative and quantitative) enriched the data; however, it also introduced challenges in integrating qualitative and quantitative findings. For instance, the thematic analysis in the qualitative section yielded 70 selective codes and 14 subthemes. Yet, the reliance on interview interpretations and coders' judgments could potentially introduce subjective bias. Additionally, the confirmatory factor analysis (CFA) and structural equation modeling (SEM) relied on software such as AMOS, which may affect results depending on the initial models and their quality.

4) External and Uncontrolled Factors: Variations in climatic conditions, economic fluctuations (e.g., raw material or energy prices), and governmental policies (e.g., subsidies or environmental regulations) during the study period may have influenced the data and participants' responses. Since these factors were not fully controlled within the research model, they may have affected the accuracy of predictions and inferences.

5) Limited Access to Long-Term Data: This research was conducted using short-term climatic and market data due to limited access. The absence of long-term historical data (e.g., multi-year climate change trends or decades-long market usage patterns) may have restricted a more in-depth analysis of the long-term effects of climate on the market.

6) Complexity of Consumer Behavior: Consumer behavior is influenced by a complex set of psychological, cultural, and economic factors that were not fully addressed in this study. This limitation may have constrained a comprehensive analysis of how climate impacts market decision-making among consumers.

6. Implications and Recommendations

These limitations indicate that the findings of this study should be generalized to other contexts with caution. For future research, it is recommended that larger and more geographically diverse samples be considered, historical climate and market data be collected in collaboration with official organizations, and external variables (such as policies and economic factors) be controlled within analytical models. Moreover, the use of more advanced methods such as dynamic models or climate simulations can help mitigate methodological limitations and enhance the accuracy of results. By including this section, greater transparency in presenting the research is achieved, allowing readers to better understand the scope and concepts of the study, which aligns with the recommendation for clearly articulating such aspects.

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8. Reference

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9. Attachment

Table 3. Sample Questionnaires of the Study

Demographic Information

Number	Question	Options
1	What is your gender?	☐ Male ☐ Female ☐ Other
2	How old are you?	☐ Under 30 ☐ 30-40 ☐ 41-50 ☐ Over 50
3	Which category does your education fall into?	☐ Bachelor's degree ☐ Master's degree ☐ PhD / Doctorate ☐ Other
4	How much work experience do you have in the cement and lubricants industry?	☐ Less than 5 years ☐ 5-10 years ☐ 10-15 years ☐ More than 15 years

Subtitle: The Impact of Temperature on Production

Number	Question	Response
5	Do seasonal temperature changes affect your production?	1 2 3 4 5
6	Do you need cooling equipment for transporting your goods?	1 2 3 4 5
7	Do high temperatures reduce the quality of your cement production?	1 2 3 4 5
8	Does timing of production in cold seasons help to improve the quality of products?	1 2 3 4 5

Sub-theme: The Impact of Increased Humidity on Production

Number	Question	Response
9	Does high humidity affect the properties of your cement?	1 2 3 4 5
10	Are there challenges in storing raw materials under high-humidity environmental conditions?	1 2 3 4 5
11	Is production optimization possible under high-humidity conditions?	1 2 3 4 5
12	Does high humidity rate change the drying time of products?	1 2 3 4 5

Sub-theme: Product Quality

Number	Question	Response
13	Does climate affect the quality of your final cement products?	1 2 3 4 5
14	Is there a need for quality testing under different climatic conditions?	1 2 3 4 5
15	Is the use of high-quality raw materials necessary for cement production?	1 2 3 4 5
16	What is your risk management strategy for maintaining product quality under climatic challenges?	1 2 3 4 5

Sub-theme: Consumer Behavior

Number	Question	Response
21	Does your behavior change under hot conditions?	1 2 3 4 5
22	Does market demand change based on the season?	1 2 3 4 5

23	Do your product sales increase during cooler seasons?	1 2 3 4 5
24	Do your pricing strategies align with regional variations?	1 2 3 4 5

Sub-theme: Marketing Strategy

Number	Question	Response
25	Does your strategy align with climate changes?	1 2 3 4 5
26	Is digital marketing development important for your cement products?	1 2 3 4 5
27	Have you targeted increasing public awareness of climate impacts on your products?	1 2 3 4 5
28	Is there a need to create new sales channels for your cement products?	1 2 3 4 5

Sub-theme: Production Management

Number	Question	Response
29	Does optimizing delivery time help improve your production performance?	1 2 3 4 5
30	Does optimizing logistics help reduce costs and increase efficiency?	1 2 3 4 5
31	Does developing a distribution network help increase market access?	1 2 3 4 5
32	Does inventory management help prevent product obsolescence or inaccessibility?	1 2 3 4 5

Sub-theme: Cost Management

Number	Question	Response
33	Do high temperatures increase your production costs?	1 2 3 4 5
34	Is reducing energy waste in production aimed at lowering costs?	1 2 3 4 5
35	Does optimizing production costs help increase profitability?	1 2 3 4 5
36	Does the use of blockchain technology in this process help reduce costs?	1 2 3 4 5

Sub-theme: Technology Innovation

Number	Question	Response
37	Is the use of advanced technologies in cement production aimed at improving product quality?	1 2 3 4 5
38	Does research and development of new products help adapt to climatic conditions?	1 2 3 4 5
39	Does the use of Internet of Things (IoT) help improve efficiency?	1 2 3 4 5
40	Is improving the efficiency of transportation systems possible through the use of advanced technologies?	1 2 3 4 5

Sub-theme: Management Innovation

Number	Question	Response
41	Does optimizing management processes help increase organizational efficiency?	1 2 3 4 5
42	Is big data used in your managerial decision-making?	1 2 3 4 5
43	Do innovative business model designs help your business?	1 2 3 4 5
44	Are environmental management developments applicable to your system?	1 2 3 4 5

Sub-theme: Environmental Impacts

Number	Question	Response
45	Is reducing greenhouse gas emissions from cement production important to you?	1 2 3 4 5
46	Do you feel the environmental impacts of climate change on the cement industry?	1 2 3 4 5
47	Is waste management in cement production necessary for your operations?	1 2 3 4 5
48	What is your approach to using recycled materials in cement product packaging?	1 2 3 4 5

Sub-theme: Social Responsibility

Number	Question	Response
49	Are social responsibilities integrated into your organization?	1 2 3 4 5
50	Is collaboration with local communities important to you?	1 2 3 4 5
51	Is there communication with the community about the environmental impact of climate change on your products?	1 2 3 4 5
52	Are there educational programs to raise public awareness about the impacts of climate change in your organization?	1 2 3 4 5