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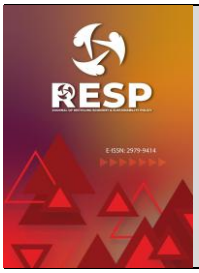

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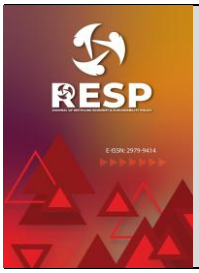

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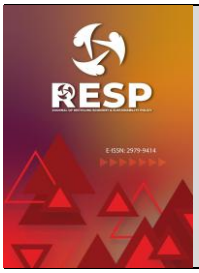

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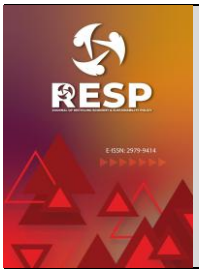

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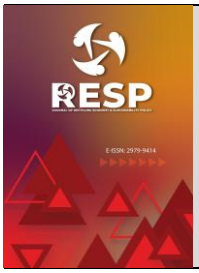

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Araştırma Makalesi ● Research Article

Innovative Strategic Framework for Enhancing Sustainability in the Sri Lankan Construction Sector Through Circular Economy

Sri Lanka İnşaat Sektöründe Döngüsel Ekonomi Yoluyla Sürdürülebilirliği Artırmaya Yönelik Yenilikçi Stratejik Çerçeve

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ANAHTAR KELİMELER

Döngüsel ekonomi
İnşaat sektörü
Stratejiler
Sürdürülebilir kalkınma

ÖZ

Bu araştırma, sürdürülebilirliği iyileştirmek ve küresel çevre hedefleriyle uyumlu hale getirmek için döngüsel ekonomi kavramının Sri Lanka'nın inşaat sektörüne nasıl entegre edilebileceğini araştırmaktır. CE uyumunun önündeki engelleri belirlemek için, sistematik bir literatür incelemesiyle başlayıp kapsamlı bir anket ve korelasyon analizini kapsayan karma yöntemli bir yaklaşım kullanılmıştır. Vurgulanan temel zorluklar arasında anlayış eksikliği, değişime direnç ve yetersiz düzenleyici çerçeveler yer almaktadır. Betimleyici istatistikler, katılımcıların bu engelleri tutarlı bir şekilde algıladıklarını göstermiştir; ancak korelasyon analizi, bilgi boşlukları, bütçe sınırlamaları ve düzenleyici sorunlar gibi engeller arasında önemli bağlantılar ortaya koymuştur. Bulgular, her ikisi de Sri Lanka'nın inşaat sektörünün küresel çevre sorunları karşısında uzun vadeli dayanıklılığı için kritik öneme sahip olan yenilikçiliği ve sürdürülebilir uygulamaları teşvik etmek için stratejik bir çerçeve sunmaktadır.

KEYWORDS

Circular economy
Construction industry
Strategies
Sustainable development

ABSTRACT

This research aims at how circular economy concepts could be integrated into Sri Lanka's construction sector to improve sustainability and line with global environmental goals. To identify barriers to CE adoption, a mixed-method approach was used, beginning with a systematic literature review and progressing to a complete survey and correlation analysis. Key challenges highlighted include a lack of understanding, resistance to change, and insufficient regulatory frameworks. Descriptive statistics demonstrated that respondents consistently perceived these obstacles; but correlation analysis revealed substantial links between barriers such as knowledge gaps, budgetary limits, and regulatory problems. The findings provide a strategic framework for promoting innovation and sustainable practices, both of which are critical to Sri Lanka's construction industry's long-term resilience in the face of global environmental issues.

1. Introduction

The global construction industry is a key driver of economic development, infrastructure development, and urbanization, contributing significantly to the global economy (Ahmad et al., 2019; Alaloul et al., 2021). However, this industry's incredible growth comes at a tremendous cost, since it is a major contributor to greenhouse gas (GHG) emissions and the generation of construction and demolition waste (CDW) (Marinković et al., 2023; Buchard & Christensen, 2023; Al-Omari et al., 2023). The construction sector, responsible for 39% of worldwide carbon dioxide (CO_2) emissions and 40% of CDW accumulation, is a significant contributor to

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environmental degradation and resource depletion (Gallego-Schmid et al., 2020; Labaran et al., 2021). Despite its significance for financial growth, the construction industry's traditional linear economic (LE) model is becoming more and more unsustainable, fostering a cycle of resource extraction, manufacturing, consumption, and disposal that stresses ecological systems and compromises long-term resilience (Petrovic et al., 2022, Zvirgzdins et al., 2019).

Existing initiatives to promote sustainability in the construction sector have been insufficient to mitigate its environmental implications (Cruz et al., 2019; Murtagh et al., 2020; Hernández et al., 2023). Although progress has been made toward greener practices, such as the use of energy-efficient technology and greener building materials, these measures have not been broadly applied or standardized (Dadzie et al., 2018; Lin & Yang, 2023). The sector's sustainability performance remains weak, with many projects still using resource-intensive and inefficient methods (Gallo et al., 2021; Ortega et al., 2023). This gap highlights the need for a creative strategy to more effectively address environmental concerns and promote sustainable growth in the business.

The construction industry in Sri Lanka reflects global trends, with similar patterns of unsustainable practices and environmental implications (Weerakoon et al., 2023). According to Wijerathna and Abeynayake (2021), due to rapid urbanization and infrastructural development-boosting construction activity throughout the island country, Sri Lanka is experiencing increased resource depletion, waste accumulation, and adverse environmental effects. The growth of traditional construction practices, along with poor regulatory oversight and waste management infrastructure, has increased the industry's environmental impact, jeopardizing the country's ecological equilibrium and sustainable development goals (SDGs) (Karunasena et al., 2023).

According to Victor and Waidyasekara (2023), despite growing concern about environmental degradation and resource scarcity, the circular economy (CE) concept has emerged as a compelling solution to the building industry's inherent unsustainable nature. The CE, founded on the concepts of regenerative design, resource efficiency, and waste minimization, represents a paradigm shift away from the old linear 'take-make-dispose' model and towards a closed-loop system that encourages the continual flow and utilization of resources and substances (Ogunmakinde et al., 2021; Nelles et al., 2019). Furthermore, CE promotes sustainable construction methods such as material reuse, recycling, and recovery of resources, resulting in increased resilience, energy savings, and conservation of the environment (Guerra-Rodríguez et al., 2020; Papamichael et al., 2023). Furthermore, the transition from the 3Rs to the 10Rs is a rising strategy for promoting environmental sustainability through resource conservation, and a decrease in waste. Theoretical models such as Industrial Ecology, Biomimicry, Cradle-to-Cradle, and Performance Economy give comprehensive approaches to circularity (Kuznetsova, 2022).

Despite growing recognition of the CE as a potential path to sustainability, there is a severe absence of research and practical application solutions tailored to the Sri Lankan context. Existing research focuses mostly on global perspectives and case studies from established economies, typically overlooking the unique challenges and opportunities found in emerging markets like Sri Lanka. Therefore, this research paper aims to develop a comprehensive implementation strategy for Sri Lanka's construction sector. The primary goal is to identify and assess the important elements influencing the adoption of CE practices in the local construction sector, as well as to provide concrete measures for facilitating this transformation. The hypothesis driving this study is that applying a CE framework in Sri Lanka's construction sector will greatly improve its sustainability performance. The research question addressed in this study is: "How can CE principles be effectively integrated into Sri Lanka's construction sector to promote sustainable development?"

By conducting this research, this article aims to offer insightful findings and useful suggestions that will aid practitioners, industry stakeholders, and legislators in promoting sustainable change in the construction sector.

2. Materials and Methods

The methodology section is essential for showcasing the accuracy and thoroughness of the research as well as assessing the study's contribution to the field. The validity and generalizability of the study's conclusions are guaranteed by a strict and transparent process. A mixed-method approach was used in this study, which included both quantitative and qualitative elements.

The first stage of the methodology is to perform the qualitative component using the Scopus database to carry out a systematic literature review (SLR). According to Baas et al. (2020), Scopus is a highly renowned and extensive abstract and citation database that offers scholarly academics superior quality information on books, conference proceedings, and journal articles. A thorough integration of search results and an evaluation of the quantity, nature, and quality of evidence relevant to a particular research question are all supplied by SLR (Siddaway et al., 2019).

Using the combination *"TITLE-ABS-KEY ((circular AND economy OR closed-loop AND economy OR circular AND practices) AND (construction AND industry OR construction AND sector OR built AND environment) AND (reuse OR recycle OR reduce)),"* the search was focused on the intersection of CE concepts with the construction industry. To guarantee pertinence to the latest developments in the CE framework, the initial search yielded 61 publications covering the period from 2019 to 2024. Subsequently, the scope was restricted to peer-reviewed

journal articles exclusively, substantiating this necessity due to their scientific validity and reliability. The sample was reduced by this filtering process to 33 articles for further examination. A series of sifts were used to further refine the results, starting with the rejection of articles whose titles did not match the goals and objectives of the study. The pool was narrowed down to 21 pertinent items by this first filter. After evaluating abstracts, articles that were not directly related to the topic were eliminated, leaving a final selection of 17 articles for further analysis (see Fig. 1). The whole texts of the chosen articles were thoroughly reviewed as part of the qualitative analysis phase, which led to 13 articles for review for the identification of potential integration solutions as well as obstacles to the use of CE concepts in the construction sector. The subsequent phases of the investigation were built upon these findings where the findings obtained by the qualitative assessment were set into assessment by the Sri Lankan construction industry practitioners through the quantitative approach.

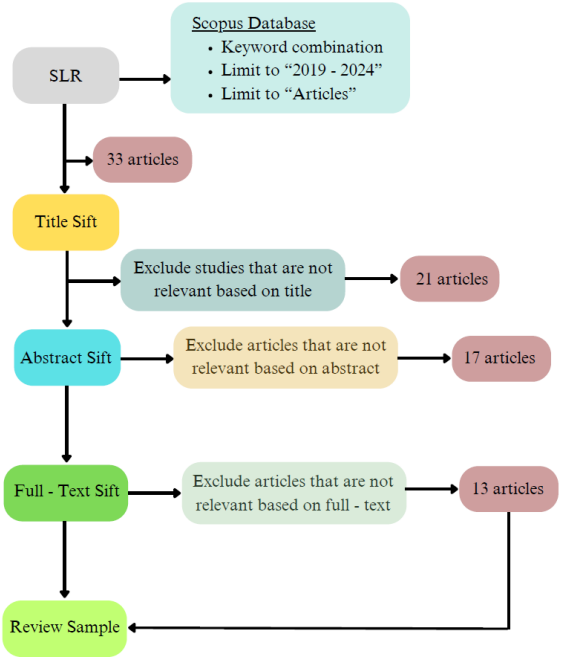

Figure 1. Overview of research methodology employed.

The purpose of the quantitative approach of the study was to gather actual data from professionals working in Sri Lanka's construction industry to evaluate their understanding, opinions, and perceptions of the CE's principles, as well as to pinpoint obstacles and assess strategies for implementation. A questionnaire survey was created and sent throughout two months (April to June 2024) among industry practitioners. The non-probability sampling approach was adopted, allowing data to be collected from a varied spectrum of experts with the least experience to veterans in the sector. After the data was collected, the responses were combined and subjected to rigorous data analysis procedures. The correlation study was carried out to investigate the relationships between several barriers to the construction industry's adoption of a CE. For a thorough grasp of these associations, the study was conducted utilizing Pearson, Kendall's tau, and Spearman correlation approaches. Using both parametric (Pearson) and non-parametric (Kendall's tau, Spearman) correlation approaches enables a robust analysis that takes into account various data features. Pearson is best for regularly distributed data, and analyzing linear relationships, but Kendall's tau and Spearman are better suited for data that does not match normality criteria, capturing both linear and nonlinear correlations. This dual technique allows for a thorough knowledge of variable connections regardless of data distribution.

Pearson correlation is a prominent statistical method for examining the linear relationship between two independent variables. The correlation coefficient, denoted by the letter "r," is a numerical value that is obtained from it that expresses the strength and direction of the linear relationship between the variables (Schober et al., 2018; Pernet et al., 2013). The following formula (Eq.1) is used to calculate the Pearson correlation coefficient (r_p):

$$r_p = \frac{\sum_{i=1}^{n}(X_i - X_0)\,(Y_i - Y_0)}{\sqrt{\sum_{i=1}^{n}(X_i - X_0)^2\,(Y_i - Y_0)^2}}$$

where n is the number of data points;

X_i and Y_i are the variable X and variable Y unique data points;

X_0 and Y_0 are the X and Y variables' means, correspondingly.

The Kendall Tau-b correlation, often known as Kendall's Tau-b, is a nonparametric statistical method for determining the degree and direction of a relationship between two variables (Hamed, 2011). The Kendall's tau correlation coefficient (r_k) is calculated using the following equation (Eq. 2):

$$r_k = \frac{A_x - B_y}{\sqrt{(A_x + B_y + C_{z_i})(A_x + B_y + C_{z_o})}}$$

Where A_x is the number of concordant pairs, which are observations in the same order;

B_y is the number of discordant pairs, which are observations with different order:

C_{zi} is the number of tied values in the variable i;

C_{zo} is the number of tied values in variable o.

A Spearman correlation coefficient is a measure of a monotonic relationship between variables that is utilized for nonnormally distributed continuous data, ordinal data, or data with significant outliers (Puth et al., 2015). The Spearman correlation coefficient (r_s) is calculated using the following equation (Eq.3):

$$r_s = 1 - \frac{6\sum d_i^2}{n(n^2 - 1)}$$

where, d_i is the difference between the ranks of corresponding variables;

n is the number of observations.

Both Kendall's tau and Spearman correlation analysis were done to further validate the results obtained from the Pearson correlation analysis. Table 1 below indicates the variables and their designated codes used in the analysis.

Table 1. Variables and their codes used for correlation analysis.

Variable name	Variable code
Lack of awareness	B1
Regulatory challenges	B2
Technological incapabilities	B3
Financial constraints	B4
Cultural resistance	B5

3. Results and Discussion

3.1. Preliminary Results

The descriptive statistics (Table 2) reflect the data collected on the barriers to adopting a CE in the construction industry. This summary covers the mean, standard deviation, variance, and skewness for each barrier, providing information about their distribution and variability. The questionnaire survey resulted in useful quantitative data for the research. The survey was able to capture 113 viewpoints from diverse industry professionals.

Table 2. Descriptive statistics of the data set.

Descriptive Statistics									
	N	Minimum	Maximum	Mean		Std. Deviation	Variance	Skewness	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Statistic	Std. Error
B1	42	10	12	10.43	.091	.590	.348	1.037	.365
B2	42	10	12	10.48	.092	.594	.353	.828	.365
B3	42	10	12	10.95	.113	.731	.534	.074	.365
B4	42	10	13	10.81	.119	.773	.597	.682	.365
B5	42	10	13	10.71	.119	.774	.599	.885	.365
Valid N (listwise)	42								

The descriptive data show that all five obstacles have mean scores close to 10 and comparatively small standard deviations, indicating that respondents see them similarly. The positive skewness of most barriers (B1, B2, B4, and B5) indicates a preference for higher values within the range, meaning that respondents frequently ranked these barriers toward the upper end of the scale. Barrier B3, with its almost symmetrical distribution, represents a more equally distributed view. These observations contribute to a better understanding of the primary tendencies and variability in views of hurdles to establishing a CE, which may be used to inspire focused initiatives to overcome the most frequently identified challenges.

The survey reveals a diverse range of roles and responsibilities in the construction industry. Figure 2 depicts the occupational profile of the responders. Engineers, architects, quantity surveyors, project managers, technical officers, and government personnel all play a crucial role in developing and implementing sustainable practices and CE concepts. Assessing how each of these key stakeholders contribute towards implementing CE and their responsibilities in the transition is crucial. Engineers, responsible for civil, mechanical, electrical, and environmental engineering, are crucial in maximizing resource efficiency and reducing waste. Quantity surveyors, responsible for cost estimation, procurement, and financial management, are also crucial in promoting CE concepts. Project managers, responsible for project operations, are crucial in promoting resource optimization and waste minimization. Technical officers and construction managers, responsible for managing building processes, are also crucial in adopting CE concepts. Government personnel play a crucial role in shaping the regulatory environment and encouraging sustainable growth. Therefore, the survey underscores the multifaceted nature of the construction industry and the need for collaboration among various stakeholders to drive innovation and sustainable practices.

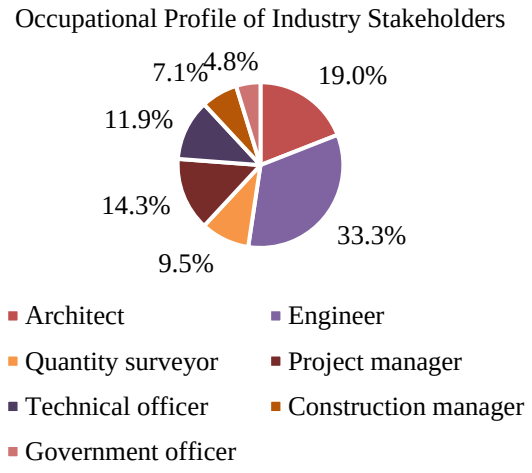

Figure 2. Occupational profile of respondents (developed by the authors)

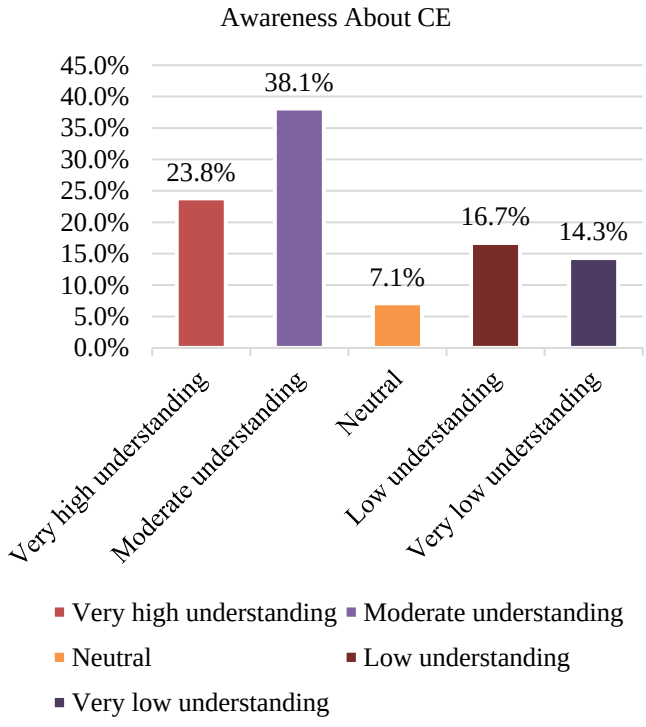

Figure 3. Awareness of CE among industry stakeholders (developed by the authors)

The study examined respondents' awareness of the CE concept in the construction industry. Figure 3 illustrates a wide variety of awareness levels. 38.1% had moderate understanding, while 23.8% had strong awareness. This is a positive indication of laying the transition towards circular practices as industry practitioners are aware of CE principles. However, 16.7% demonstrated little comprehension and 14.3% had very little knowledge, showing a need for improved awareness and education. This group might benefit from focused outreach and capacity-building initiatives that encourage information sharing and enable professionals to integrate CE concepts. Furthermore, the survey shows a strong consensus on the importance of sustainable building practices in Sri Lanka's construction sector. 95.2% of respondents consider these practices essential, highlighting the industry's shift towards responsible practices. This shift can lead to reduced carbon emissions, improved resource efficiency, and increased market competitiveness.

The study's findings offer a mixed picture of Sri Lanka's current application of CE concepts in construction practices.

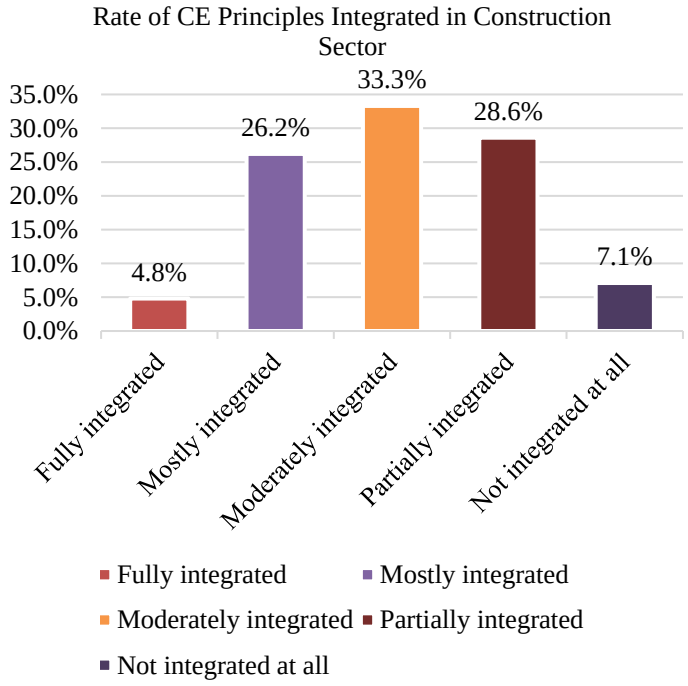

Figure 4. Usage of CE principles in Sri Lankan construction sector.

According to Figure 4, respondents reported that CE principles are mostly integrated (26.2%) or slightly integrated (28.6%). This suggests that there is a growing knowledge and use of CE concepts in the construction industry, although there is still room for growth and refinement. With around 33.3% of respondents evaluating integration as moderate, there is evidence of continued efforts to incorporate CE principles into construction methods, showing a steady trend towards more sustainable and resource-efficient approaches to building and development. However, a small minority of respondents (7.1%) reported that CE principles are not implemented at all, underlining the need for targeted interventions and capacity-building initiatives to promote CE principles.

Since there is still room for development in understanding CE principles before the effective incorporation of the idea, the survey indicates that the Sri Lankan construction sector needs measures to promote CE practices. Awareness and education activities are the most commonly acknowledged, with 83.3% of respondents recognizing their significance.

Policy and legal regulation are also important, with 66.7% indicating the necessity for government involvement. Research and development funding is likewise encouraged, with 78.6% seeing its innovation potential. Stakeholder involvement and collaborative platforms are essential, as is embedding the CE into national engineering curricula and providing financial incentives. Figure 5 indicates proposed strategies by respondents to overcome the barriers and for successful integration.

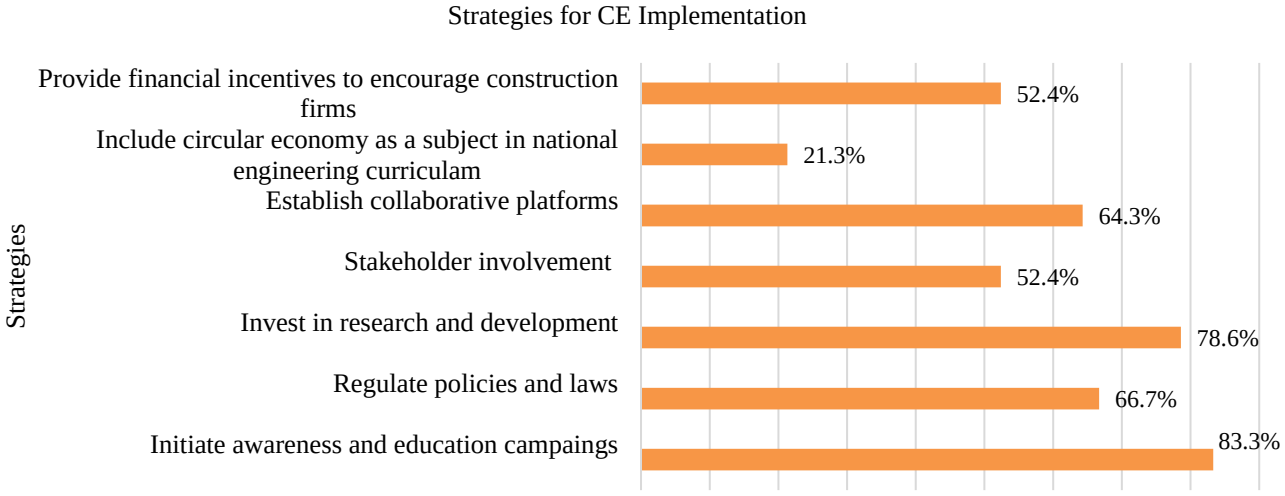

Figure 5. Proposed strategies for CE implementation.

As a result, preliminary results suggest that coordinated work is required to encourage the adoption of CE concepts in Sri Lanka's construction sector. However, it is necessary to completely identify the link between the barriers and their nature to overcome them through effective measures and achieve SDGs.

3.2. Assessing the Relationship Among Barriers to Implementing CE.

The correlation analysis of the barriers to adopting CE in the construction industry gives a thorough understanding of their interrelationships. Pearson, Kendall's tau, and Spearman correlation approaches all yield significant results, providing important details into how to overcome these hurdles.

The Pearson correlation analysis in Table 3 shows some significant correlations among the obstacles that exist. For instance, barriers B1 and B2 have a moderate positive correlation ($r = 0.377$, $p = 0.014$), indicating that when barrier B1 increases, so does barrier B2. Similarly, B1 and B5 have a modest positive correlation ($r = 0.328$, $p = 0.034$), showing that these barriers follow a similar pattern. The noteworthy positive correlation ($r = 0.568$, $p < 0.001$) between B2 and B5 indicates a significant connection between these obstacles. In addition, a moderate positive correlation ($r = 0.372$, $p = 0.015$) between B3 and B4, as well as between B4 and B5 ($r = 0.355$, $p = 0.021$), indicates interconnectivity. Pearson correlations suggest that specific barriers tend to co-occur, implying underlying similar causes or reasons.

Table 3. Results of the Pearson correlation analysis among barriers for implementing CE.

Correlations						
		B1	**B2**	**B3**	**B4**	**B5**
B1	Pearson Correlation	1	.377*	.162	.076	.328*
	Sig. (2-tailed)		.014	.307	.631	.034
	Sum of Squares and Cross-products	14.286	5.429	2.857	1.429	6.143
	Covariance	.348	.132	.070	.035	.150
	N	42	42	42	42	42
B2	Pearson Correlation	.377*	1	.110	.096	.568**
	Sig. (2-tailed)	.014		.489	.545	.000
	Sum of Squares and Cross-products	5.429	14.476	1.952	1.810	10.714
	Covariance	.132	.353	.048	.044	.261

	N	42	42	42	42	42
B3	Pearson Correlation	.162	.110	1	.372*	.062
	Sig. (2-tailed)	.307	.489		.015	.698
	Sum of Squares and Cross-products	2.857	1.952	21.905	8.619	1.429
	Covariance	.070	.048	.534	.210	.035
	N	42	42	42	42	42
B4	Pearson Correlation	.076	.096	.372*	1	.355*
	Sig. (2-tailed)	.631	.545	.015		.021
	Sum of Squares and Cross-products	1.429	1.810	8.619	24.476	8.714
	Covariance	.035	.044	.210	.597	.213
	N	42	42	42	42	42
B5	Pearson Correlation	.328*	.568**	.062	.355*	1
	Sig. (2-tailed)	.034	.000	.698	.021	
	Sum of Squares and Cross-products	6.143	10.714	1.429	8.714	24.571
	Covariance	.150	.261	.035	.213	.599
	N	42	42	42	42	42

**. Correlation is significant at the 0.05 level (2-tailed).*

***. Correlation is significant at the 0.01 level (2-tailed).*

Kendall's tau and Spearman correlation study (see Table 4) indicates the Pearson correlation results by stressing the non-parametric correlations among the obstacles. A positive correlation ($\tau = 0.212$, $p = 0.159$) between B1 and B2 supports the Pearson results, although it is not statistically significant. A positive correlation ($\tau = 0.220$, $p = 0.132$) between B1 and B5 confirms the pattern found in the Pearson analysis. The substantial positive correlation ($\tau = 0.529$, $p < 0.001$) between B2 and B5 indicates a meaningful link between these obstacles. Furthermore, a moderate positive correlation ($\tau = 0.305$, $p = 0.030$) between B3 and B4 confirms the Pearson correlation, whereas a positive correlation ($\tau = 0.217$, $p = 0.125$) between B4 and B5 underlines the interconnectivity found. Kendall's tau results support the patterns obtained using Pearson correlation, however, some connections are weaker.

The Spearman correlation analysis reveals the substantial correlations between the barriers, demonstrating the stability of these findings across correlation methods. A positive correlation ($\rho = 0.218$, $p = 0.165$) between B1 and B2 backs with Pearson's and Kendall's tau findings. The positive correlation ($\rho = 0.237$, $p = 0.131$) between B1 and B5 is consistent with other correlation approaches. A considerable positive correlation ($\rho = 0.555$, $p < 0.001$) between B2 and B5 shows a significant link. A moderate positive correlation ($\rho = 0.334$, $p = 0.031$) between B3 and B4 is consistent with Pearson and Kendall's tau results, while a positive correlation ($\rho = 0.238$, $p = 0.128$) between B4 and B5 confirms the interconnectivity.

Table 4. Results of the non-parametric correlation analysis among barriers for implementing CE.

Correlations							
			B1	**B2**	**B3**	**B4**	**B5**
Kendall's tau	**B1**	Correlation Coefficient	1.000	.212	.134	.050	.220
		Sig. (2-tailed)	.	.159	.354	.729	.132
		N	42	42	42	42	42
	B2	Correlation Coefficient	.212	1.000	.082	.067	.529**
		Sig. (2-tailed)	.159	.	.570	.644	.000
		N	42	42	42	42	42
	B3	Correlation Coefficient	.134	.082	1.000	.305*	.069
		Sig. (2-tailed)	.354	.570	.	.030	.625
		N	42	42	42	42	42
	B4	Correlation Coefficient	.050	.067	.305*	1.000	.217
		Sig. (2-tailed)	.729	.644	.030	.	.125
		N	42	42	42	42	42
	B5	Correlation Coefficient	.220	.529**	.069	.217	1.000

		Sig. (2-tailed)	.132	.000	.625	.125	.
		N	42	42	42	42	42
Spearman's	**B1**	Correlation Coefficient	1.000	.218	.143	.054	.237
		Sig. (2-tailed)	.	.165	.366	.734	.131
		N	42	42	42	42	42
	B2	Correlation Coefficient	.218	1.000	.087	.073	.555**
		Sig. (2-tailed)	.165	.	.583	.644	.000
		N	42	42	42	42	42
	B3	Correlation Coefficient	.143	.087	1.000	.334*	.074
		Sig. (2-tailed)	.366	.583	.	.031	.640
		N	42	42	42	42	42
	B4	Correlation Coefficient	.054	.073	.334*	1.000	.238
		Sig. (2-tailed)	.734	.644	.031	.	.128
		N	42	42	42	42	42
	B5	Correlation Coefficient	.237	.555**	.074	.238	1.000
		Sig. (2-tailed)	.131	.000	.640	.128	.
		N	42	42	42	42	42

***. Correlation is significant at the 0.01 level (2-tailed).*

**. Correlation is significant at the 0.05 level (2-tailed).*

The correlation study demonstrates the interconnectedness of barriers to establishing a CE in the construction industry. The substantial positive correlations across numerous barriers, which were detected consistently across Pearson, Kendall's tau, and Spearman techniques, indicate that these impediments are not isolated but rather interconnected. For example, the high relationship between B2 and B5 suggests that eliminating one of these obstacles may simultaneously overcome the other. This interconnection necessitates integrated methods that address numerous barriers to improve efficacy. Furthermore, the moderate correlations detected between other pairs of barriers (e.g., B1 and B2, B3 and B4) indicate shared roots or implications. A comprehensive strategy that takes into account the larger context and relationships between these barriers may be more effective than tackling them individually. Understanding these connections enables improved intervention prioritization, perhaps leading to more significant increases in CE adoption.

Ultimately, the correlation analysis provides useful information on the intricate network of barriers to implementing a CE in the construction sector in Sri Lanka. These findings can help shape more comprehensive plans for overcoming these challenges and promoting sustainable practices in the sector.

3.3. Strategic Framework for Implementation of CE

Implementing a CE in Sri Lanka's construction industry necessitates a strategic framework linked with the SDGs. The correlation study of barriers to CE gives vital insights for establishing focused strategies to effectively overcome these challenges. Figure 6 illustrates the proposed strategic framework for implementing CE that aligns with SDGs for the Sri Lankan built environment.

The correlation analysis demonstrated strong correlations between various barriers, indicating they are interrelated. As a result, a strategic framework must take a comprehensive approach to address several impediments at once. For example, the substantial relationship between barriers B2 (Lack of Knowledge and Awareness) and B5 (Financial constraints) suggests that increasing knowledge and awareness may also ease financial restrictions (Rodriguez-Espindola et al., 2022; Atiku, 2020). This method supports SDG 4 (Quality Education) and SDG 9 (Industry, Innovation, and Infrastructure) by encouraging educational programs and creative finance solutions. Implementing comprehensive educational and training programs is critical for addressing the knowledge and awareness gap. These initiatives should address all stakeholders in the construction industry, including legislators, contractors, and workers. Workshops, seminars, and certification programs based on CE principles and best practices might be among the initiatives (Guerreschi et al., 2023; Bugallo-Rodriguez & Vega-Marcote, 2020; Zandee et al., 2022). Collaboration with academic institutions and international organizations can improve the quality and scope of these educational initiatives (Mendoza et al., 2019; Danvers et al., 2023). This method supports SDGs 4 (Quality Education) and 12 (Responsible Consumption and Production). Financial restrictions are a substantial impediment to CE adoption. According to Munaro et al. (2020), the implementation framework should contain measures that incentivize enterprises to adopt CE practices, including tax breaks, subsidies, and grants. Furthermore, increasing access to green finance choices might assist overcome financial constraints (Jinru et al., 2021; Zhang et al., 2020). Public-private partnerships may also be effective in mobilizing resources and sharing risks (Kolodiziev et al., 2017; Matayev & Berzhanov, 2020). This method promotes long-term economic growth and climate resilience, which

contributes to SDGs 8 (Decent Work and Economic Growth) and 13 (Climate Action).

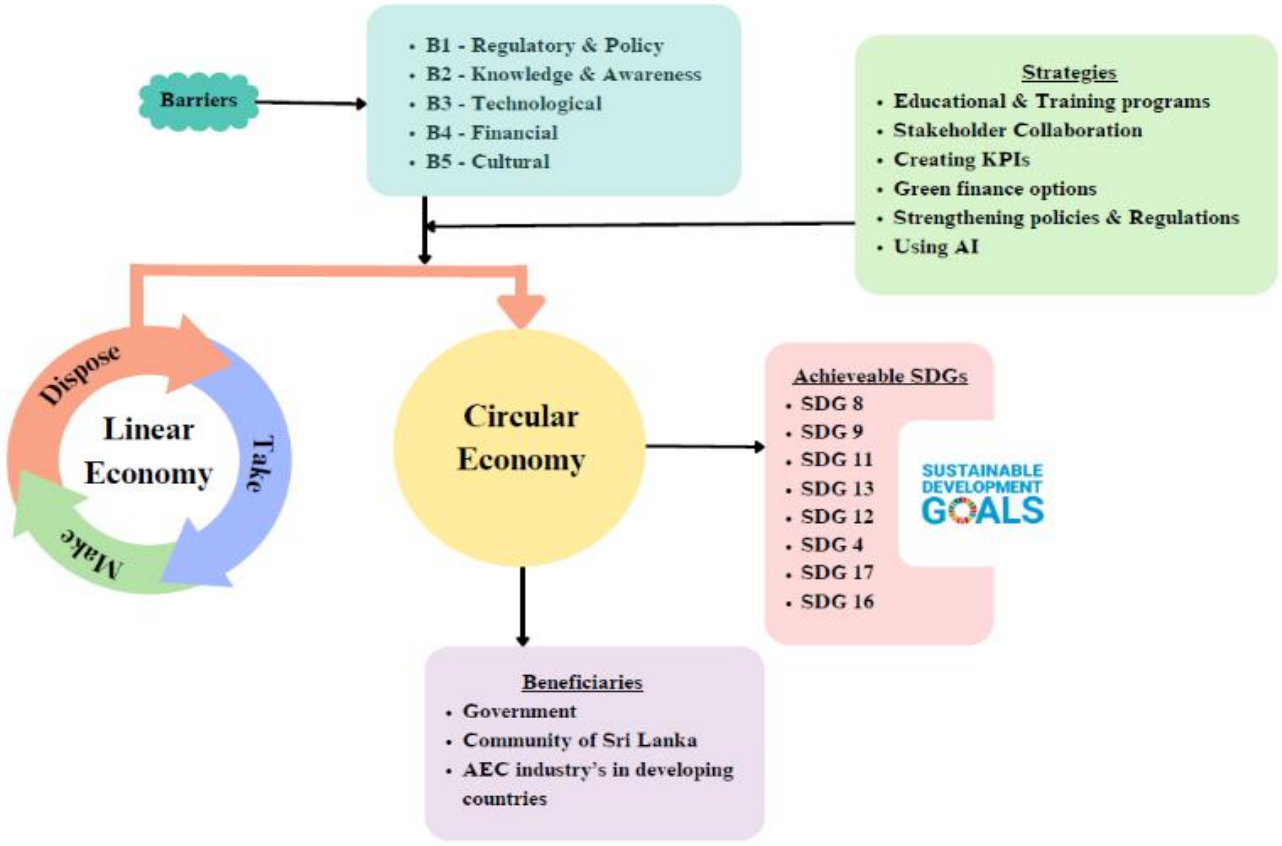

Figure 6. Framework for implementing CE and achieving SDGs in the built environment.

The correlation analysis reveals that legislative constraints (B1), technological impediments (B3), and a lack of infrastructure (B4) are all linked. Regulations must be strengthened to promote CE practices (Mhatre et al., 2021). This entails creating clear CE standards and requirements for construction, guaranteeing compliance via efficient evaluation and enforcement, and promoting innovation in sustainable technology (Ghufran et al., 2023). It is also vital to invest in infrastructure that promotes recycling, reuse, and the use of sustainable materials through technological advancements such as artificial intelligence (AI) (Weerakoon et al., 2024; Nascimento et al., 2019; Joensuu et al., 2023). This strategy is consistent with SDGs 9 (Industry, Innovation, and Infrastructure) and 11 (Sustainable Cities and Communities).

All stakeholders, including government agencies, private sector firms, civil society groups, and the general public, must actively participate and collaborate to ensure effective CE implementation (Mishra et al., 2019; Arsova et al., 2021). Multi-stakeholder forums may help with discourse, information exchange, and coordinated action. Fostering collaborative projects and activities can result in novel solutions and increased impact (Eisenreich et al., 2021). This strategy promotes SDG 17 (Partnerships for the Goals) by encouraging collaboration and collective effort for sustainability. Furthermore, a strong monitoring and evaluation system is required to track progress, identify difficulties, and assess the effectiveness of CE projects (Alamerew et al., 2020). Creating key performance indicators (KPIs) that are connected with CE objectives and SDGs can give useful data for continual development (Hristov & Chirico, 2019). Regular reporting and open sharing of findings help foster confidence along with accountability within parties. This method supports SDG 16 (Peace, Justice, and Strong Institutions) by encouraging openness and good governance.

The strategic action plan for establishing a CE in Sri Lanka's construction industry must overcome the interconnected hurdles discovered by correlation analysis. The suggested approaches not only help to accomplish a number of SDGs but also promote Sri Lanka's building sector to being more robust and sustainable.

4. Conclusions

The outcomes of this study highlight the crucial need to incorporate CE principles into Sri Lanka's building sector to improve sustainability and resilience. Despite advancements, challenges such as a lack of knowledge,

opposition to change, and insufficient regulatory frameworks remain. There were significant relationships between regulatory and financial barriers and the requirement for specific initiatives such as policy assistance and financial incentives. These findings underline the importance of interventions including awareness campaigns, policy regulation, R&D funding, and stakeholder involvement in overcoming these barriers and promoting sustainable practices in the business.

Furthermore, the study draws many critical conclusions, including the construction industry's significant contribution to GHG and worldwide construction waste. It is critical to effectively manage construction and demolition waste (CDW) and use novel techniques. The shift from the 3Rs to the 10Rs is a growing approach for sustainability, resource efficiency, and waste reduction. Theoretical frameworks such as Industrial Ecology, Biomimicry, Cradle-to-Cradle, and Performance Economy provide holistic approaches to circularity. Policies at all levels play an important role in aiding this transformation, and most respondents understand the crucial relevance of sustainable building techniques for the future of Sri Lanka's construction sector.

Some significant recommendations are suggested to establish CE principles. Government and commercial organizations should conduct targeted awareness campaigns, and government agencies should work together to distribute information and promote awareness through seminars and training programs. Relevant entities should develop and implement regulatory frameworks and incentives to encourage sustainable activities. Prioritizing multi-stakeholder engagement will encourage cooperation and community involvement in achieving long-term construction objectives. Furthermore, funding for research and development in sustainable technology and construction processes is critical.

Implementing these recommendations and encouraging cross-sectoral collaboration would assist in removing bottlenecks, encouraging innovation, and accelerating Sri Lanka's transition to a more sustainable and resilient construction industry, in line with the SDGs. As a result, this study contributes significantly to society by offering a road map for incorporating CE principles into Sri Lanka's building sector, which is critical for promoting sustainability and resilience. This research prepares the road for successful policy interventions and stakeholder involvement by identifying and addressing the major impediments to sustainable practice. The recommendations for awareness campaigns, policy regulations, and R&D funding are directly aligned with the United Nations Sustainable Development Goals (SDGs), particularly those for sustainable cities and communities (SDG 11), responsible consumption and production (SDG 12), and climate action (SDG 13). Implementing these measures will speed up the construction industry's transition to sustainability, benefitting society as a whole.

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RESP

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Derleme Makalesi ● Review Article

Kesikli Seçim Deneyleri ile Çevresel Mal ve Hizmetlerin Ekonomik Değerlemesi

Economic Valuation of Environmental Goods and Services Using Discrete Choice Experiments

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ANAHTAR KELİMELER

Kesikli Seçim Deneyleri
Çevresel Değerleme
Rassal Fayda Teorisi
Ekonometrik Modeller
Çevre Politikaları

ÖZ

Bu çalışma, çevresel mal ve hizmetlerin ekonomik değerlemesi açısından giderek önem kazanan Kesikli seçim deneyleri üzerine odaklanmaktadır. Kesikli seçim deneyleri, bireylerin piyasa dışı çevresel mallar ve hizmetler üzerindeki tercihlerini ortaya koymak için kullanılan güçlü bir yöntem olarak öne çıkmaktadır. Çalışma, kesikli seçim deneylerinin teorik temellerini, özellikle rassal fayda teorisini ve bunun çevresel tercihlerin modellenmesindeki rolünü ayrıntılı bir şekilde incelemektedir. Ayrıca, deney tasarımında dikkat edilmesi gereken nitelik ve seviye seçiminden deneysel tasarım ve veri toplama süreçlerine kadar olan adımları kapsamlı bir şekilde ele almaktadır. Çalışma, çevresel mal ve hizmetlerin ekonomik değerlemesinde kesikli seçim deneylerin uygulanmasına ilişkin pratik rehberlik sunarken, bu yöntemin diğer çevresel ekonomik değerleme yöntemleri ile karşılaştırmasını da yapmaktadır. Bunun yanı sıra, çalışmada kesikli seçim deneylerinde kullanılan ekonometrik modeller ve bu modellerin sağladığı avantajlar üzerinde durulmaktadır. Çalışma, son olarak kesikli seçim deneylerinin çevre politikaları üzerindeki etkilerini tartışmakta ve bu yöntemlerin karar vericiler için nasıl bir araç olabileceğini değerlendirmektedir.

KEYWORDS

Discrete Choice Experiments
Environmental Valuation
Random Utility Theory
Econometric Models
Environmental Policies

ABSTRACT

This study focuses on Discrete Choice Experiments (DCEs), which are increasingly gaining importance in the field of environmental valuation. DCEs are highlighted as a powerful method for revealing individuals' preferences for non-market environmental goods and services. The study delves into the theoretical foundations of DCEs, particularly Random Utility Theory, and its role in modeling environmental preferences. Additionally, it comprehensively addresses the steps involved in the selection of attributes and levels, experimental design, and data collection processes that must be considered in DCE design. While providing practical guidance on the application of DCEs in environmental valuation, the study also compares this method with other environmental valuation techniques. Furthermore, it emphasizes the econometric models used in DCEs and the advantages they offer. Finally, the study discusses the impact of DCEs on environmental policies and highlights how these methods can serve as valuable tools for decision-makers.

1. Giriş

Çevresel mal ve hizmetlerin ekonomik değerlemesi çevre politikalarının şekillendirilmesi, doğal kaynak yönetimi, biyoçeşitlilik ve ekosistem hizmetlerinin sağlanması gibi alanlarda kritik bir rol oynamaktadır (Bateman vd. 2002). Çevresel varlıkların büyük bir kısmı doğrudan bir piyasa fiyatına sahip olmadığından, bu tür değerlerin belirlenmesi karmaşık bir süreci gerektirir. Çünkü biyolojik çeşitliliğin korunması, su kaynaklarının yönetimi, temiz hava ve doğal manzara gibi ekosistem hizmetleri piyasa dışı mallar olarak kabul edilir ve geleneksel piyasa mekanizmaları aracılığıyla fiyatlandırılamaz (Costanza vd. 1997). Bu noktada, çevresel değerleme yöntemleri devreye girer ve bu yöntemler, bu tür kaynakların ekonomik değerinin ölçülmesine olanak tanır.

Çevresel mal ve hizmetler, doğal ekosistemlerin sağladığı ve insan refahına doğrudan veya dolaylı olarak katkıda bulunan

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ürünler ve hizmetlerdir. Bu mal ve hizmetler, doğrudan ekonomik fayda sağlamaktan, ekosistemlerin işleyişini desteklemeye ve insan sağlığını korumaya kadar geniş bir yelpazede fayda sağlar. Bunlar genellikle "Ekosistem Hizmetleri" (Ecosystem Services) olarak adlandırılmakta; Destekleyici Hizmetler (Supporting Services), Düzenleyici Hizmetler (Regulating Services), Tedarik yada Temel Hizmetler (Provisioning Services) ve Kültürel Hizmetler (Cultural Services) olmak üzere dört ana kategoride değerlendirilmektedir (Everard, 2021). Destekleyici Hizmetler besin döngüsü, toprak oluşumu, yaşam alanlarının korunması, biyoçeşitlilik gibi ekosistem süreçlerinin işleyişini ve diğer ekosistem hizmetlerinin üretimini destekleyen ve ekosistemlerin işleyişi için gerekli olan süreçlerdir. Düzenleyici Hizmetler iklimin düzenlenmesi, hava kalitesi, erozyon, hastalık ve zararlılarla mücadele ve tozlaşma gibi faydaları içermektedir. Tedarik yada Temel Hizmetler gıda, yakıt, lif, tatlı su, tıbbi maddeler ve enerji gibi ekosistemlerden elde edilen ürünleri ifade eder. Kültürel Hizmetler estetik ve manevi anlamlar, folklor ve sanata ilham, rekreasyon ve turizm gibi insan yaşamını zenginleştiren, çoğunlukla maddi olmayan faydaları içermektedir. Bu çalışmada çevresel mal ve hizmetler genel olarak tüm ekosistem hizmetleri için kullanılmaktadır.

Kesikli Seçim Deneyleri, Kesikli Tercih Deneyleri yada Ayrık Seçim/Tercih Deneyleri olarak kullanılan Discrete Choice Experiments (DCE), yaklaşımı çevresel değerleme alanında önemli bir araç olarak kullanılmaktadır (Hoyos 2010, Mariel vd. 2021, Schulz vd. 2024). DCE'ler, bireylerin belirli bir çevresel mal veya hizmetin farklı özelliklerine verdikleri değeri ölçme olanağı sunar ve bu sayede çevre politikalarının şekillendirilmesine katkıda bulunur (Louviere vd. 2000). Bu yöntem, bireylerin çevresel mal ve hizmetlerin farklı özellikleri arasındaki tercihlerini ve ödünleşimlerini analiz ederek, çevresel iyileştirmeler için ne kadar ödeme yapmaya istekli olduklarını ortaya koyar (Hanley vd. 2001). Örneğin, bir nehrin temizlenmesi, bir orman alanının korunması veya hava kalitesinin iyileştirilmesi gibi çevresel değişikliklerin ekonomik değeri, DCE'ler aracılığıyla ölçülebilir.

DCE yaklaşımının önemi, yalnızca bu tür değerleri ölçebilme kapasitesinde değil, aynı zamanda çevresel mal ve hizmetlerin karmaşıklığını ve çok boyutluluğunu yakalayabilme yeteneğinde yatmaktadır. Çevresel mal ve hizmetler genellikle birçok farklı nitelik ve faktörden etkilenir; bu nedenle, DCE'ler, bu çeşitliliği göz önünde bulundurarak bireylerin gerçek dünyadaki tercihlerini daha doğru bir şekilde modelleyebilir (Train, 2009). Ayrıca, DCE'ler, bireylerin tercih heterojenliğini ve farklı çevresel değişikliklerin bireyler üzerindeki farklı etkilerini analiz etme olanağı sağlar, bu da politika yapıcılar için son derece değerli bir bilgi kaynağıdır (Greene & Hensher, 2003). Çevresel zorlukların artan karmaşıklığı ve aciliyeti göz önüne alındığında, DCE'lerin ve genel olarak çevresel değerleme yöntemlerinin önemi daha da artmaktadır.

Bu çalışma, DCE yaklaşımının çevresel bağlamda nasıl uygulanacağını ele alan kapsamlı bir rehber sunmayı amaçlamaktadır. Makale, DCE'lerin teorik temellerini, tasarım ilkelerini, pratik uygulama stratejilerini ve ileri düzey analitik tekniklerini ayrıntılarıyla açıklayarak, sağlam ve güvenilir bir temel oluşturmayı amaçlamaktadır. Çalışma ayrıca Açığa Vurulmuş/Çıkarılmış Tercihler (Revealed Preferences) ve Beyan Edilmiş Tercihler (Stated Preferences) gibi yöntemleri de ele almaktadır.

2. Çevre Değerleme Yöntemlerine Genel Bakış

Çevre değerleme yöntemleri, piyasa fiyatı olmayan çevresel mal ve hizmetlerin değerini ölçmek için esastır. Bu yöntemler genel olarak açığa vurulmuş tercih yöntemleri, beyan edilmiş tercih yöntemleri ve fayda transferi yaklaşımları olarak sınıflandırılabilir. Her yöntemin kendine özgü güçlü ve zayıf yönleri vardır ve yöntem seçimi, değerlenen çevresel mal veya hizmetin türüne ve belirli bağlama bağlıdır (Navrud, & Pruckner, 1997).

2.1 Açığa Vurulmuş Tercihler Yöntemleri (Revealed Preferences)

Açığa vurulmuş tercihler yöntemleri, çevresel mal ve hizmetlerin değerini, ilgili piyasalardaki gözlemlenmiş davranışlara dayanarak çıkarır. Bu yöntemler, bireylerin gerçek dünyadaki durumlarda yaptıkları seçimlere dayanır ve dolayısıyla gerçek ekonomik davranışlara dayanır. En yaygın kullanılan iki açığa vurulmuş tercih yöntemi, Hedonik Fiyatlandırma Yöntemi ve Seyahat Maliyeti Yöntemi'dir (Freeman vd. 2014).

2.1.1 Hedonik Fiyatlandırma Yöntemi

Hedonik Fiyatlandırma Yöntemi (Hedonic Pricing Method: HPM), mülk değerleri gibi piyasa fiyatlarını etkileyen çevresel özelliklerin değerini tahmin etmek için kullanılır. Yöntem, bir piyasa malının, örneğin bir evin fiyatını, hava kalitesi, parklara yakınlık veya gürültü seviyeleri gibi çevresel faktörler dahil olmak üzere çeşitli niteliklerin değerine ayırır. Bu çevresel nitelikler ile mülk fiyatları arasındaki ilişkiyi analiz ederek, çevresel malların örtük değeri tahmin edilebilir (Rosen, 1974). HPM, mülk piyasalarıyla yakından ilişkili çevresel malların değerlemesinde özellikle yararlıdır. Ancak, verilerin mevcudiyeti ve bireylerin çevresel kalite farklarının tamamen farkında olduğu ve bu farklara yanıt verdiği varsayımı ile sınırlıdır.

2.1.2 Seyahat Maliyeti Yöntemi

Seyahat Maliyeti Yöntemi (Travel Cost Method: TCM), parklar, plajlar veya doğa rezervleri gibi rekreasyon alanlarının değerini, bireylerin bu alanları ziyaret etmek için katlandıkları maliyetleri gözlemleyerek değerlendirir. Temel varsayım, bir alanı ziyaret etmek için harcanan zaman ve paranın, o alana erişim için ödenen fiyatı temsil etmesidir. Seyahat maliyetlerine dayanarak ziyaret talebini tahmin ederek, alanın rekreasyon hizmetlerinin değeri çıkarılabilir

(Clawson ve Knetsch, 1966).

TCM, açık hava rekreasyon alanlarının değerlemesinde yaygın olarak kullanılır ve gözlemlenmiş davranışlara dayanır. Ancak, sadece kullanım değerlerini değerlendirir ve varlık değeri veya miras değeri gibi kullanım dışı değerleri içermeyen bir alanın toplam ekonomik değerini tam olarak yakalayamayabilir.

2.2 Beyan Edilmiş Tercih Yöntemleri

Beyan edilmiş tercih yöntemleri (Stated Preference Method), çevresel malların ve hizmetlerin ekonomik değerini belirlemek için kullanılan bir grup anket tabanlı analitik tekniktir. Bu yöntemler, bireylerin belirli çevresel durumlar karşısında verecekleri olası tepkileri tahmin etmek amacıyla, bireylere doğrudan tercihleri hakkında sorular sorar (Hanley & Czajkowski 2019). Beyan edilmiş tercih yöntemleri, özellikle piyasa fiyatı olmayan veya doğrudan gözlemlenemeyen çevresel malların ve hizmetlerin ekonomik değerini tahmin etmek için kullanılır. Bu yöntemler, biyolojik çeşitlilik, manzara estetiği veya temiz hava gibi piyasa davranışlarına yansıyan piyasa dışı malların değerlemesinde özellikle yararlıdır. En yaygın kullanılan beyan edilmiş tercih yöntemleri, Koşullu Değerleme Yöntemi ve Kesikli Tercih Deneyleri'dir.

2.2.1 Koşullu Değerleme Yöntemi

Koşullu Değerleme Yöntemi (Contingent Valuation Method: CVM), bireylere belirli bir çevresel değişiklik için ne kadar ödemeye razı olacaklarını (Willingness to Pay: WTP) veya ne kadar kabul edeceklerini (Willingness to Accept: WTA) soran anket tabanlı bir yaklaşımdır. CVM, kullanım değerleri ve kullanım dışı değerler dahil olmak üzere geniş bir yelpazede çevresel mal ve hizmetleri değerlendirmek için kullanılabilir. Bu yöntem, hava kalitesinin iyileştirilmesi, tehlike altındaki türlerin korunması ve ekosistem restorasyonu gibi kamu mallarının değerlemesinde çevre ekonomisinde yaygın olarak uygulanmıştır (Carson, 2012).

CVM'in gücü, piyasa davranışlarına yansımayan kullanım dışı değerler dahil olmak üzere toplam ekonomik değeri yakalama yeteneğinde yatar. Ancak, Hipotetik sapma, stratejik sapma ve protesto yanıtları gibi birkaç yanlılık yada sapma türüne de tabidir ve bu da sonuçların geçerliliğini etkileyebilir (Arrow vd. 1993).

2.2.2 Kesikli Seçim Deneyleri

Bu çalışmada ayrıntılı olarak ele alınan Kesikli Seçim Deneyleri yada Ayrık Seçim/Tercih Deneyleri çevresel bir mal veya hizmetin farklı özellikleri arasında yapılan ödünleşimleri (marjinal ikame) içeren bir dizi varsayımsal senaryo sunan bir beyan edilmiş tercih yöntemidir. Yanıtlayanların yaptığı seçimleri analiz ederek, DCE'ler farklı niteliklerin göreceli önemi ve belirli çevresel iyileştirmeler için ödeme istekliliği hakkında bilgi sağlar (Louviere vd. 2000).

DCE'ler, tercih heterojenliğini yakalama yeteneği ve birden fazla nitelik arasında karmaşık ödünleşim modellerini esneklikle modelleme imkanı gibi CVM'e göre birkaç avantaj sunar. Ancak, seçim görevlerinin gerçekçi ve anlaşılır olmasını sağlamak için dikkatli bir tasarım ve uygulama gerektirirler.

2.3 Fayda Transferi

Fayda Transferi, bir bağlamdan başka bir bağlama mevcut değerleme tahminlerini aktararak çevresel mal ve hizmetlerin değerini tahmin etmek için kullanılan bir yöntemdir. Bu yaklaşım, zaman veya kaynakların sınırlı olduğu durumlarda, birincil değerleme çalışmalarının pratik olmadığı durumlarda sıklıkla kullanılır. Fayda Transferi, değer transferi ve fonksiyon transferi olmak üzere iki ana yaklaşımla gerçekleştirilebilir.

2.3.1 Değer Transferi

Değer transferi, önceki bir çalışmadan elde edilen parasal değeri doğrudan yeni bir bağlama uygulamayı içerir. Örneğin, önceki bir çalışma bir bölgede sulak alan restorasyonu için ödemeye razı olmayı (WTP) tahmin ettiyse, bu değer, benzer özelliklere sahip başka bir bölgede sulak alan restorasyonunun faydalarını tahmin etmek için aktarılabilir. Değer transferinin doğruluğu, orijinal ve hedef bağlamlar arasındaki benzerliğe ve orijinal çalışmanın kalitesine bağlıdır (Johnston vd. 2015).

2.3.2 Fonksiyon Transferi

Fonksiyon transferi, önceki bir çalışmadan tahmin edilen bir fayda fonksiyonunun yeni bir bağlama aktarılmasını içerir. Farklılıkları yansıtmak için WTP'yi çevresel malın ve nüfusun çeşitli özelliklerine bağlayan fayda fonksiyonu, orijinal ve hedef bağlamlar arasındaki farklılıkları yansıtacak şekilde ayarlanabilir. Fonksiyon transferi, spesifik bağlamların özelliklerine dayalı olarak ayarlamalara izin verdiği için genel olarak değer transferine göre daha esnek ve daha doğru kabul edilir (Rosenberger & Phipps, 2007).

Fayda Transferi, birincil değerleme verilerinin bulunmadığı durumlarda maliyet-fayda analizi yapmak için politika analizlerinde yaygın olarak kullanılır. Ancak, değerlerin aktarılabilirliği ve orijinal çalışmalardaki olası hatalarla ilgili sınırlamalara tabidir.

3. Kesikli Seçim Deneylerinin Teorik Temelleri

Kesikli Seçim Deneyleri, Thurstone (1927) tarafından geliştirilen ve daha sonra McFadden (1974) tarafından genişletilen Rassal Fayda Teorisi'ne (RUT) dayanmaktadır. RUT'a göre, bireyin belirli bir alternatiften elde ettiği fayda, alternatiflerin niteliklerine dayalı olarak gözlemlenebilen ve modellenebilen deterministik bir bileşenden ve bireysel tercihlerdeki gözlemlenmeyen faktörleri ve rastgeleliği yakalayan stokastik bir bileşenden oluşur (Hensher vd. 2015).

3.1 Rassal Fayda Teorisi

Rassal Fayda Teorisine göre bireyin fayda fonksiyonu şu şekilde ifade edilir:

$$U_{ij} + V_{ij} + e_{ij}$$

- U_{ij}, i bireyinin alternatif j'den elde ettiği toplam faydadır.
- V_{ij}, birey i'nin alternatif j'yi seçerken elde ettiği sistematik ya da deterministik fayda bileşenini temsil eder. Bu, faydanın gözlemlenebilir faktörlerle açıklanabilen kısmıdır.
- e_{ij}, faydanın rassal bileşenidir ve gözlemlenmeyen faktörleri yakalar ve *IID* olduğu varsayılır.

Deterministik bileşen V_{ij}, lineer bir fonksiyon olarak şu şekilde yazılabilir:

$$V_{ij} = \beta_0 + \sum_{k=1}^{K} \beta_k X_{ki\,j}$$

- $X_{ki\,j}$, birey i için alternatif j'nin k. niteliğini temsil eder.
- β_k, k. niteliğe ilişkin marjinal faydayı temsil eder.

Bir bireyin belirli bir alternatifi seçme olasılığı, o alternatifin diğer alternatiflere göre göreceli faydasıyla belirlenir. En yaygın olarak kullanılan multinominal logit modeli (MNL) ile bu olasılıkların tahmini şu şekilde ifade edilir:

$$P_{ij} = \frac{e^{V_{ij}}}{\sum_{m=1}^{J} e^{V_{im}}}$$

burada J, seçim kümesindeki toplam alternatif sayısını temsil eder (Hensher vd. 2015).

3.2 Multinominal Logit (MNL) Modelinin Genişletilmesi

MNL modeli yaygın olarak kullanılmakla birlikte, alternatiflerin bağımsızlığı varsayımını (independence of irrelevant alternatives: IIA) zorunlu kılar (McFadden vd, 1977). IIA varsayımı, iki alternatif arasındaki seçim olasılıklarının, diğer alternatiflerin varlığından etkilenmediğini ima eder. Bu sınırlama, tercih heterojenliğini (preference heterogeneity) hesaba katabilen ve IIA varsayımını gevşetebilen karışık logit (Mixed Logit: MXL) ve gizli sınıf modelleri (Latent Class Models: LCM) gibi daha esnek yaklaşımlarla dikkate alınabilir (Greene & Hensher 2003).

MXL modeli, β_k katsayılarının belirli bir dağılımı (örneğin, normal, log-normal) takip ettiğini varsayarak, tercihlerde rassal değişime izin verir. Bu yaklaşım, bireyler arasındaki gözlemlenmeyen heterojenliği yakalar ve çevre değerlemesinde bireylerin çevresel niteliklere yönelik tercihleri geniş ölçüde farklılık gösterebildiğinde özellikle yararlıdır (Train, 2009).

LC modeli ise, popülasyonun, her biri kendi tercih setine sahip olan farklı sınıflara ayrıldığını varsayar. Bireyler, seçimlerine dayanarak bu sınıflara olasılıksal olarak atanır ve böylece popülasyon içindeki farklı tercih kalıplarının tanımlanması sağlanır (Greene & Hensher, 2003).

Son zamanlarda ise GMNL (Generalized Multinomial Logit) modeli geliştirilmiştir. Bu yaklaşım, MXL modelinin genişletilmiş halidir ve daha fazla esneklik sağlar. GMNL modeli, sadece tercih heterojenliğini değil, aynı zamanda ölçek heterojenliğini de (scale heterogeneity) yakalayabilir. Ölçek heterojenliği, bireylerin seçim süreçlerinde ne kadar tutarlı olduklarıyla ilgilidir ve bu tutarlılık, belirli bir birey için diğerlerinden farklılık gösterebilir. GMNL modeli, bu heterojenliği hesaba katabilmek için MXL modelini ölçek faktörüyle genişletir (Fiebig vd. 2010).

4. Kesikli Seçim Deneylerinin Tasarımı

Bir DCE'nin tasarımı, her biri sonuçların geçerliliği ve güvenilirliği üzerinde önemli bir etkiye sahip olabilen birkaç kritik adımdan oluşur. Tasarım süreci, niteliklerin (attributes) ve seviyelerin (levels) seçimi, deneysel tasarımın oluşturulması ve seçim kümelerinin oluşturulmasını içerir. Bu adımların her biri DCE tasarımında dikkatlice ele alınmalıdır. Böylece DCE, yanıtlayanların tercihlerini doğru bir şekilde yakalar ve politika açısından geçerli içgörüler sunar.

4.1 Nitelik ve Seviye Seçimi

Bir DCE tasarımında niteliklerin ve seviyelerin seçimi en önemli adımlardan biridir. Nitelikler, değerlendirilen çevresel mal veya hizmetin özelliklerini temsil ederken, seviyeler her bir nitelik içindeki değişim aralığını tanımlar. Niteliklerin ve seviyelerin seçimi, bireylerin yapmaya istekli oldukları ödünleşimleri yakalayabilecek, ilgili, anlaşılır ve teorik olarak gerekçelendirilmiş olmalıdır ve hem teorik hem de ampirik kanıtlarla desteklenmelidir (Mariel vd. 2013).

4.1.1 Niteliklerin İlgililiği

Nitelikler, ilgili çevresel mal veya hizmetle olan ilgilerine göre seçilmelidir. Bireylerin tercihlerini etkilemesi muhtemel temel yönleri yakalamalıdır. Örneğin, bir orman koruma DCE'sinde, ilgili nitelikler arasında korunmuş orman alanı, biyolojik çeşitlilik seviyeleri, rekreasyon olanakları ve maliyet bulunabilir. Niteliklerin seçimi aynı zamanda politika açısından geçerlilik potansiyelini de dikkate almalı, böylece sonuçların gerçek dünyadaki karar verme süreçlerini bilgilendirebilmesini sağlamalıdır (Hanley vd. 2001).

4.1.2 Nitelik Sayısı

Bir DCE'ye dahil edilen niteliklerin sayısı, kapsamlılık (comprehensiveness) ile bilişsel karmaşıklık (cognitive complexity) arasında bir denge sağlamalıdır (Pearce vd. 2021). Çok fazla niteliğin dahil edilmesi, yanıtlayanları

bunaltabilir ve yorgunluğa veya tutarsız yanıtlara yol açabilir. Diğer yandan, çok az niteliğin dahil edilmesi, çevresel malın eksik temsil edilmesine neden olabilir ve tercih tahminlerinin yanlı olmasına yol açabilir. Çoğu DCE, değerlendirilen malın karmaşıklığına ve hedef popülasyonun bilişsel kapasitesine bağlı olarak dört ila sekiz nitelik içerir (Louviere vd. 2000).

4.1.3 Seviye Seçimi

Her bir niteliğin seviyeleri, gerçek dünyada olası değişim aralığını yansıtacak şekilde seçilmelidir. Katılımcıların alternatifler arasındaki anlamlı farkları algılamalarına izin verecek kadar belirgin olmalı, ancak çok uç olmamalıdır (Shang & Chandra (2023). Seviye seçimi, mevcut literatür, uzman görüşmeleri ve pilot çalışmalarla belirlenebilir. Bazı durumlarda, çevresel malın mevcut durumunu temsil eden bir "mevcut durum" seviyesi dahil etmek gerekli olabilir (Rolfe vd. 2000).

4.1.4 Nitelik ve Seviyelerin Ön Testi

Niteliklerin ve seviyelerin tamamlanmadan önce, katılımcılar için anlaşılabilir ve ilgili olduklarından emin olmak için ön testler yapmak önemlidir. Ön testler, odak grupları, bilişsel görüşmeler veya küçük ölçekli pilot anketler olabilir. Bu testler, niteliklerin açıklığındaki, seviyelerin gerçekçiliğindeki ve genel seçim görevinin karmaşıklığındaki potansiyel sorunları tanımlamaya yardımcı olabilir. Ön test sonuçlarına dayalı ayarlamalar, DCE'nin geçerliliğini artıracaktır (Carson vd. 1994).

4.2 Deneysel Tasarım

Bir DCE'nin deneysel tasarımı, katılımcıların değerlendireceği seçim kümelerini oluşturmayı içerir. Bir seçim kümesi, her biri farklı nitelik seviyesi kombinasyonlarıyla karakterize edilen iki veya daha fazla alternatiften oluşur. Tasarım, seçim kümelerinin, fayda fonksiyonu parametrelerinin tahmin edilmesi için maksimum bilgi sağlayacak şekilde istatistiksel olarak verimli olmasını sağlamalıdır (Louviere vd. 2011).

4.2.1 Tam Faktöriyel ve Kısmi Faktöriyel Tasarımlar

Tam faktöriyel tasarım (Full Factorial Design), nitelik seviyelerinin tüm olası kombinasyonlarını içerir ve tüm ana etkiler ve etkileşimlerin tahmin edilmesine olanak tanır. Ancak, tam faktöriyel tasarımlar, ürettikleri çok sayıda seçim kümesi nedeniyle genellikle pratik değildir ve bu durum yanıtlayıcı yorgunluğuna yol açabilir. Kısmi faktöriyel tasarımlar (Fractional Factorial Design), tüm olası kombinasyonlardan bir alt küme seçerek bu sorunu ele alır ve bu sayede ana etkiler ve seçilen etkileşimler tahmin edilebilir (Louviere 2000; Carson & Louviere 2010).

4.2.2 Etkin Deneysel Tasarımlar

Etkin deney tasarımları (Efficient Experiment Design), parametreler hakkındaki ön bilgilere dayanarak seçim kümelerini optimize eder ve seçim kümelerinin sayısını azaltırken istatistiksel verimliliği korur. Bu tasarımlar, parametrelerin olası değerleri hakkında ön bilgi olduğunda, örneğin önceki çalışmalar veya pilot testlerden, özellikle yararlıdır (Vanniyasingam vd. 2018). Etkin tasarımlar, nitelikler, seviyeleri, istenilen etkinlik düzeyi ve diğer kısıtlamaların belirtilmesine olanak tanır (Rose & Bliemer, 2009).

4.2.3 Seçim Setlerinin Oluşturulması

Seçim setlerinin (Choice Sets) oluşturulması, her setteki alternatif sayısına ve her yanıtlayıcıya sunulacak seçim seti sayısına bağlıdır. Alternatiflerin sayısının fazla olması seçimin karmaşıklığını artırır. Seçim setlerinin sayısı, yeterli veri elde etme ihtiyacı ile yanıtlayıcı yorgunluğu potansiyeli arasında bir denge sağlamalıdır (Hess vd. 2012). Genel olarak, çoğu DCE, yanıtlayıcı başına 8 ila 16 seçim kümesi sunar ve bu sayı, görevin karmaşıklığına ve dahil edilen niteliklerin sayısına göre değişebilmektedir (Hensher vd. 2015).

4.3 Mevcut Durum veya Seçmeme Seçeneğinin Dahil Edilmesi

Bir DCE tasarımında mevcut durum (Status Quo) veya seçmeme seçeneğinin (No-Choice Option, opt out) dahil edilmesi, kritik bir husustur. Mevcut durum seçeneği, çevresel malın mevcut durumunu temsil eder ve katılımcılara DCE'de sunulan varsayımsal senaryolara "katılmama" seçeneği sunar. Bu seçeneğin dahil edilmesi, gerçek dünyadaki karar verme süreçlerinin daha gerçekçi bir temsilini sağlayabilir, çünkü bireylerin sıklıkla hiçbir şey yapmama veya mevcut durumu sürdürme seçeneği vardır (Veldwijk vd. 2014) . Ancak, bazı katılımcıların sürekli olarak mevcut durumu seçmesi durumunda, tasarımın istatistiksel verimliliğini azaltabilir ve bu da yanıtların çeşitliliğinde eksikliğe yol açabilir (Adamowicz vd. 1998).

5. Kesikli Seçim Deneylerinin Uygulanması

Bir DCE'nin uygulanması, literatüre dayanarak oluşturulan sağlam bir anket tasarımı, iyi bir örneklem seçilmesi ve yüksek kaliteli verilerin toplanmasını içerir. Bu adımların her biri, sonuçların geçerliliğini ve güvenilirliğini sağlamak için kritik öneme sahiptir.

5.1 Anket Geliştirme

Anket, bir DCE'de veri toplamak için kullanılan birincil araçtır. Katılımcılara seçim görevini, nitelikleri ve seviyeleri açıkça açıklayacak şekilde tasarlanmalıdır. Anket, değerlenen çevresel mal veya hizmet hakkında arka plan bilgileri, çalışmanın amacı ve seçim görevlerini tamamlama talimatlarını içeren bilgileri içermelidir.

5.1.1 Niteliklerin ve Seviyelerin Açık Bir Şekilde Açıklanması

Nitelikler ve seviyeler, katılımcıların yapmak zorunda

oldukları ödünleşimleri anlamalarını sağlamak için açıkça açıklanmalıdır. Görsel yardımcılar, örneğin resimler, diyagramlar veya ikonlar, karmaşık bilgileri iletmeye yardımcı olabilir ve seçim görevini daha ilgi çekici hale getirebilir. Niteliklerin ve seviyelerin dili basit ve anlaşılır olmalı, katılımcıları yanıltabilecek teknik terimlerden kaçınılmalıdır (Bateman vd. 2002).

5.1.2 Anketin Ön Testi

Anketin ön testi, açıklık, anlaşılırlık ve seçim görevlerinin genel tasarımı ile ilgili potansiyel sorunları tanımlamak için gereklidir. Ön testler, bilişsel görüşmeler, odak grupları veya hedef popülasyondan küçük bir örnekle pilot anketler kullanılarak gerçekleştirilebilir. Bu testler, katılımcıların nitelikleri ve seviyeleri anlayıp anlamadıklarını, seçim görevlerinin çok karmaşık veya zahmetli olup olmadığını ve anketin herhangi bir bölümünün kafa karıştırıcı veya yanıltıcı olup olmadığını ortaya çıkarabilir (De Bekker-Grob vd. 2012).

5.1.3 Potansiyel Sapmalar

Bir DCE'nin sonuçlarını etkileyebilecek potansiyel sapmalar vardır. Bunlar arasında stratejik sapma (strategic bias), hipotetik sapma (hypothetical bias) ve protesto yanıtlar'dır (protest responses). Stratejik sapma, katılımcıların tercihlerini abartarak veya küçümseyerek çalışmanın sonucunu etkilemeye çalıştıkları durumlardan kaynaklanır (Meginnis vd. 2021). Hipotetik sapma, katılımcıların DCE'de sunulan varsayımsal senaryoları, gerçek dünyadaki bir durumda olduğu kadar ciddiye almadıkları durumlarda ortaya çıkar (Buckell vd. 2020). Protesto yanıtları, katılımcıların ödünleşim yapmayı reddettikleri veya DCE'nin varsayımına karşı güçlü bir muhalefet ifade ettikleri, genellikle mevcut durumu seçme veya gerçekçi olmayan yanıtlar verme durumlarında ortaya çıkar (Chen & Cho 2021). Anket, bu sapmaları en aza indirmek için tasarlanmalı; örneğin, senaryoların varsayımsal doğası vurgulanmalı ve niteliklerin ve seviyelerin gerçekçi ve ilgili olduğundan emin olunmalıdır (Carlsson ve Martinsson, 2001).

5.2 Örnekleme Stratejileri

Bir DCE'nin uygulanmasında temel bir husus, temsilci bir örneklemin seçilmesidir. Örnek, ilgi alanındaki nüfusu yansıtmalı ve fayda fonksiyonu parametrelerinin sağlam bir şekilde tahmin edilmesine olanak tanıyacak kadar büyük olmalıdır. Hedef popülasyona ve araştırma hedeflerine bağlı olarak birkaç örnekleme stratejisi uygulanabilir.

5.2.1 Tabakalı Örnekleme

Tabakalı örnekleme, nüfusun yaş, cinsiyet, gelir veya coğrafi konum gibi özelliklerine göre alt gruplara veya tabakalara ayrılmasını içerir. Her tabakadan rastgele bir örnek alınır ve bu, örneğin bütün nüfusu temsil etmesini sağlar. Tabakalı örnekleme, hedef popülasyonun çeşitli olduğu durumlarda özellikle yararlıdır, çünkü bu, belirli alt gruplar içinde tercihlerin analiz edilmesine olanak tanır (Hensher vd. 2015).

5.2.2 Örneklem Çerçevesi ve Katılım Yöntemleri

Örnekleme çerçevesi ve katılım yönteminin seçimi, hedef popülasyona bağlıdır. Örneğin, hedef popülasyon genel halksa, rastgele numara arama (RDD) yaklaşımı veya çevrimiçi panel uygun olabilir. Eğer hedef popülasyon, bir çevre politikasından etkilenen yerel sakinler gibi belirli bir grupsa, hedeflenmiş bir katılım yaklaşımı gerekli olabilir. Örneklem çerçevesi dikkatlice seçilmeli, ilgi alanındaki nüfusun tamamını kapsamalı ve yanlılıktan arındırılmış olmalıdır (Johnston vd. 2017).

5.2.3 Örnek Büyüklüğünde Dikkate Alınması Gerekenler

Bir DCE için gereken örnek büyüklüğü, niteliklerin ve seviyelerin sayısı, seçim görevlerinin karmaşıklığı ve tahminlerde istenilen kesinlik düzeyi gibi birkaç faktöre bağlıdır (Yang vd. 2015). Genel olarak, tercihlerdeki küçük farkları tespit etmek ve karışık logit veya gizli sınıf modelleri gibi daha karmaşık modellerin tahmin edilmesine olanak tanımak için daha büyük örneklem büyüklükleri gerekli olmaktadır.

5.3 Veri Toplama Yöntemleri

DCE'lerde veri toplama, yüz yüze görüşmeler, telefon görüşmeleri, çevrimiçi anketler ve posta anketleri gibi çeşitli yöntemlerle gerçekleştirilebilir. Veri toplama yönteminin seçimi, hedef popülasyonun internet erişimi, okuryazarlık düzeyi ve kültürel normlar gibi durumları dikkate almalıdır.

Çevrimiçi anketler, maliyet etkinliği, hızı ve geniş ve coğrafi olarak dağılmış bir popülasyona ulaşma yeteneği nedeniyle giderek daha popüler hale gelmektedir. Bunlar DCE'ler için özellikle yararlıdırlar, çünkü etkileşimli öğelerin, örneğin tıklanabilir seçim kümelerinin ve görsel yardımcıların kullanılmasına olanak tanır. Ancak, çevrimiçi anketler daha düşük yanıt oranlarına sahip olabilir ve internet erişimi sınırlı olan popülasyonlar için uygun olmayabilir (Callegaro vd. 2015).

Yüz yüze görüşmeler, veri toplama süreci üzerinde yüksek düzeyde kontrol sağlar ve okuryazarlık veya internet erişimi sorunları olan popülasyonlarda yararlı olabilir. Görüşmeciler, seçim görevlerini açıklayabilir, soruları yanıtlayabilir ve katılımcıların anketi anlamalarını sağlayabilir. Ancak, yüz yüze görüşmeler diğer yöntemlerden daha maliyetli ve zaman alıcıdır ve sosyal uygunluk yanlılığı getirebilir. Bu durumda, katılımcılar, gerçek tercihlerinden ziyade sosyal olarak kabul edilebilir olduğunu düşündükleri yanıtları verebilirler (Johnston vd. 2017).

5.3.3 Karışık Yöntem Anketleri

Karışık yöntem anketleri, çevrimiçi anketler ve yüz yüze görüşmeler gibi farklı veri toplama yöntemlerini

birleştirerek kapsamı ve yanıt oranlarını maksimize eder. Örneğin, düşük internet erişimi olan bölgelerde çevrimiçi bir anket, yüz yüze görüşmelerle desteklenebilir. Karışık yöntem anketleri, bireysel yöntemlerin sınırlamalarını hafifletmeye ve tercihlerin daha kapsamlı bir resmini sunmaya yardımcı olabilir (De Leeuw, 2005).

6. Kesikli Seçim Deneyi Verilerinin Analizi

DCE verilerinin analizi, fayda fonksiyonu parametrelerinin tahmin edilmesini, tercih heterojenliğinin değerlendirilmesini ve refah ölçümlerinin hesaplanmasını içerir. DCE verilerini analiz etmek için kullanılacak ekonometrik modelin seçimi, seçim görevlerinin karmaşıklığına, verilerin doğasına ve araştırma hedeflerine bağlıdır. Multinominal logit modeli (MNL) en yaygın kullanılan model olmakla birlikte, tercih ve ölçek heterojenliğini yakalama yetenekleri ve IIA varsayımını karşılama esneklikleri nedeniyle MXL, LCM ve GMNL yöntemleri sıklıkla tercih edilmektedir.

6.1.Multinominal Logit Modeli

MNL modeli, DCE analizinde en basit ve en yaygın kullanılan modeldir. Rassal fayda bileşeninin alternatifler ve bireyler arasında bağımsız ve aynı dağılımlı (IID) olduğunu varsayar ve bu da IIA varsayımının karşılanmasına yol açar. MNL modeli hesaplama açısından verimlidir ve tahmin edilmesi kolaydır, bu da onu başlangıç analizleri için popüler bir seçenek haline getirir. Ancak, IIA varsayımı, özellikle gözlemlenmeyen faktörlerin katılımcıların seçimlerini etkilediği durumlarda pratikte geçerli olmayabilir (McFadden, 1974).

6.1.1 MXL Yaklaşımı

MXL yöntemi MNL modelinin sınırlamalarını, bireyler arasında tercihlerde rastgele değişime izin vererek ele alır. MXL modelinde, β_k katsayıları rastgele değişkenler olarak ele alınır ve belirli bir dağılım (örneğin, normal, log-normal) ile belirlenir. Bu yaklaşım, bireyler arasındaki gözlemlenmeyen heterojenliği yakalar ve alternatifler arasındaki daha esnek yedekleme kalıplarına izin verir. MXL modeli, bireylerin çevresel niteliklere yönelik tercihlerinin geniş ölçüde farklılık gösterebildiği çevre değerlemesinde özellikle yararlıdır (Train, 2009).

6.1.2 LCM Yaklaşımı

LCM yaklaşımı, popülasyonun her biri kendi tercih setine sahip olan farklı sınıflara ayrıldığını varsayar. Bireyler, seçimlerine dayanarak bu sınıflara olasılıksal olarak atanır ve böylece popülasyon içindeki farklı tercih kalıplarının tanımlanması sağlanır. LCM, çevresel kaliteyi maliyete göre önceliklendiren veya tam tersini yapan alt grupların belirlenmesi için özellikle yararlıdır. Bu bilgi, hedeflenen politikaların ve müdahalelerin tasarımında değerli olabilir (Greene ve Hensher, 2003).

6.1.3 GMNL Yaklaşımı

GMNL (Generalized Multinomial Logit) modeli ise, MXL modelinin genişletilmiş versiyonudur ve daha fazla esneklik sağlar. GMNL modeli, bu heterojenliği hesaba katabilmek için MXL modelini ölçek faktörüyle genişletir (Fiebig et al., 2010). GMNL modeli, sadece tercih heterojenliğini değil, aynı zamanda ölçek heterojenliğini de yakalayabilir. Ölçek heterojenliği, bireylerin seçim süreçlerindeki tutarlılık düzeyleriyle ilgilidir. Yani, bazı bireyler kararlarını daha tutarlı ve belirli yaparken, diğerleri daha belirsiz veya tutarsız kararlar verebilir. Bu tutarlılık düzeyi, bir bireyden diğerine değişebilir ve GMNL modeli bu farklılıkları hesaba katar. Dolayısıyla GMNL modeli, çevre politikalarının daha doğru ve etkili bir şekilde tasarlanmasına katkıda bulunur. Çünkü karar vericilere, toplumun çevresel projelere ve politikalara nasıl tepki verdiği konusunda daha kapsamlı bir anlayış sağlar.

6.2 Marjinal Ödeme İstekliliğinin Tahmini

Bir DCE'nin temel sonuçlarından biri, çevresel bir mal veya hizmetin niteliklerine yönelik marjinal ödeme istekliliğinin (MWTP) tahmin edilmesidir. MWTP, bireylerin bir nitelikteki marjinal iyileştirme için ödemeye razı oldukları para miktarını temsil eder. Bu, fayda fonksiyonunun tahmin edilen katsayılarından aşağıdaki formül kullanılarak türetilebilir:

$$MWTP_k = \frac{\beta_k}{\beta_{cost}}$$

burada β_k seçim setlerinde MWTP hesaplanacak niteliğin, β_{cost} ise maliyet niteliğinin katsayıdır. MWTP tahminleri, bireylerin farklı niteliklere verdiği ekonomik değerin bir ölçüsünü sağlar ve bu da politika kararlarını bilgilendirmek için kullanılabilir (Hanemann, 1984).

6.3 Refah Tahmini ve Politika Etkileri

DCE'lerde refah tahmini, bir çevresel mal veya hizmetin niteliklerindeki bir değişiklikten kaynaklanan tüketici fazlasındaki değişikliğin hesaplanmasını içerir. Telafi edici değişim (The compensating variation: CV), refahın yaygın olarak kullanılan bir ölçüsüdür ve bu, bireyleri değişiklikten önceki kadar iyi durumda bırakan para miktarını temsil eder. CV, tahmin edilen fayda fonksiyonu ve MWTP değerleri kullanılarak hesaplanabilir (Bateman vd. 2002).

DCE'lerden elde edilen refah tahminleri, özellikle maliyet-fayda analizi bağlamında politika yapıcılar için değerli içgörüler sağlayabilir. Politika yapıcılar, çevresel iyileştirmelerden elde edilen refah kazanımlarını ilgili maliyetlerle karşılaştırarak farklı politika seçeneklerinin etkinliğini ve arzu edilirliğini değerlendirebilirler. Ayrıca, refah tahminleri, ekosistem hizmetleri için ödeme planlarının, çevresel tazminat programlarının ve diğer piyasa temelli araçların tasarımını bilgilendirmek için kullanılabilir (Johnston vd. 2017).

7. Kesikli Seçim Deneylerinin Zorlukları ve Sınırlamaları

Geniş çapta kullanılmaları ve avantajlarına rağmen, DCE'ler, bu deneyleri tasarlarken ve uygularken araştırmacıların dikkate alması gereken çeşitli zorluklar ve sınırlamalarla karşı karşıyadır. Bu zorlukların ele alınması, sonuçların geçerliliğini ve güvenilirliğini sağlamak için kritik öneme sahiptir.

DCE'lerdeki temel zorluklardan biri, seçim görevlerinin bilişsel karmaşıklığıdır ve bu da yanıtlayıcı yorgunluğuna ve tutarsız yanıtlara yol açabilir (Cognitive Complexity and Respondent Fatigue). Çok sayıda nitelik ve seviye içeren karmaşık seçim görevleri, katılımcıları bunaltabilir ve rastgele veya bilgilendirici olmayan seçimlere yol açabilir. Bu sorunu hafifletmek için araştırmacılar, seçim görevlerini basitleştirme, nitelik sayısını azaltma ve seçim setlerini farklı katılımcılar arasında yaymak için bloklama tasarımlarını kullanma gibi teknikler kullanabilir (Louviere vd. 2000).

Tercih heterojenliği, farklı bireylerin çevresel nitelikler için farklı tercihlere sahip olabileceği bir diğer zorluktur. MXL, LC ve GMNL modelleri gibi gelişmiş ekonometrik modeller gözlemlenmeyen heterojenliği hesaba katabilse de, bu heterojenliği yakalamak ve yorumlamak karmaşık bir görev olmaya devam etmektedir. Araştırmacılar, tercih heterojenliğinin sonuçların genellenebilirliği ve çevresel politikaların tasarımı üzerindeki etkilerini dikkatlice ele almalıdır (Train, 2009; Fiebig vd. 2010).

Hipotetik sapma bir diğer genel sorundur. Katılımcıların DCE'de sunulan varsayımsal senaryoları, gerçek dünyadaki bir durumda olduğu kadar ciddiye almadıklarında ortaya çıkar. Bu yanlılık yada sapma, ödeme istekliliği ve diğer tercih ölçümlerinin şişirilmesine veya küçültülmesine yol açabilir. Bu sapmayı azaltmak için araştırmacılar, seçim setleri için net ve gerçekçi bir bağlam sağlama, çalışmanın önemini vurgulama ve senaryoların gerçekçiliğini değerlendirmek için anket sonrası sorular ekleme ve katılım teşviği gibi teknikler kullanabilirler (Murphy vd. 2005, Buckel vd. 2020).

Protesto yanıtlar da DCE uygulamalarında önemli sorunlardır. Araştırmacılar, örneğin katılımcıların seçimlerinin nedenlerini araştırmak için takip soruları kullanarak ve protesto yanıtlarını analizden çıkararak bu sapmaları belirleme ve ele alma konusunda dikkatli olmalıdır (Meyerhoff & Liebe, 2009).

8. Tartışma ve Sonuç

DCE'ler, çevresel mal ve hizmetlerin ekonomik değerlemesinde güçlü ve esnek bir yöntem sunarak kamu tercihlerine ilişkin içgörüler sağlar. Bu içgörüler politika yapma süreçleri için kritik bir öneme sahiptir. Diğer taraftan DCE'lerin dikkatlice tasarlanması ve uygulanması, ödeme istekliliği, refah değişiklikleri ve tercih heterojenliğinin dikkate alınması çevresel politikaların ekonomik değerini belirlemek ve güvenilir tahminler elde etmek için son derece önemlidir.

Bu çalışma, çevresel değerlemede DCE'lerin yürütülmesi için kapsamlı bir rehber sunmuş ve teorik temeller, tasarım ilkeleri, pratik uygulama stratejileri ve ileri düzey analitik teknikleri kapsayan geniş bir açıklama sunmuştur. DCE'ler belirli zorluklar ve sınırlamalara tabi olsa da, bu zorluklar dikkatli planlama, ön testler ve uygun ekonometrik modellerin kullanımı yoluyla hafifletilebilir. Çevresel zorluklar giderek daha karmaşık ve acil hale geldikçe, sağlam ve güvenilir değerleme yöntemlerinin önemi nedeniyle DCE'lerin bu alanda önemli bir rol oynamaya devam etmesi beklenmektedir. Bu yolla çevresel politikaların kamu tercihlerine ve değerlerine dayalı olarak oluşturulmasının mümkün olabileceği değerlendirilmektedir.

DCE'lerin temel avantajlarından biri, bireylerin çevresel mal ve hizmetlere yönelik karmaşık tercihlerini modelleyebilme yeteneğine sahip olmasıdır. Bu yöntem, farklı çevresel niteliklerin bireyler tarafından nasıl değerlendirildiğini ve hangi niteliklerin daha yüksek bir değere sahip olduğunu belirlemeye olanak tanır. Özellikle, DCE'lerin bireylerin ödünleşimlerini ve tercih heterojenliğini yakalamada etkili olması, tercih heterojenliği, bireyler arasındaki farklılıkların, çevresel niteliklere verilen değerler üzerindeki etkisini ortaya koyması politika yapıcılar için kritik bir bilgidir. Ancak, DCE'lerin uygulanması bazı zorlukları da beraberinde getirir. Örneğin, deney tasarımında kullanılan niteliklerin ve seviyelerin doğru seçimi, sonuçların geçerliliği açısından büyük önem taşır. Yanlış veya eksik nitelik seçimleri, bireylerin gerçek tercihlerini yansıtmayan sonuçlara yol açabilir. Bu nedenle, nitelik ve seviye seçiminde literatürden, uzman görüşlerinden ve pilot çalışmalardan yararlanmak son derece önemlidir.

DCE'lerin bir diğer avantajı, bu yöntemin hem kullanım hem de kullanım dışı değerleri ölçebilmesidir. Örneğin, bir doğal parkın rekreasyonel kullanım değeri (kullanım değeri) ile parkın varlığından duyulan memnuniyet (kullanım dışı değer) DCE'lerle ölçülebilir. Bu, çevresel mal ve hizmetlerin tam ekonomik değerini anlamak açısından önemlidir. Ek olarak, DCE'lerin sağladığı verilerin, çeşitli ekonometrik modellerle (MXL, LC, GMNL gibi) analiz edilmesi, tercih heterojenliğinin ve ölçek heterojenliğinin daha iyi anlaşılmasını sağlar. Bu modeller, çevresel niteliklerin bireyler üzerindeki etkilerini daha doğru bir şekilde tahmin etmemize olanak tanır ve bu da çevresel politika önerilerinin daha sağlam temellere dayanmasına katkıda bulunur.

Öte yandan, DCE'ler varsayımsal bir senaryo sunar ve bu da yanıtlayıcıların gerçekte nasıl davranacakları konusunda bazı belirsizliklere yol açabilir. Hipotetik sapma olarak bilinen bu durum, sonuçların geçerliliğini etkileyebilir. Bu nedenle, DCE'lerin tasarımında ve uygulanmasında bu tür sapmaları en aza indirmek için dikkatli bir yaklaşım benimsenmelidir. Bu da, senaryoların gerçekçi olmasını sağlamak, teşvik, katılımcılara yeterli bilgi vermek ve anketleri dikkatle tasarlamak gibi adımlarla mümkündür.

DCE'lerin çevresel değerleme çalışmalarında etkinliği, deney tasarımının kalitesine, nitelik ve seviye seçiminin doğruluğuna ve veri toplama süreçlerinin dikkatli bir şekilde yürütülmesine de bağlıdır. Sonuç olarak, DCE'lerin çevresel mal ve hizmetlerin değerlemesinde daha geniş bir alanda kullanılabileceği ve bu sayede çevresel politikaların daha etkili bir şekilde yönetilebileceği değerlendirilmektedir. Bu çalışma, çevresel ekonomi alanında DCE'lerin kullanımına yönelik daha fazla araştırmaya zemin hazırlamakta ve bu yöntemin çevresel karar alma süreçlerinde önemli bir araç olarak kabul edilmesini önermektedir. Sonraki araştırmalar, DCE'lerin farklı çevresel bağlamlarda nasıl uygulanabileceğini ve bu uygulamaların sonuçlarının çevresel politikalar üzerindeki uzun vadeli etkilerini daha derinlemesine inceleyebilir. DCE'lerin sonuçlarının gerçek dünya davranışlarıyla ne kadar örtüştüğünü değerlendirmek ve sapmaları en aza indirmek için daha fazla metodolojik araştırma yapılması gerekmektedir.

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RESP

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Araştırma Makalesi ● Research Article

Kamu Borçlarının Özel Sektör Yatırımları Üzerinde Etkisi : Türkiye Örneği

The Impact Of Public Debt On Private Sector Investments: The Case Of Türkiye

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ANAHTAR KELİMELER

Kamu borçları
Özel sektör Yatırımları
ARDL
Fourier ADL

ÖZ

Bu çalışma, artan kamu borcunun Türkiye'deki özel yatırımlar üzerindeki asimetrik ve uzun dönem etkilerini incelemeyi amaçlamaktadır. Çalışma, 1975-2023 dönemini kapsayan zaman serisi verilerini içermektedir. Bu çalışmanın sonuçları, kamu harcamalarındaki artışın bütçe açığını ve dolayısıyla kamu borcunu artırarak özel sektörün mali kaynaklarında azalmaya katkıda bulunduğunu göstermektedir. Ayrıca, özel sektöre yapılan yatırımların kamu borcu tarafından dışlandığı tespit edilmiştir. Bu bağlamda, bulgular klasik teoriyi desteklemektedir. Fourier test sonuçlarına göre yapılan analiz, kamu sektörünün özel sektör üzerinde hiçbir etkisinin olmadığını öne süren Ricardo Denklik Teoremi'ni desteklemektedir. Sonuç olarak, kamu sektörünün mali kaynaklarının kalkınma projelerine yönlendirilmesi, altyapıya yatırım yapılması ve özel sektörün kalkınma projelerine daha fazla katılmasının teşvik edilmesi önerilmektedir.

KEYWORDS

Public debt
Private investment
ARDL
Fourier ADL

ABSTRACT

This study aims to examine the asymmetric and long-term effects of increasing public debt on private investments in Turkey. It encompasses time series data covering the period from 1975 to 2023. The findings of this study suggest that an increase in public expenditures, leading to a budget deficit and consequently increasing public debt, contributes to a reduction in financial resources available to the private sector. Additionally, it was found that investments in the private sector are crowded out by public debt. In this regard, the findings support the classical theory. The analysis based on Fourier test results supports the Ricardo Equivalence Theorem, which posits that the public sector has no impact on the private sector. In conclusion, it is recommended that public sector financial resources be directed towards development projects, investment in infrastructure, and encouraging greater participation of the private sector in development projects.

1. Giriş

Dünya genelinde, özellikle gelişmekte olan ekonomiler, büyük ölçüde yüksek borç servisi yüklerinden kaynaklanan mali açıkların artışıyla karşı karşıya kalmaktadır.

Kamu borcu, özel yatırımlar üzerinde iki şekilde etkili olabilmektedir: Birincisi, özel yatırımı dışlamasıdır (Gökpınar, 2022). Birçok çalışmanın bulguları, kamu borcu fazlalığı oluştuğunda veya borç eşiği aşıldığında ekonomik büyümenin önemli ölçüde ivme kaybettiğini göstermektedir. Bu büyüme kaybının yüksek faiz ve enflasyon oranları ile özel yatırımların dışlanması sonucunda meydana geldiği vurgulanmaktadır (Ncanywa ve Masoga, 2018). Bu durumda, yüksek kamu borcu oranı, özel sektör yatırımcıların daha yüksek vergiler ödemeyi beklemesine yol açarak yatırımlar üzerinde ağır bir yük oluşturmaktadır. (Ünsal, 2020)

Borcu geri ödemek için kullanılan kaynaklar, eğitim, sağlık ve güvenlik gibi sosyal hizmetlerin sağlanmasına yönelik alternatif fırsat maliyetini temsil eder ve bu durum, kamu borcunun özel yatırımlar üzerindeki dışlayıcı etkisini (crowding out) yansıtır.

İkincisi, özel yatırımları çekme (crowding in) yansıtabilir,

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kamu borcu verimli alanlarda kullanıldığında, alınan dış borç çarpan etkisiyle yatırım seviyesini artırarak ekonomik büyümede önemli bir rol oynamaktadır (Yavuz, 2014). Mevcut kamu harcamalarının vergiler yoluyla finanse edilmesinin, borçla finansmana göre daha fazla dışlama etkisi yarattığı ileri sürülmektedir (Ahmed ve Miller, 2000).

Özel sektör yatırımlarının sürdürülebilirliği ve GSYİH'ya katkı sağlaması, etkili kamu politikalarıyla mümkün hale gelebilir. Bu bağlamda, yatırım ortamının iyileştirilmesi, kredi erişim imkanlarının artırılması ve üretken yatırımlara öncelik verilmesi gibi konular, özel sektör yatırım politikaları ile hükümet politikaları arasındaki uyumlu koordinasyona büyük ölçüde bağlıdır (Altunöz, 2013).

Bu çalışmada, Türkiye'de kamu borcunun özel sektör yatırımları üzerindeki etkisi 1975-2023 dönemi için ARDL testi ile analiz edilmektedir. Bu amaç doğrultusunda, bu çalışmanın geri kalanı aşağıdaki gibi düzenlenmektedir. Bölüm 1'te Özel Yatırımlar İçin Kamu Borcunun Sürdürülebilir Kalkınmadaki Rolü. Bölüm 2'de literatürdeki ilgili çalışmalar incelenmektedir. Bölüm 3'te 1975 sonrası Türkiye'de kamu borcunun gelişimi ele alınmaktadır. Bölüm 4'te teorik anlayış, ampirik yöntem ve veri tanımı sunulmaktadır. Bölüm 5'te ampirik bulgular ortaya konmaktadır. Son olarak, Bölüm 6'te sonuçlara yer verilmekte ve geleceğe yönelik öneriler sunulmaktadır.

2. Özel Yatırımlar İçin Kamu Borcunun Sürdürülebilir Kalkınmadaki Rolü

Sürdürülebilir kalkınma, ekonomik büyümenin uzun vadede devam ettirilebilmesini sağlamak amacıyla kaynakların etkin ve verimli kullanımını ifade eder. Sürdürülebilir kalkınma, çevresel ve sosyal faktörleri de dikkate alarak ekonomik faaliyetlerin gelecek nesillere zarar vermeden sürdürülmesini hedeflemektedir. Sürdürülebilir kalkınmanın yatırımlar üzerindeki etkisi şu şekillerde özetlenebilir (Gülcemal, 2021)

- Uzun Vadeli Büyüme: Sürdürülebilir kalkınma politikaları, yatırımların uzun vadeli ekonomik büyümeyi destekleyecek şekilde yönlendirilmesini sağlar. Bunun yanında, ekonomik istikrarı artırır ve finansal piyasaların güvenini kazanmaktadır.
- Risk Azaltma: Sürdürülebilir yatırımlar, çevresel ve sosyal riskleri minimize ederek işletmelerin uzun vadeli sürdürülebilirliğini artırır. Başka bir deyişle, yatırımcıların risk algısını azaltır ve yatırım ortamını iyileştirmektedir.
- İnovasyon ve Verimlilik: Sürdürülebilir kalkınma, yenive verimli teknolojilerin kullanılmasını teşvik eder. Bu bağlamda, üretim maliyetlerini düşürür ve rekabet gücünü artırmaktadır.
- Kaynak Verimliliği: Sürdürülebilir kalkınma, doğal kaynakların verimli kullanılmasını ve israfın önlenmesini sağlar ve ekonomik büyüme için gerekli olan kaynakların sürekliliğini sağlamaktadır.

Türkiye'deki Kamu-Özel İşbirliği (KÖİ) projeleri genellikle özel sektörün döviz bazlı kredilerle altyapı yatırımlarını belirli bir imtiyaz sözleşmesi çerçevesinde gerçekleştirdiği projelerdir. Devlet, bu projeler için yüklenici firmalar ve finansman sağlayıcıları için yatırımı cazip hale getirmek amacıyla kar garantileri sağlar. Ancak, işletme dönemi boyunca devletin üstlendiği riskler ve yüksek maliyetler, ekonominin iç dengesi için bir tehdit oluşturabilir. KÖİ projelerinin dış ekonomik dengenin sürdürülebilirliği üzerindeki uzun vadeli etkileri, dikkatle yönetilmesi gereken önemli bir konudur. (Alagöz ve Yokuş, 2017)

3. Literatür Taraması

İktisat teorileri, kamu borcunun genel ekonomik yapı ve özellikle özel sektör yatırımları üzerindeki etkisinin gücü ve niteliği konusunda farklı görüşler öne sürmüştür. Literatürde kamu borcunun etkileri, kamu politikası araçlarının önemli bir unsuru olarak ayrıntılı bir şekilde tartışılmıştır. Bu bağlamda, kamu ile özel sektör arasındaki ilişkinin doğası ve kamu borcu stokunun özel yatırımlar üzerindeki etkisinin kapsamı üzerine tartışmalar devam etmektedir.

Taban ve Kara (2006) çalışmalarında Türkiye için 1989:1-2004:4 döneminde EKK yöntemiyle yaptıkları analizde, kamu borçlanmasının, iç borçlanma faiz oranlarının ve kamu sabit sermaye yatırımlarının özel sektör yatırımlarını dışladığını tespit etmişlerdir. Diğer yandan, enflasyon oranının özel yatırımlar üzerinde bir etkisi olmadığını saptamışlardır. Ek olarak bütçe açığının özel yatırımlar üzerinde önemli bir etkisinin olmadığını ortaya koymuşlardır.

Altunöz (2013), çalışmasında 1990-2010 dönemini kapsayan sabit fiyatlarla kamu iç borç stoku, tüketici fiyat endeksi (TÜFE), devlet iç borçlanma faiz oranları, kamu sabit sermaye yatırımları, reel GSMH ve özel yatırım harcamaları kullanarak kamunun iç borçlanmasının özel sektör yatırımları üzerindeki dışlama etkisini ekonometrik modellerle araştırılmıştır. ARDL yöntemi testinin kullanıldığı çalışmada, kamu iç borçlanmasının özel kesim yatırımları üzerinde azaltıcı etkisinin olduğu, bir başka deyişle dışlama etkisinin bulunduğu sonucuna ulaşılmıştır.

Akomolafe vd. (2015) 1990-2010 dönemi için Nijerya üzerine yaptıkları çalışmada kamu borcunu dış borç ve iç borç olarak ikiye ayırılmıştır. Johansen Eşbütünleşme testi ve Vektör Hata Düzeltme Modeli (VECM) kullanarak, iç borcun hem kısa dönem hem de uzun dönem iç yatırımı azalttığını sonucuna ulaşılmıştır. Ancak, dış borcun uzun vadede yatırımlar üzerinde çekme etkisi (crowding in) oluşturduğunu tespit etmişlerdir.

Benzer bir şekilde Aydın ve Özcan (2015), Türkiye'de kamu borçlanması ile özel yatırımlar arasındaki ilişkiyi incelemişlerdir. Panel veri analizi kullanarak yapılan Granger nedensellik testi ve panel eşbütünleşme testi sonuçlarına göre, kamu borçlanmasının özel sektör yatırımlarını olumsuz yönde etkilediği ve kamu borçlarının artmasıyla özel sektör yatırımlarının azaldığı sonucuna

varılmıştır

Bir diğer çalışmada, Doğan vd. (2015), Türkiye üzerine yaptıkları araştırmada kamu borçlanmasının özel sektör yatırımları üzerindeki etkisini incelemişlerdir. 2002-2014 dönemini kapsayan ve Türkiye'deki 81 ilin yıllık verilerini içeren bir veri seti kullanılarak panel veri analizi yöntemiyle yapılan çalışmada, kamu borçlanmasının özel sektör yatırımlarını olumsuz yönde etkilediği tespit edilmiştir.

Kamundia vd. (2015), Kenya için 1950-1988 dönemi verilerini kullanarak kamu borcu ile özel yatırımlar arasındaki nedenselliğin yönünü belirlemek için Granger nedensellik testi kullanılmıştır. Ghura ve Hadjimichael (1996) iç büyüme modeline dayanarak yapılan bu ampirik çalışmada, Granger nedensellik testi, kamu borcunun özel yatırım seviyesinin belirlenmesinde büyük rol oynadığını göstermektedir. Çalışmanın sonuçlarına göre, kamu borcu özel yatırımlar üzerinde olumsuz bir etkisi olduğu tespit edilmiştir.

Bir diğer çalışmada, Anıl ve Gülbahar (2018), Türkiye'de kamu borçlanması ile özel sektör yatırımları arasındaki ilişki ARDL modeli kullanılarak incelemişlerdir. Çalışmanın sonuçları, uzun dönemde kamu borçlanmasının özel sektör yatırımlarını olumlu yönde etkilediğini göstermiştir. Ayrıca, Granger nedensellik testi uygulanmış ve kamu borçlanması ile özel sektör yatırımları arasında uzun vadeli bir ilişki olduğu, kamu borçlanmasının özel sektör yatırımlarını teşvik ettiği bulunmuştur.

Bilgili ve Koçak (2019), Türkiye'de kamu borçlanması ile özel yatırımlar arasındaki ilişki ekonometrik olarak incelemişlerdir. Çalışmanın sonuçları, kamu borçlanmasının özel sektör yatırımlarını olumlu yönde etkilediğini göstermektedir. Vektör hata düzeltme modeli (VECM), Johansen eşbütünleşme testi ve Granger nedensellik testi kullanılarak yapılan analizler,, kamu borçlanmasının özel sektör yatırımlarını artırdığını ortaya komaktadır.

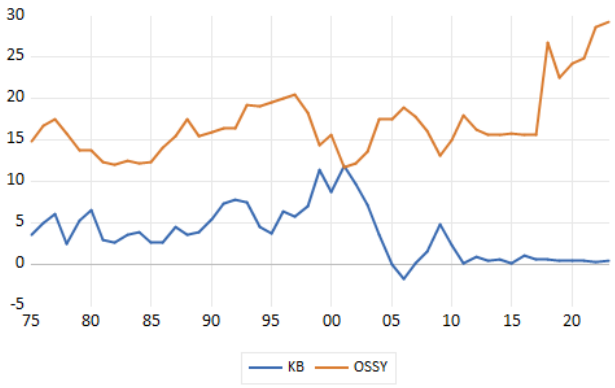
Yine benzer bir şekilde Özsoy ve Türkcan (2019), Türkiye'deki kamu borçlanmasının özel sektör yatırımları üzerindeki etkisini incelemişlerdir. Elde edilen bulgular, kamu borçlanmasının özel yatırımlarını olumsuz yönde etkilediğini göstermektedir. Panel veri analizi kullanılarak Türkiye'nin farklı bölgelerini ve sektörlerini içeren bir veri seti üzerinde yapılan bu araştırmada, kamu borçlanmasının özel sektör yatırımları üzerindeki etkisinin negatif olduğu görülmektedir.

Gökpınar (2022), Türkiye'de 1986-2020 dönemini kapsayan yıllık verileriyle Sánchez Juárez ve García-Almada (2016) ve Ncanywa-Masoga (2018) çalışmalarında ele alınan modeller dikkate alarak ARDL yöntemiyle analiz edilmiştir. Elde edilen analiz sonuçlarına göre, kamu borçlanmasının uzun ve kısa dönemde kamu ve özel sektör yatırımları üzerindeki etkisinin negatif olduğu görülmektedir.

4. Türkiye'de 1975 sonrası dönemde kamu borcunun gelişimi

Türkiye'nin 1975-2023 dönemine ilişkin özel sabit sermaye yatırımları ile kamu kesimi borçlanma gereğine ait veriler Şekil 1'de yer almaktadır.

Şekil 1. Özel Sabit Sermaye Yatırımları ile kamu kesimi borçları



Kaynak: Strateji ve Bütçe bakanlığı Temel Ekonomik Göstergeler (2023)

Şekil 1 incelendiğinde Türkiye'deki özel yatırımla ilgili olarak genellikle dört farklı aşama gözlemlenebilir:

İlk olarak, 1977'den 1985'e kadar özel yatırımda bir düşüş görülmektedir.İkincisi, hükümetin Kamu İktisadi Teşebbüslerini (KİT) özelleştirmeye yönelik aldığı tedbirler sayesinde, 1994 kriz döneminde özel yatırımlar üzerinde önemli bir etkisinin olmadığı dikkat çekmekte ve bu dönemde 1985'ten 1997'ye kadar yatırımlarda iyi toparlanma görülmektedir.Üçüncüsü, 2001 krizi dönemindeki incelenen dönem içindeki en düşük noktaya doğru bir gerileme yaşanmaktadır. Ancak, finansal krizlerin aşılması ve küresel ekonomik büyümenin hızlanmasıyla birlikte, ilk on yılın çoğunda özel yatırım seviyelerinde artışlar gözlenmektedir. Özellikle 2000'den itibaren hükümetin yabancı yatırım çekme ve bazı kamu kısıtlamalarını kaldırması bu artışta etkili olduğu görülmektedir.. Dördüncüsü ise 2008 krizi dönemindeki ikinci büyük düşüş yaşanmış ve ardından 2018'in ilk aylarında incelenen dönem içinde en yüksek seviyeye ulaşmıştır.

Bununla birlikte, aynı dönemleri kapsayan kamu borcunun gidişatı, yatırımın tersi yönde üç aşamayı da yansıtmaktadır.. Bu dönemde kamu borcunun etkisi oldukça belirgindir. Özel yatırımın en düşük seviyeye gerilemesiyle2000 yılı sonunda kamu borcu en yüksek seviyesineulaşmıştır. Ayrıca, 2001 krizinden sonra kamu borcunun hacminde keskin bir düşüş yaşanırken özel sektör yatırım harcamaları ise yükselmeye başlamıştır. Bununla birlikte, 2008 krizinde, kamu borcu hacminin 2001'de elde edilen dönemin sonuna kadar en yüksek seviyesine yükselmesiyle özel yatırımlar en düşük seviyesine inmiştir

5. Veri Seti ve Metodoloji

Çalışmada 1975–2023 dönemine ilişkin yıllık bir veri seti kullanılmıştır. değişkenler arasındaki ilişkinin incelenmesinde De Mendonça-Brito (2021) modelinden faydalanmıştır. Çalışmada kullanılan değişkenlere ait veriler Türkiye Strateji ve Bütçe bakanlığı Temel Ekonomik Göstergeler veri tabanından sağlanmıştır.

De Mendonça-Brito (2021) modelindeki bağımlı değişken özel yatırımdır. Son yıllarda kamu borcu/GSYH oranındaki artışın ortaya çıkardığı finansal bozulmanın yatırımları etkilediğinden dolayı analiz edilen bu dönem gözlem için daha elverişlidir. Modeldeki ana bağımsız değişken ise kamu borcudur. Kamu borcu, ekonominin önemli makroekonomik değişkenlerinden biridir ve yatırımcıların karar alma sürecinin temel belirleyicilerinden biri olarak kabul edilmektedir. Hakura'ya (2020) göre, yüksek kamu borcu / GSYİH oranı, ekonomik büyümeyi ve yatırımı engellemektedir. Kamu kesimi borcu özel sektör yatırım harcamaları üzerindeki etkisini izlemek için eşitlik (1)'de yer alan De Mendonça-Brito (2021) modeli kurulmuştur.

$$\text{OSSY} = \alpha_0 + \alpha_1 KB + \alpha_2 \text{TUFE} + \alpha_3 \text{GSYH} + \alpha_4 \text{TDA} + \varepsilon t \quad (1)$$

OSSY : Özel sektör sabit sermaye yatırımlar / GSYH oranı

KB : İç borç stokunun / GSYH oranı (kamu kesimi borçlanma gereğinin)

TUFE : Enflasyon (TÜFE / yıl sonu)

GSYH : Sabit fiyatlarla gayri safi yurtiçi hasıla

TDA : Ticari dışa açıklık (dış ticaret hacmi), ithalat ve ihracat toplamı / GSYH oranını temsil etmektedir.

4.1. Birim Kök Testi

Zaman serilerinin analizine başlamadan önce bu serilerin durağanlığının incelenmesi gerekmektedir. Bu amaç doğrultusunda değişkenlere ilişkin birim kök testi sonuçları Tablo 1'de yer almaktadır.

Tablo 1. Birim Kök Testi (ADF – PP) Sonuçları

Değişkenler	ADF İst.	PP İst.
Düzey		
OSSY	0.6122 (0)	0.8566 (4)
KB	-1.4714 (0)	-1.4874 (1)
TUFE	-2.5979 (0)	-2.4576 (2)
GSYH	1.8394 (0)	1.4585 (3)
TDA	1.9908 (0)	4.9661 (18)
Birinci Fark		
DOSSY	-7.8894 (0) ***	-7.8906 (1) ***
DKB	-6.8687 (0) ***	-6.8691 (1) ***
DTUFE	-8.6677 (0) ***	-8.7790 (2) ***
DGSYH	-5.5087 (0) ***	-5.6329 (4) ***
DTDA	-6.3449 (0) ***	-6.3255 (2) ***

Tablo 1'de ***, %1 anlamlılık düzeylerini göstermektedir.. ADF ve PP birim kök testi sonuçları, %1 anlamlılık düzeyinde tüm değişkenler birinci farkları aldıktan sonra durağan hale geldiği görülmektedir. Parantez içindekiler optimal gecikme uzunluğu göstermektedir. ADF modelinde Schwarz bilgi kritik; PP modelinde ise Bartlett Kernel ile belirlenmiştir.

Tablo 1 gibi tüm değişkenlerin birinci farkının durağan hale getirilmiştir. Başka bir deyişle I(1) olduğu anlaşılmaktadır.

Tablo 2. Birim Kök Testi (Fourier ADF) Sonuçları

Değişkenler	F-test değeri	K	P
OSSY	1.49	3	0
KB	2.92	1	0
TUFE	6.2	1	0
GSYH	3.91	1	0
TDA	6.11	1	0

Not: Sabitli model için Kritik değerleri %1, 5% ve 10% düzeylerinde sırasıyla (10.35, 7.58 ve 6.35) olduğunu gösterilmektedir (Enders ve Lee, 2012: 197).

Tablo 2 görüldüğü gibi Fourier ADF testi, değişkenler üzerinde uygulanmıştır; ancak f test değerleri 5% kritik değerini aşamadıkları için fourier terimleri anlamsız bulunmuştur. Bu nedenle tüm değişkenler için birim kök hipotezi H(0) reddedilmez. Bunun sonucunda analizi ADF birim kök testi sonuçlarına dayanmıştır.

4.2. Yöntem (ARDL)

Denklem (1) ARDL modeline uyarlanmış formu eşitlik (2)'deki denklemde gösterilmiştir.

$$\Delta \text{OSS} Y_t = \alpha_0 + \sum_{j=1}^{p} \alpha_{1,j}\, \Delta OSSY_{t-k} + \sum_{j=0}^{p} \alpha_{2,j}\, \Delta KB_{t-k} + \sum_{j=0}^{p} \alpha_{3,j}\, \Delta TUFE_{t-k} + \sum_{j=0}^{p} \alpha_{4,j}\, \Delta GSYH_{t-k} + \sum_{j=0}^{p} \alpha_{5,j}\, \Delta TDA_{t-k} + \lambda_1 \text{OSSY}_{t-1} + \lambda_2 \text{KB}_{t-1} + \lambda_3 \text{TUFE}_{t-1} + \lambda_4 \text{GSYH}_{t-1} + \lambda_5 \text{GSYH}_{t-1} + \varepsilon t \quad (2)$$

Δ fark katsayısı , α_0, εt ve p sırasıyla sabit terimi, hata terimi ve uygun gecikme uzunluğunu temsil etmektedir. $\lambda_1 \ldots\ldots\ldots \lambda_5$ kısa dönem katsayı tahminlerini, $\alpha_1 \ldots\ldots\ldots \alpha_5$ uzun dönem katsayı tahminlerini göstermektedir (Pesaran vd, 2001). F istatistiği ile sınır testi sınanmaktadır. Burada hesaplanan F istatistiği değeri, kritik değerlerden büyükse H0 reddedilerek eşbütünleşme ilişkisinin olduğu; küçük ise H0 reddedilmez ve eşbütünleşme ilişkisinin olmadığı anlamına gelir.

Sıfır hipotezi H0: $\alpha_1 = \alpha_1 = \ldots\ldots\ldots = \alpha_k = 0$

Alternatif hipotezi H1: $\alpha_1 \neq \alpha_1 \neq \ldots\ldots\ldots \neq \alpha_k \neq 0$

Hata düzeltme modeli belirlenmek için denklem eşitlik (3)'deki gibi görülmektedir.

$$\sum_{j=0}^{p} \alpha_{4,j}\, \Delta GSYH_{t-k} + \sum_{j=0}^{p} \alpha_{5,j}\, \Delta TDA_{t-k} + \lambda_1 \text{OSSY}_{t-1} + \lambda_2 \text{KB}_{t-1} + \lambda_3 \text{TUFE}_{t-1} + \lambda_4 \text{GSYH}_{t-1} + \lambda_5 \text{GSYH}_{t-1} + \omega \text{ETC}_{t-1} + \varepsilon t \quad (3)$$

ETC_{t-1} hata düzeltme terimini temsil etmektedir. ω hata düzeltme katsayısı, bu katsayı negatif ve istatitiksel olarak anlamlı olmasını beklenmektedir ve bir sonraki dönemde hata düzeltme derecesini temsil etmektedir.

Tablo 3. F İstatistiği – Sınır Testi Sonuçları

	K	F - Test İstatistiği	% 5 Kritik değerleri		% 10 Kritik değerleri	
			Alt sınır I(0)	Üst sınır I(1)	Alt sınır I(0)	Üst sınır I(1)
ARDL	4	11.32	2.86	4.01	2.45	3.52
FARDL	4	10.95	2.86	4.01	2.45	3.52

Tablo 3'te görüldüğü gibi ARDL ve FARDL, her iki modelde F istatistiği üst sınır kritik değerlerinden daha büyüktür. Bu nedenle H0 reddedilerek alternatif hipotez kabul edilerek değişkenler arasında bir eşbütünleşme ilişkisi olduğu görülmektedir.

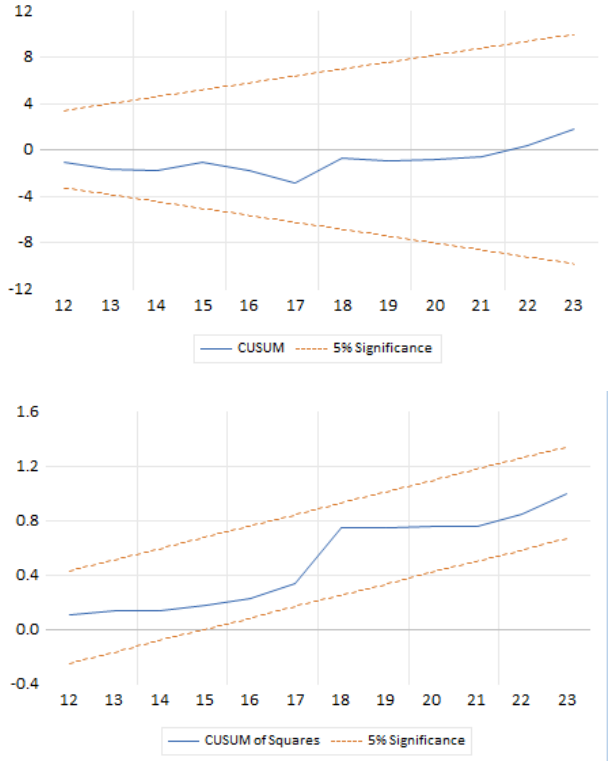
4.3. Tanısal Testler

Tablo 4'te, değişkenlerin tanısal test sonuçları sunulmaktadır.

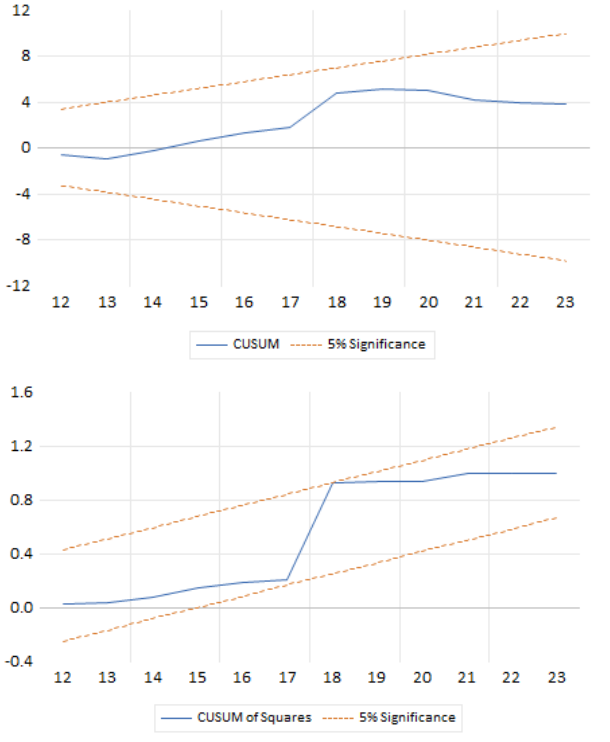
Tablo 4. Diagnostik Testler

Tanısal Testler	ARDL	Fourier ADL
F- İstatistiği	16.84279 (0.0000)	18.17955 (0.0000)
R^2	0.927539	0.689153
R_d^2	0.872469	0.651245
Jarque - Bera	0.020791 (0.989659)	86.03009 (0.0000)
Ramsey Testi	1.048148 (0.3132)	1.189968 (0.2826)
X_{BG}^2 Breusch Godfrey	2.552209 (0.01)	1.741145 (0.4187)
X_{BPG}^2 Breusch-Pagan-Godfrey	0.694273 (0.6875)	14.64205 (0.1012)

Tablo 4'de ARDL ve Fourier ADL için Jarque-Bera, Ramsey Reset, Breusch Godfrey LM ve Breusch-Pagan-Godfrey testleri yer almıştır, R^2 değeri bakıldığında ARDL ve FADL testlerinde açıklama gücü yüksek olduğunu göstermektedir, Jarque - Bera test sonuçları ARDL testinin hata terimleri normal dağıldığını gösterirken FADL testi için normallikten spamı tespit etmiştir. Ayrıca, Ramsey Testi, modellerin kurulmasının hata olmadığını göstermiştir. Çalışmada, otokorelasyon ve değişen varyans sorunları sırasıyla Breusch Godfrey LM testi ve Breusch-PaganGodfrey testleri ile incelenmiş ve tesat sonuçlarısorun olmadığını ortaya koymuştur.



Şekil 2. ARDL - CUSUM ve CUSUMSQ testleri



Şekil 3. FADL - CUSUM ve CUSUMSQ testleri

Şekil 2 ve Şekil 3'e göre ARDL ve Fourier ADL modellerde yapısal kırılma yoktur ve parametre tahminleri geçerlidir. Başka bir deyişle parametre tahminleri kararlı yapıya sahiptir.

6. Ampirik Bulguları

Tablo 5'e göre kamu borçları (KB), enflasyon (TUFE), gayri safi yurtiçi hasıla (GSYH) değişkenlerin olasılık değerlerinin %5'ten büyük oldukları görülmekte ve istatistiksel olarak anlamlı sonuç verdikleri bulunmuştur. Öte yandan dış ticaret hacmi (TDA) istatistiksel olarak anlamsız olduğunu gözlemlenmektedir. Bu bağlamda dış ticaret hacmi uzun dönem özel kesim yatırımları üzerinde anlamlı bir etkisinin bulunmadığını göstermektedir. Ayrıca uzun dönemde kamu borcunun özel yatırımlar üzerinde negatif yönde bir etki göstermektedir. Başka bir deyişle, kamu borcunun özel yatırımları dışladığını ifade edilmiştir. Kamu borçlarında meydana gelecek olan bir birimlik bir artış özel kesim yatırımlarını 0.31 azaltmaktadır. Diğer taraftan, TUFE ve GSYH, özel yatırımlar üzerinde pozitif bir etkiye sahip olduğu görülmektedir. Bunun sonucunda, TUFE oranında oluşacak % 1 birimlik bir artış, uzun dönem özel yatırımlar üzerinde % 12 artış gözlemlenecektir. Ayrıca GSYH değişkende % 1 birimlik bir artış özel yatırımları üzerinde % 1,3 artmasına yol açacaktır.

Tablo 5. ARDL Modeli (4.0.3.4.3) Tahmin Sonuçları – Uzun Dönem (bağımlı değişken: özel sabit sermaye yatırımları)

Değişkenler	Katsayılar	Standart Hatalar	t-istatistiği	Olasılık
KB	-0.31556	0.115279	-2.73739	0.0112
TUFE	0.125499	0.013232	9.484504	0.0000
GSYH	0.013631	0.003202	4.256803	0.0003
TDA	0.037802	0.054354	0.695486	0.4932

Tablo 6. Fourier ADL Modeli (4.2.3.0.3) Tahmin Sonuçları – Uzun Dönem (bağımlı değişken: özel sabit sermaye yatırımları)

Değişkenler	Katsayılar	Std. Hata	t-ist.	Olasılık
KB	0.006996	0.126083	0.055487	0.9562
TUFE	0.117531	0.013331	8.816279	0.0000
GSYH	0.015127	0.003027	4.997261	0.0000
TDA	0.072546	0.037817	1.918348	0.0666

Tablo 6'da uzun dönem Fourier ADL testi tahmin sonuçları gösterilmektedir. Elde edilen değişkenlerin değerleri (KB) ve (TDA) için istatistiksel olarak anlamsız çıkmaktadır. Diğer taraftan TUFE ve GSYH için anlamlı ve pozitif bir etkisinin olduğu görülmektedir. Başka bir deyişle, enflasyon oranı ve gayri safi yurtiçi hasılanın artışlarının özel sektör yatırımlarını artırdığı tespit edilmiştir. Enflasyon oranında meydana gelecek olan bir birimlik bir artış, özel kesim yatırımlarını 0.11 artmasına sebep olacaktır. Bunu yanında, GSYH'de % 1 birimlik bir artış özel yatırımların 0.01 artması beklenmektedir.

Özet olarak Türkiye'de kamu borcunun özel sektör yatırımları üzerindeki etkisinin analiz edildiği ekonometrik bulgularının birbirine benzerliği bulunmamaktadır. Bu bağlamda ARDL modelinin uzun dönem sonuçları Türkiye ekonomisinde dışlama etkisinin geçerli olduğunu ortaya koymaktadır. Diğer yandan, Fourier ADL modelinin uzun dönem sonuçlarına göre kamu borcunun özel sektör yatırımları üzerinde uzun dönemde etkisi bulunmamaktadır.

Tablo 7. ARDL Modeli Tahmin Sonuçları – Kısa Dönem (bağımlı değişken: özel sabit sermaye yatırımları)

Değişkenler	Katsayı	Std. Hata	t-ist.	Olasılık
C	10.192	1.254	8.126	0.000
D(OSSY(-1))	0.549	0.142	3.853	0.001
D(OSSY(-2))	0.564	0.122	4.610	0.000
D(OSSY(-3))	0.226	0.109	2.075	0.048
D(TUFE)	0.070	0.015	4.635	0.000
D(TUFE(-1))	-0.071	0.016	-4.522	0.000
D(TUFE(-2))	-0.031	0.013	-2.472	0.021
D(GSYH)	0.017	0.004	3.921	0.001
D(GSYH(-1))	-0.001	0.004	-0.209	0.836
D(GSYH(-2))	-0.014	0.005	-3.042	0.006
D(GSYH(-3))	-0.014	0.005	-3.030	0.006
D(TDA)	-0.047	0.078	-0.601	0.553
D(TDA(-1))	-0.087	0.077	-1.130	0.269
D(TDA(-2))	-0.249	0.084	-2.966	0.007
DUM	-7.347	1.097	-6.698	0.000
F istatistiği ve olasılık değeri				6.915 (0.000)
CointEq(-1)*	0.000	0.175049	-	0.0000

Tablo 7'de kısa dönem ARDL tahmin sonuçları ve hata düzeltme modeli sunulmuştur. Buna göre kısa dönemde enflasyon oranı istatistiksel olarak anlamlı çıkmıştır, Enflasyon değişkeninin düzeyde olumlu yönde etkileyip, gecikme dönemlerin değerleri ise olumsuz yönde etkilemektedir. Gayri safi yurtiçi hasılanın düzeyde katsayısı istatistiksel olarak anlamlı ve özel yatırımları tamamladığını göstermektedir. Ancak 2 ve 3 dönem gecikme değerleri özel yatırımlar üzerinde negatif bir etkisi olduğu ve 1 dönem gecikme değerinde anlamsız olduğu görülmektedir. Son olarak dış ticaret hacmi (TDA) sadece 2 dönem gecikme değerinde anlamlı olduğu ve özel yatırımlar üzerinde negatif etkiye sahip olduğu görülmektedir. ECT_{t-1} katsayısı ise beklendiği üzere negatif işaretli ve istatistiksel olarak anlamlıdır. ECT_{t-1} katsayısı sonucuna göre kısa dönemde ortaya çıkan şoklar bir dönem sonra 1.41 oranında düzeltilerek uzun dönem denge değerlerine yaklaşmaktadır.

Tablo 8. Fourier ADL Modeli Tahmin Sonuçları – Kısa Dönem (bağımlı değişken: özel sabit sermaye yatırımları)

Değişkenler	Katsayı	Std. Hata	t-ist.	Olasılık
C	6.445	0.797	8.088	0.000
D(OSSY(-1))	0.684	0.159	4.290	0.000
D(OSSY(-2))	0.825	0.136	6.081	0.000
D(OSSY(-3))	0.338	0.106	3.186	0.004
D(KB)	-0.146	0.136	-1.073	0.294
D(KB(-1))	-0.418	0.123	-3.400	0.002
D(TUFE)	0.067	0.014	4.635	0.000
D(TUFE(-1))	-0.089	0.016	-5.441	0.000
D(TUFE(-2))	-0.050	0.013	-3.817	0.001
D(TDA)	0.087	0.071	1.224	0.233
D(TDA(-1))	-0.058	0.071	-0.817	0.422
D(TDA(-2))	-0.315	0.080	-3.909	0.001
DUM	-7.570	1.067	-7.097	0.000
SINN	2.694	0.501	5.377	0.000
COSS	1.168	0.344	3.392	0.002
F istatistiği ve olasılık değeri				8.212 (0.000)
CointEq(-1)*	0.000	0.206841	-	0.0000

Tablo 8'den elde edilen sonuçlar, önceki dönemlerde özel yatırımın (OSSY) mevcut özel yatırım üzerinde olumlu ve pozitif bir etkisi bulunmakta ve yüzde 1 düzeyinde istatistiksel olarak anlamlı olduğu görülmektedir. Kamu borcu (KB) cari dönemde istatistiksel olarak anlamsız çıkmıştır, bir dönem gecikme değeri ise anlamlı ve özel yatırım üzerinde olumsuz bir etkisi olduğu görülmektedir. Kamu borcunda bir birimlik bir artış, özel kesim yatırımlarında % 21 bir düşüşe yol açacaktır. Enflasyon oranı (TUFE), cari dönemde yatırımlar üzerinde olumlu ve istatistiksel olarak anlamlı bir etkiye sahiptir. Bununla birlikte, bir ve iki dönem öncesine ait özel yatırımlar üzerinde olumsuz ve istatistiksel olarak anlamlı bir etkisi tespit edilmektedir. Son olarak dış ticaret hacmi (TDA) cari ve bir dönem öncesine ait özel yatırımlar üzerinde istatistiksel olarak anlamsız bir etkisini bulunmuştur. Bunun yanında ikinci gecikmede kısa vade katsayısı istatistiksel olarak anlamlı ve özel yatırımları dışladığını göstermektedir. Ayrıca, dış ticaret hacminde bir birimlik bir artış özel kesim yatırımların % 31 azaltmasını beklenmektedir.

ECTt-1 katsayısı, Fourier ADL modelinde negatif bir hata düzeltme terimi katsayısıdır ve istatistiksel olarak anlamlıdır. Böylece bir şok meydana geldikten sonra 1.64 oranında uzun dönem dengede hızlı bir iyileşme olduğu anlamına gelmektedir.

7. Sonuç

Bu çalışmada, Türkiye 1975-2023 döneminde kamu borcunun özel yatırım üzerinde etkisi ARDL ve Fourier ADL yöntemleri kullanılarak enflasyon oranı, gayri safi yurtiçi hasıla, dış ticaret hacmi ile analiz edilmiştir.

ARDL test sonuçlara göre, kamu borçların özel yatırımları uzun dönemde olumsuz etkilediğini, ancak kısa dönemde hiç etkilemediğini göstermiştir. Kamu borçlarının özel yatırım üzerindeki kısa dönemde etkisini bulunmadığı "Ricardo Denklik Teoremi" görüşüyle uyumlu olduğu,uzun dönemdeki etkisinin klasik iktisatçıların görüşüyle uyumlu olduğu tespit edilmiştir. Diğer taraftan Fourier ADL sonuçlara göre, kamu borçlarının uzun dönemde istatistiksel olarak anlamlı bir etkisi bulunmamıştır. Kısa dönemde ise bir dönem öncesine ait özel yatırımlar üzerinde istatistiksel olarak anlamlı ve güçlü bir etkisi olduğu bulunmuştur.

Kamu borçlarının özel sektör yatırımları üzerinde negatif bir etkisi olduğu sonucuna ulaşılmıştır. Bu bağlamda kısa dönemde Türkiye'de kamu borçlarının artmasını özel kesim yatırımlarının azalmasına sebep olacaktır.

Enflasyon oranı ve gayri safi yurtiçi hasılanın kısa dönemde özel sektör yatırım üzerinde istatistiksel olarak anlamlı ve negatif yönde etkiledikleri görülmüştür. Ancak uzun vadede GSYH ve TUFE ile özel sektör yatırım arasındaki pozitif bir ilişki olduğu görülmüştür. Bu olumlu etki şu şekilde değerlendirilebilir:

Uzun vadede özel yatırım ile GSYH arasında pozitif bir ilişkinin varlığı nedeni, GSYH'nın artmasıyla toplam talep arttırmaktadır ve böylece özel sektörün kullanabileceği yatırım fırsatları artmaktadır. Türkiye'de döviz kurundaki düşüşle ve enflasyondaki artış, özel sektör ihracatına bağlı sektörlere yatırımları arttırabilmektedir. çünkü yabancı para elde ettikleri gelir yoluyla üretim maliyetlerindeki artışını kurtulabilmektedir.

Son olarak, Özel sektör yatırımlarının sürdürülebilirliği ve GSYİH'ye katkısı, etkili kamu politikalarıyla desteklenmelidir. Yatırım ortamının iyileştirilmesi, krediye erişimin artırılması ve üretken yatırımların teşvik edilmesi gibi konular, özel sektör yatırım politikaları ile hükümet politikaları arasındaki koordinasyona bağlı olarak gerçekleşebilir. Bu bağlamda, özel sektörün sağlam bir şekilde büyümesi ve ekonomik büyümeye olumlu katkı sağlaması için uygun bir çerçevenin oluşturulması kritik öneme sahiptir.(Altunç ve Şentürk, 2010)

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RESP

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Araştırma Makalesi ● Research Article

Human Resources, "Green HR" and Job Satisfaction

İnsan Kaynakları, "Yeşil İK" ve İş Memnuniyeti

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A N A H T A R K E L İ M E L E R

Sürdürülebilirlik
İK
Yeşil Anlaşma
Çalışan memnuniyeti
Literatür analizi

Ö Z

Bu çalışma, 21. yüzyılın başlarından itibaren sürdürülebilirlik ve çevre dostu düşüncenin İK (İnsan Kaynakları) alanına ulaşıp, hatta bu alana nüfuz ettiği bir dönemde, oldukça güncel bir konuyu ele almaktadır. Bu makalenin amacı, AB'nin Yeşil Mutabakatı'nı ve bunun sürdürülebilir bir İK politikasıyla olan bağlantısını sunmaktır. Yayının özel önemi, 21. yüzyılda çalışan memnuniyetinin koşulları çerçevesinde İK politikalarının sürdürülebilirlik bağlamında yeniden yorumlanmasıyla vurgulanmaktadır. Bu makale, rekabetçi sektörlerde, yükseköğretim ve sağlık sektörlerinde bu konularla ilgili son araştırma sonuçlarını, literatür analizi yöntemiyle ortaya koymaktadır. Makalenin sonuç düşüncesi olarak, çalışan memnuniyeti ve bağlılığının entegre bir başarı faktörü olduğunun yeniden hatırlatılması önemlidir.

K E Y W O R D S

Sustainability
HR
Green Deal
Employee satisfaction
Literature analysis

A B S T R A C T

The present study is particularly timely as by the beginning of the 21st century, the idea of sustainability and green thinking had reached and even permeated the field of HR. The aim of the present paper is to present the EU's Green Deal, and its connection with a sustainable HR policy. The particular importance of the publication is emphasized by the fact that HR policies are reinterpreted in the context of sustainability, the conditions for employee satisfaction in the 21st century. The present paper is thus outlines the recent research results on these issues in the competitive-, higher education- and health sectors, based on the method of literature analysis. As a concluding thought of this paper, it is worth reiterating the integral success factor of employee satisfaction and engagement.

1. Introduction

Sustainability has become a buzzword not only in terms of relevant content, but also in terms of a growing number of disciplines (Pieccarini & Novitz, 2020: 7-8). While there is undoubtedly a case for research into sustainability, has it not been eclipsed by the question of the fate of workforce (Borim-de-Souza etal., 2015). Individuals establish organizations, companies, and manage them. Accelerated change has created a competitive environment where the workforce must also contend with the spread of automation (Schlogl et al., 2021; Upchurch, 2018).

Amid the workplace impacts of robotics, artificial intelligence, digitalization, pandemics, home office, inflation, human capital must remain the focus (Cascio & Montealegre, 2016). Despite the pressures on employees, it is also essential to discuss when employee satisfaction occurs and what components it depends on in order to meet future organizational goals (Klenert et al, 2023: 280-293). Human resources are still one of the most important factors in the operation of companies, and employee performance is highly dependent on their satisfaction, so employees need to be addressed (Mondolo, 2022; Chen & Li, 2024). People will still be working in the workplace, even if technological progress reaches the stage where they have to

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deal with artificial intelligence, society, organizations as human structures, will still function (Plastino & Purdy, 2018). Artificial intelligence is now an active mechanic of our day, despite the fact, that its regulation is still in its infancy and legislation is clearly unable to keep up with the pace of technological development (Falus et al., 2022).

The current industrial revolution is driven mainly by technological progress, digitalization, automation, and globalization. During these changes, however, the workforce is being hit by intensifying influences that also warrant the attention and care of employers. Former labor markets are fragmenting and becoming more personalized and traditional forms of employment are being partially or completely eliminated or transformed. At the same time, the dividing lines between private life and work are fading, while new methods of control, new occupational risks, occupational health effects such as techno-stress (Komlos & Falus, 2023), information overload, risks of human-robot interactions (Kardkovács, 2023).

While we are on the road to sustainability (Falus, 2024), or "sustainable development" as it was in earlier years, but is now a less important term, the question arises of what happens to people and the workforce along the way. This is also important because the need for soft skills is predicted to intensify in the future. Employee performance, motivation, and satisfaction have a significant impact on the success of a company. The focus of this study is therefore on human resources and, within this, employee satisfaction, for the reasons given above.

The analysis of the issue also covers trends that are intrinsically linked to the theme of a sustainable, renewable economy. These will be followed by a discussion of satisfaction issues in practice.

2. Sustainability and Green Deal, as well as HR

2.1. Green Deal

The European Green Deal is a set of policy measures intended to ensure the initiation of the green transition process in the EU and ultimately the realization of the climate neutrality goal set for 2050 (EU Commission, 2019). The Green Deal aims to stimulate investment in low-carbon technologies, increase energy efficiency and shift to zero-emission energy sources, as well as reduce consumption of natural resources and better protect natural habitats. The Green Deal adopted and favored by the European Union, will affect all areas of business, including manufacturing, procurement, supply chain management, finance, and human resources. Organizations will need to make complex and long-term efforts to meet the conditions set out in the agreement. However, less than half (40%) of companies are aware of the EU Green Deal and only around half (49%) consider their company to be prepared for the complex criteria dictated by the requirements.

In a survey, around 300 business leaders from ten EU member countries, plus Norway, Switzerland and the UK, were asked about their companies' response to the EU agreement. The majority of companies do not yet have a coordinated action plan in place to adapt as effectively as possible to the forthcoming changes. Most companies are taking steps on sustainability initiatives in a piecemeal way, along a long-term program. The challenge for the managers interviewed is to understand and manage all the dimensions of the agreement across their company as a whole. According to the survey, the majority of companies are taking steps to become more sustainable: two-thirds have already earmarked financial resources for investments in sustainability over the next three to five years. However, investments are being made on an ad hoc basis rather than as part of an integrated plan. Among the priorities of the companies surveyed are to increase the use of clean energy sources (78%), reduce energy consumption (60%), reduce waste and plastic use (59%) and reduce carbon emissions (59%) (PwC, 2022).

2.2 Sustainability and the leaders of organizations

The intentions and attitudes of managers will be a key moment in the context of sustainability factors. A previous study showed that 95% of business leaders believe that their ability to manage change and crisis needs to be improved (PwC,2021).

PwC's Global Crisis and Resilience Survey focuses on understanding today's threats and how organizations are focusing their resources, efforts and investments to become more resilient. Around 2,000 business leaders worldwide were surveyed on how they are preparing for and responding to this new way of operating. From the responses, it became clear that a clear paradigm shift in the understanding of resilience is needed. Whereas in the past it was understood to mean mitigating potential losses or meeting regulatory obligations, today it is about real resilience as a core competitive advantage and a prerequisite for any successful business strategy. Some explicitly stress the revolutionary nature of resilience. However, many also report that their organizations have not taken the necessary steps to implement a resilience agenda, and some have not even consciously addressed it. Overall, many organizations still lack the essential elements of resilience needed to succeed (PwC, 2023; Branicki et al., 2023).

It is also important to clarify the criteria for leaders who will manage future risks and crises with resilience built into organizational operations. This includes understanding the impact of stress and uncertainty and shaping their emotions and behaviors accordingly; reviewing less useful attitudes and building on their strengths; and developing more options for crisis management; examine how stress impacts on the dynamics and performance of the managed organization; identify catalysts to improve organizational and stakeholder performance and develop resilience in decision-making processes (PwC, 2024).

Organizational leaders' main considering for the near future is the disruption of supply chains, employee retention and recruitment, and the potential for cyber-attacks. In this difficult period, therefore, managers in organizations need to pay particular attention to their workforce. 80% of organizations identified investing in employee wellbeing as the most important action they took in the year. Taking into account the pandemic, economic turmoil, profound cultural changes and other challenges of the times, mental health was ranked number one (PwC, 2023).

2.3. Sustainability and HR Policy

The transition to green operations required by the agreement will affect all key processes of the organizations, including work management, human resources, and other management processes. The widespread adoption of digitalization and, subsequently, today's artificial intelligence-based administration has also transformed business. By automating office processes, companies can save money, time, and energy, and one of the benefits of digitalization is transition to paperless which is currently a trend (Lázár, 2023). However, sustainability does not stop there it also applies to HR processes.

The Green Deal's recommendations also cover energy efficiency, innovative solutions, recycling, and building people's skills. One of the four pillars of the plan is therefore specifically related to human capital. New skills and a skilled workforce will be needed in the sector as new technologies take hold. In order to develop the skills needed for the green transition, it is proposed to establish industry academies for the zero net emissions target, which will facilitate the introduction of training and retraining programs in strategic industries, and to explore how to combine an approach that recognizes and prioritizes the existence of real skills with current skills-centered approaches; review how to make it easier for non-EU nationals to enter a priority area of the EU labor market; and assess how public and private funding can be leveraged to support skills development(European Commission, 2023).

The growing role of sustainable development, and above all its ecological aspects, in creating a modern corporate competitive advantage is leading to the popularization of the issue of integrating environmental practices into the field of human resource management, the so-called Green HR. A survey of a representative population of around 150 young companies revealed that the more the impact of an activity is valued, the more often it is implemented in the companies surveyed. Thus, in order to expand the implementation of the Green HR concept in Polish young enterprises, it is necessary to raise awareness and disseminate knowledge about the impact that Green HR can have on the sustainable development of organizations (Bombiak & Marciniuk-Kluska, 2018).

By organizing skills development, HR can help to transfer the company's green approach. They can provide faster, manageable, sustainable solutions from an administrative, process management, and communication perspective. The organization may prefer to offer electro-mobility (Jóźwiak & Falus, 2022) as an environmentally friendly fringe benefit that is also attractive to employees. There are already companies that offer an employee discount (GreenGO, 2024).

There can also be added value in terms of team building by organizing programs with employee participation that promote sustainability achievements, such as tree planting or workshops on sustainable cooking or housekeeping (Wilson-Powel, 2020). The sustainability ambitions of the organization can also be integrated into the performance appraisal system. It can also be included in the criteria of the formal evaluation method and, in this context and it can be used to validate these values, in addition to the qualitative and quantitative experiences of the past, in the definition of future tasks (Wolk et al., 2009).

Perhaps the easiest way to incorporate sustainability considerations into the training and development process is to include them in the training and development process. The objectives of green training and development may include: raising awareness of current environmental issues (e.g. newsletters, briefings by environmental organizations); educating employees on work practices that allow them to reduce waste, save energy and resources (e.g. recycling, switching off computers at the end of working hours); and promoting and organizing employee innovation programs to explore opportunities to become more sustainable in their workplace (Sárközy et al., 2023).

Reward schemes can integrate financial or non-financial rewards for sustainable employee activities, team benefits, and rewards for innovative activities. To successfully implement environmentally sustainable production processes, scientists and practitioners need to accept that organizations are made up of people. Human beings are driven by their emotions, instincts, life and career aspirations, identities, contexts, and relationships. Green HR is a tool for engaging people in sustainability and, consequently, a means to ensure that sustainability goals are met to the greatest extent possible. The dimensions of green HR can be green recruitment and selection; green education and training; pay and reward systems; green appraisal and performance management; green communication; green team building; empowerment and supportive leadership (Labella-Fernández & Martínez-del-Río, 2019).

The role of human resource management in sustainable development can be described along three dimensions:

a) supporting environmentally conscious management: training, effective communication, motivating organizational members;

b) developing organizational change: integrating environmental values into organizational culture, developing competences for sustainability management,

promoting environmental ethics; and

c) alignment of functional dimensions: enforcing environmental criteria in recruitment and selection, reflecting environmental aspects in job descriptions, environmental education, performance appraisal and rewarding based on a sustainable strategy (Csehné et al., 2021).

In order to achieve the above objectives, maintenance efforts must be made part of the organizational culture in organizational practice. As this requires the utilization of the employee's other software skills, a positive supportive attitude is important. However, employee satisfaction is also essential for meeting future organizational goals. The next chapter explores the issues, factors and context of employee satisfaction.

3. Satisfaction

The majority of Hungarian companies have problems with low levels of employee satisfaction and commitment to the company (Nagy, 2004). Job satisfaction is determined by the following factors: individual (personality, education, intelligence, interests, attitude); social (co-worker relationships, collaborative access); cultural (values, habits, beliefs); organizational (size, type of organization, human resource solutions, leadership); and environmental (economic, social, technological) (Klein & Klein, 2020).

Satisfaction can have endogenous factors, such as activity, independence, and creativity, as well as exogenous factors, such as human relations, remuneration, and working conditions. People are most likely to perform to the best of their ability in a place where they feel they belong. One of the most motivating factors, in addition to fair financial compensation, is a sense of organizational attachment (Lövey et al., 2008:59). Job satisfaction is also closely related to the performance and quality of the work done by the employee, and therefore has an impact on the success of the organization because a satisfied employee has a creative attitude (Sypniewska, 2014).

According to some, employee satisfaction is a relatively stable individual characteristic that is difficult to change (Nemes & Szlávicz, 2011). Others argue that employee satisfaction and commitment to the organization can change dynamically depending on the employee-friendly policies of the organization (Berkesné, 2018). According to Herzberg's two-factor theory, satisfaction and dissatisfaction should be separated. Motivators influence the development of satisfaction, while hygiene factors influence the presence or absence of dissatisfaction (Bakacsi, 2015). Satisfaction is said to occur when the employee gets what he or she expects (Klein, 2021).

3.1 Employee satisfaction in the competitive sector

In addition to employing well-prepared staff, organizational communication also plays an important role in effective human resource management. As a result of this consistent information, employees are aware that the organization is committed to looking after them. These experiences increase job satisfaction (Kinicki et al., 1992).

A study examined US construction industry managers in relation to empowerment, participation and satisfaction of the staff they manage. The results show that empowerment is significantly associated with autonomy and the power to solve problems that arise, which also underpins satisfaction (Halvorsen, 2005). Employees at AT&T, as well as other companies, reported increased job satisfaction and productivity when working from home, according to research from the Henry B. Tippie School of Business at the University of Iowa. They cited not only the savings of an average of one hour of driving time per day as the reason for this, but also the fact that they were no longer exposed to the distractions that co-workers caused (Stewart-Kenneth, 2011). Another US study examined telecommunication workers' job satisfaction in relation to their use of and satisfaction with different communication channels and their personality type. The results showed that extraversion, openness, agreeableness and conscientiousness were positively correlated with job satisfaction (Smith et al., 2018).

In Britain, other approaches also emphasize that good work is an opportunity for development and fulfillment. In particular, skill-use, task variety and task discretion were found to be most important, but job security was also very important, while pay and job demands were found to be of medium importance (Williams et al., 2020: 29-50).

3.2 Employee satisfaction in education

A study of Greek universities revealed the work environment aspects of satisfaction. The results concluded that satisfaction is higher for endogenous factors (e.g. activity, independence, creativity, etc.) than for exogenous ones (e.g. human relations, remuneration, colleagues, working conditions, etc.) (Karamanis et al., 2019).

Also in the field of education, the survey explored the satisfaction of young teachers working in leading universities in major cities in Turkey and their overall job satisfaction. Life satisfaction and overall job satisfaction are closely related to mobbing, time spent on research, formal and informal pressures, and subjective job security (Cerci & Dumdulag, 2019).

One study looked at transformational and transactional leadership in Iran. The results showed that transformational leadership and employees' job satisfaction and perceived organizational support positively and significantly influence employees' organizational behavior. In addition, employees' job satisfaction was shown to mediate the relationship between transformational and transactional leadership and employees' organizational behavior (Asgari et al., 2020).

3.3. Satisfaction in the health sector

Turnover has a significant cost in any organization, so it is also important to look at the relationship between satisfaction and exit. One study looked at the impact of nurses' job satisfaction, job motivation, nursing practice environment, personal characteristics and absenteeism on their intention to leave the workplace in Croatia. Results show that nurses' job satisfaction and higher absenteeism rates are clear predictors of their future turnover (Smokrović et al., 2019).

And 212 health service organizations were inspected in hospitals in the north-east of Iran. It was shown that authentic leadership negatively influenced attachment insecurity, and attachment insecurity was found to be a factor affecting job satisfaction (Rahimnia & Sharifirad, 2015).

4. Conclusion

After outlining the domestic trends in sustainability in Europe, we presented the requirements of the future leaders committed to our focus topic. We then looked at sustainability efforts that can be adapted to HR practice. However, "winning" HR as an organizational factor with free will is necessary for the success of the sustainability processes outlined, and we therefore consider employee satisfaction as a prerequisite for change. In order to illustrate the complexity of employee satisfaction, we have drawn on research findings from different areas of employment.

Transformation will bring to an end the era of strong technical skills and weak soft skills in the workforce. Skills that will be valued in the future include creativity, curiosity, compassion, collaboration and critical thinking. These factors can help HR to succeed in its sustainability education activities. The role of HR in sustainability can be seen in shaping the organizational culture, integrating values, creating a supportive HR system, developing competencies (Csehné, 2021).

Green HR practices are effective tools for greening organizations and their operations. Tools for green job design and job analysis are available to HR, such as incorporating environmental activities into job functions, including them in job specifications, and creating teams or positions that address sustainability issues (Arulrajah et al., 2015).

In Hungary, the "Best Workplace" survey showed that organizations can be successful if their employees are committed; their leaders are well prepared and credible in the eyes of their staff; they drive the whole organization towards clear and attractive goals; and they mainstream sustainability in their human resources strategy and day-to-day operations (Bukovics et al., 2014).

Preference for best practices is not possible for projects aiming to achieve complex sustainability. Only good practices based on diagnoses adapted to local conditions can lead to results. Social marketing is essential for any local development related to sustainability and cannot be successful without the involvement of the community and the simultaneous development of human (knowledge) capital (Klausmann-Dinya, 2023).

As a concluding thought of this paper, it is worth reiterating the integral success factor of employee satisfaction and engagement, which Bukovics summed up excellently*: "CSR = HR + PR. Or to restate the equation: CSR - HR = PR, i.e. if employees are not engaged, then CSR is just a PR gimmick. In such cases, the organization is quickly revealed to be discredited because they preach water and drink wine"* (Bukovics et al., 2014).

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RESP

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Araştırma Makalesi ● Research Article

2030 Outlook for Global Cargo: ARIMA Predictions for Maritime Trade

2030 Küresel Yük Görünümü: Deniz Ticareti İçin ARIMA Tahminleri

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ANAHTAR KELİMELER

Denizcilik talebi
Yük hacmi
Deniz ticareti
ARIMA tahmini
Kuru yük

ÖZ

Deniz taşımacılığı sektörünün yüksek sermaye gereksinimleri göz önüne alındığında, karar verme sürecindeki hatalar önemli mali sonuçlara yol açabilir. Sonuç olarak, doğru gelecek tahminleri riski en aza indirmek için çok önemlidir. Bu çalışma, Kuru Yük, Ham Petrol ve Diğer Tanker yükleri olarak sınıflandırılan denizyolu yüklerinin 2030 yılına kadar olan görünümünü tahmin ederek sektör paydaşları ve politika yapıcılar için karar destek mekanizmaları sağlamayı amaçlamaktadır. Veri seti, 52 yıllık gözlemden oluşan 1970-2021 dönemini kapsamaktadır. Otoregresif Entegre Hareketli Ortalama (ARIMA) tahminlerimize göre, Kuru yük hacimlerinin 2021 yılına kıyasla 2030 yılına kadar %11,1 oranında artması beklenirken, Diğer Tanker yük hacimlerinin %1,2 oranında azalması ve Ham Petrol tanker hacimlerinin %10,7 oranında düşmesi öngörülmektedir. Çalışmanın tahminleri, gelişen yük ortamına ilişkin önemli bir anlayış sunmakta, küresel ticaret modellerindeki potansiyel değişimleri ve rekabet gücü ile verimliliği korumak için denizcilik sektöründe stratejik planlama ihtiyacını vurgulamaktadır. Bu bulgular, denizcilik sektörü katılımcılarının ve politika yapıcıların filo yönetimi, altyapı yatırımları ve değişen yük taleplerine uyum sağlamak için mevzuat düzenlemelerine ilişkin bilinçli kararlar almalarına yardımcı olacaktır.

KEYWORDS

Shipping demand
Cargo volume
Maritime trade
ARIMA forecast
Dry bulk

ABSTRACT

Given the high capital requirements of the maritime transportation sector, errors in decision-making can lead to significant financial consequences. As a result, accurate future projections are crucial for minimizing risk. This study aims to provide decision support mechanisms for industry stakeholders and policymakers by forecasting the outlook for seaborne cargoes—categorized as Dry, Crude Oil, and Other Tanker cargoes—through to 2030. The dataset covers the period from 1970 to 2021, consisting of 52 annual observations. Based on our autoregressive integrated moving average (ARIMA) estimates, Dry cargo volumes are projected to grow by 11.1% by 2030 compared to 2021, whereas Other Tanker cargo volumes are expected to decrease by 1.2%, and Crude Oil tanker volumes are anticipated to decline by 10.7%. The study's projections offer a crucial understanding of the evolving cargo landscape, highlighting potential shifts in global trade patterns and the need for strategic planning in the maritime industry to maintain competitiveness and efficiency. These findings will help maritime sector participants and policymakers make informed decisions regarding fleet management, infrastructure investments, and regulatory adjustments to adapt to shifting cargo demands.

1. Introduction

In the last decades, due to the increasing speed of globalization, the world economy is becoming increasingly dependent on freight transportation (Çakmak and Çalışkan,

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2024). While freight transportation activities increase the circulation of raw materials and finished products, they also support regional development economically. The increasing dependence of the world economy on freight transportation makes it imperative to improve freight transportation planning processes (Schank et al., 2008). Transport systems, which are of indisputable importance for today's world economy, are powerful systems open to change in terms of the form and amount of freight and passenger traffic at different time periods. The reasons for these changes are examined in the literature in three groups: economic, technical and organizational. And the correct assessment of these changes, the prediction of the supply-demand balance that determines the market price and the correct prediction of the future of the transport system are key elements of the planning and success of the system (Dragu et al., 2017).

In order to achieve well-functioning freight transportation systems, which are seen as an indispensable element of every successful economy, it is necessary to improve the demand for goods movement and the physical infrastructure in parallel and ensure that they act in harmony with each other. Freight transportation markets are markets with high time sensitivity (Regan et al., 2000). While the strengthening of this market, which can directly affect the strengthening of the global or regional economy, is among the important strategic goals of countries, the inadequacy of the physical infrastructure to meet the demand in question will, at best, lead to delays in freight transportation, will affect the country's economy in the opposite direction, and countries will be deprived of this value that creates an opportunity for economic strengthening.

Approximately 90% of international trade is carried out by maritime transport (Nuran, 2023). It is known that the main factors underlying the economic and political strength of many world countries with developed economies are the success and performance they have shown in the maritime field and the advantages they have gained from having a say in the world's seas (Germir, 2022). In this study, we aimed to estimate freight traffic up to 2030 using freight statistics published by UNCTAD. The research findings are crucial for both the maritime sector and policymakers, as the maritime industry is highly capital-intensive, requiring significant investments in infrastructure, superstructure, and ships. Mistakes in planning can lead to considerable inefficiencies and resource misallocation, making accurate forecasts essential for informed decision. Our findings hold significant importance for the maritime sector, providing benefits to transportation companies in three keyways. (i) With future load forecasting, shipping companies can optimize their fleets and plan capacity more effectively, minimizing the risk of both idle and insufficient capacity. (ii) Forecasts enable companies to make informed decisions regarding port infrastructure, storage facilities, and new ship orders, ensuring that resources are allocated efficiently. (iii) Demand forecasts help reduce financial risks by offering a clearer picture of future demand, allowing companies to better navigate uncertainties. Furthermore, the impact extends beyond transportation companies to other sectors, including shipbuilding yards, ship dismantling facilities, ports, provisioning companies, ship fuel suppliers, refineries, warehouses, alternative transportation modes, insurance providers, and mining companies. Given that these industries are closely linked to maritime transportation, accurate demand forecasting is crucial for their strategic planning and operational success. For policymakers, demand forecasts offer significant benefits in three main areas. (i) As policymakers are often responsible for planning and financing infrastructure investments, demand forecasts help assess how well a country's infrastructure can handle future traffic, thereby minimizing costly outcomes such as under- or over-investment. (ii) Changes in traffic volumes serve as indicators of economic trends, enabling policymakers to develop future commercial and economic policies. (iii) Shifts in freight traffic influence transportation costs due to factors such as economies of scale, service frequency, and delivery speed, making forecasts critical for sustaining commercial activities with sustainable transport costs.

Our ARIMA estimation results indicate that by 2030, the amount of dry cargo will increase by 11.1% compared to 2021, while the volume of other tanker cargo will decrease by 1.2%, and crude oil tanker volumes will decline by 10.7%. The decrease in crude oil transportation may be attributed to several factors, including the increasing transition to renewable energy sources (Khan and Shaheen, 2020; Yu et al., 2022), the growing adoption of electric vehicles (Unger, 2015; World Economic Forum, 2023), and the tightening of environmental regulations in the world and decarbonization policies in the maritime sector (Müller-Casseres et al. 2021). Yu et al. (2022: 2889) expressed that a strong conviction exists that progress in renewable energy sources eventually reduces the economy's dependence on crude oil and associated products. Khan and Shaheen (2020: 442) discovered a negative and significant connection between renewable energy use and crude oil import demand in nations such as China, India, and Japan. According to IRENA (2021: 75), the global economy's decarbonization would need the electrification of end-use industries, such as the road transport industry, which would reduce the amount of crude oil, and its derivatives traded. Climate policies lead to a decreased demand for global shipping as a result of diminished fossil fuel commerce. With the execution of a climate policy, a reduction in the market for coal, oil, gas, and chemicals may decrease global shipping activity by approximately 20% by 2050 and 25% by 2100 (Müller-Casseres et al. 2021: 10). Carbon pricing methods used in the transportation industry may elevate operational expenses for companies and projections indicate that shipping freight rates might rise by 10–30%, given the shipping sector's significant dependence on carbon-based fuels for optimal performance (UNEP FI, 2024: 10-11). If the commitments made to mitigate the effects of climate change are upheld, there will be a significant reduction in the demand for fossil fuels throughout the world for the duration of the long term

(Puyo et al., 2024: 2). Additionally, the shift of ships toward alternative, environmentally friendly fuels such as LNG, biofuel, and hydrogen—similar to the transition seen with electric vehicles—could also reduce the demand for oil-based fuels in shipping. According to Puyo et al. (2024), low and zero carbon hydrogen-based liquid fuels could substitute oil and they might acquire market share in oil-dependent aviation and shipping sectors. Improvements in energy efficiency further contribute to this decline in crude oil demand. The fact that other tanker cargoes did not decrease as much as crude oil can be interpreted as the rising demand for environmentally friendly cargoes, such as LNG, offsetting the decline in demand for petroleum products.

This study's novelty lies in its thorough and multifaceted approach to maritime cargo volume forecasting, which offers sector specific insights for optimal fleet management and resource allocation. The study also provides strategic planning insights for sustainable development in the maritime industry, with a focus on data-driven decision-making in infrastructure investments and policy formation for various maritime industry stakeholders.

The paper is structured as follows: Section 2 reviews the demand forecasting literature, particularly in the transportation industry. Section 3 identifies the data and methodology used in the study. The results are presented in Section 4, and finally, the findings and their implications are discussed in the last section.

2. Literature

In the current literature, there are many studies on demand forecasting in the transportation sector, conducted with different sample groups and different research methods. Tsekeris and Tsekeris (2011) compared the studies written in the field of demand forecasting in the transportation sector in terms of the methods they used. Lopes et al. (2014) analyzed the application of spatial statistics tools in the analysis of sustainable transportation planning and transportation demand. Okoro et al. (2016) provided a comprehensive perspective on the existing literature by examining the studies published on demand forecasting in the transportation sector, while Comi et al. (2012) studied on demand forecasting in urban freight transportation. Banerjee et al., (2020) investigated the subject of demand forecasting in the scheduled passenger transportation sector, and similarly, Wardman et al. (2007) studies on demand forecasting in the railway sector.

When examined within the scope of application areas, there are studies examining the subject of forecasting over the entire supply chain (Babai et al., 2022), in the railway sector (Profillidis and Botzoris, 2007; Tsai et al., 2009; Li et al. 2012; Milenković and Bojović, 2016), in the international airline sector (Faraway and Chatfield, 1998; Chen et al., 2009; Yao et al., 2014; Jungmittag, 2016; Ghomi and Forghani, 2016), in the maritime sector (Randers and Göluke, 2007; Dragu et al, 2017; Solak Fiskin, and Cerit, 2021; Ubaid et al. 2021; Wang et al, 2024), specifically in the shipbuilding sector (Gasparotti and Rusu, 2018; Wada et al.,2018; Wada et al., 2021; Han et al., 2024), demolition market (Kagkarakis et al. 2016), port sector (Tongzon, 1991; Jugović et al. 2011; Parola et al. 2020) and cruise line sector (Sun et al. 2011).

For the airline transportation, the studies included the variables such as monthly total airline passengers (Faraway and Chatfield, 1998), the number of people and freight transported, the distances traveled and aircraft operations in the main regions (Jungmittag, 2016), daily passenger data for business and economic class flights from an airline in Türkiye (Ghomi and Forghani, 2016). Additionally, daily train sales data (Tsai et al. 2009), monthly railway passenger volume (Li et al. 2012; Milenković et al. 2014) and average rail passenger travel distance, unit cost of transport by rail, car ownership index, number of busses working in interurban routes, unit cost of transport by bus etc. (Profillidis and Botzoris, 2007) were analyzed as variables in the forecasting studies for railway transportation mode. Forecasting studies related to tourism and passenger transportation industry were generally covered variables such as historical data of tourist/visitor arrivals in using time series, autoregressive moving average (ARMA), autoregressive integrated moving average (ARIMA) and seasonal autoregressive integrated moving average (SARIMA) forecasting (Ghalehkhondabi et al., 2019). Sun et al. (2011) taken into consideration of the booking histories cruises for a specific itinerary and cruise ship, and the details of the bookings included cruise's date of sail, week of departure, length of stay, type of cabin, and amount paid.

Solak Fiskin and Cerit (2021) reviewed and categorized forecasting studies for shipping industry and examined both theoretical and empirical investigations. They categorized the reviewed forecasting studies in shipping into following distinct themes; seaborne trade, average haul, ship demand, merchant fleet, ship productivity, freight rate, port/terminal traffic, and other shipping forecasts. According to the results of the study, while seaborne trade forecast studies mostly included export and import data, gross domestic product(GDP)/gross national product (GNP), trade volume, freight rate, commodity and distance as variables, the studies related to freight rate forecasting mainly covered new building, second-hand and demolition prices, freight index, freight rate, charter rates, oil price, oil production and fleet size/capacity variables. GDP/GNP, export and import data, new building prices and trade volume are the most frequently used variables in all covered studies. conversely, industrial production index, inflation rates, electric consumption, profits and expansion of building & construction are discovered as the least used variables in the studies.

ARIMA (Autoregressive Integrated Moving Average Model) is a modeling system that is widely used in literature in various fields such as GDP modeling (Muma and Karoki, 2022), energy consumption modeling (Aydın, 2014), food production estimation and modeling (Mishra et al., 2023),

and estimation of population projections (Vanella et al., 2020). When evaluated specifically for the transportation sector, it has been determined that the ARIMA method is used in demand forecasting in regular passenger transportation (Banerjee et al., 2020), in air quality prediction inside transportation vehicles (Kadiyala and Kumar, 2014), in future traffic amount prediction (Liu et al., 2021), in studies on intelligent transportation systems (Han and Song, 2003; Kaffash et al, 2021), and in studies on tourism and passenger transportation sectors (Lim and McAleer, 2002; Ghalehkhondabi et al., 2019).

In the ARIMA method, the variables added to the model in order to achieve the purpose of the study are generally determined by the researcher in accordance with the nature of the study and supported by the literature. However, in the literature, the ARIMA model is generally used on highly correlated variables such as GDP, GNP, export, import (Khan and Khan, 2020), revenue (Kinney, 1978), etc. When examined specifically in the transportation sector, it was seen that in a study conducted for the purpose of estimating road transportation prices, the producer price index (PPI) for full truckload data obtained from the Bureau of Labor Statistics (BLS) and the average monthly price data obtained from a website serving as an online freight board for road transportation were used (Miller, 2019), and in a study aimed at estimating the gasoline consumption amounts of the transportation system in a certain region, the gasoline consumption data of the previous period in the same region were included in the model (Waheed Bhutto, et al., 2017).

When the studies conducted using the ARIMA method on the maritime sector are examined, it is observed that in the study aiming at effective maritime accident estimation, variables such as "*number of maritime accidents, capsizing, collision, contact, fire/explosion, hull failure, stranding/grounding, adverse weather conditions*" (Wang et al., 2023) were added to the model, while in a study conducted to measure the impact of the economic crisis on maritime trade, variables such as "*number of passenger ships, number of passengers, number of passengers embarked in Greek ships, number of passengers embarked and disembarked, GDP, unemployment rate, employment, oil price, active population*" (Aivazidou and Politis, 2017) were included. In addition, it is possible to come across univariate models in the form of time series for a specific purpose in the literature; examples include the study where recorded data of cargo/container throughput is used to estimate cargo volume at ports (Shu, et al., 2014; Bal and Çalışır, 2018), where the container handling volume of a given country is used to estimate container volume in that country within a certain time period, or where weekly data from China Containerized Freight Index (CCFI) and Shanghai Containerized Freight Index (SCFI) are used to estimate container freight rates on a given route (Munim and Schramm, 2017), or Baltic Dry Index (Şahan et al., 2018).

A review of the literature reveals that most studies on the demand side of maritime transportation tend to focus on specific aspects such as container volumes, freight rates, passenger numbers, and ship counts. However, forecasting total cargo volumes in the context of global cargo traffic offers critical insights into the future of freight rates by accounting for supply-demand dynamics. Moreover, since container shipping involves final products, the demand for cargoes like dry bulk, energy, and general goods significantly influences container demand. In this regard, forecasting all cargo types globally, using the United Nations Conference on Trade and Development (UNCTAD) classification, provides a more comprehensive analysis of market trends. The originality of our study lies in this holistic approach to global cargo forecast, which enhances the understanding of interconnected markets. Our findings are highly beneficial for transportation companies, enabling them to optimize fleet management, plan port infrastructure and new ship orders, and mitigate financial risks by forecasting future cargo demand. These forecasts also benefit related sectors such as shipbuilding, demolition, ports, fuel suppliers, and insurance, all of which rely on maritime transport for strategic planning. For policymakers, demand forecasts assist in infrastructure investment planning, provide insights into economic trends, and help manage transportation costs, ensuring sustainable commercial activity and economic policy development.

3. Data and Methodology

We collected data on seaborne shipments of dry cargo, crude oil, and other tanker cargoes, published by UNCTAD (2024), measured in millions of metric tons. The dataset covers the period from 1970 to 2021, consisting of 52 annual observations. It represents cargo traffic through global seaports, excluding cabotage and transshipment cargoes. Dry cargo refers to cargo such as dry bulks (e.g., coal, ores, grains), pallets, bags, crates, and containers. 'Other tanker' refers to tanker trade excluding crude oil and includes refined petroleum products, gas, and chemicals.

When examining the annual averages, Dry Cargo emerges as the most transported category, with an average of 3.7 billion metric tons per year. The highest volume recorded was 8 billion metric tons in 2021. Crude Oil Cargo ranks second, averaging 1.5 billion metric tons annually, followed by Other Tanker Cargo, which averages 6.4 million metric tons.

An analysis of the descriptive statistics for annual average growth rates reveals that Dry Cargo experienced the highest growth rate, averaging 4.7% per year. This is followed by Other Tanker Cargo at 3.3%, and Crude Oil Cargo at 0.6%. In terms of maximum annual growth rates, Other Tanker Cargo saw the largest increase, surging by 48.2% between 2005 and 2006. Dry Cargo recorded a 24.4% growth between 1997 and 1998, while Crude Oil Cargo experienced a 13.6% growth from 1972 to 1973. The sharp increase in Other Tanker Cargo between 2005 and 2006 is thought to be due to the hurricanes that devastated the Gulf of Mexico and the southern states of the United States in late 2004. Due to

the destruction of a significant portion of U.S. refinery capacity and oil and gas production at the end of the Atlantic hurricane season, especially after the second half of 2005, the demand for both gasoline and other tanker cargoes was high and their inventories were quite low, which rapidly increased the demand for refined petroleum product imports during the period in question (Danish Ship Finance, 2006). When the Dry Cargo increase between 1997 and 1998 is examined, it is observed that the increase in economic growth in Western Europe and the USA in 1997 increased the world dry cargo demand, and that the world dry cargo demand entered a decreasing trend due to the emergence of the Asian financial crisis in early 1998 (UNCTAD, 1998). When the increase in Crude Oil Cargo observed between 1972-1973 is examined, it is observed that the US made changes in its oil import policies as a result of the increase in demand for oil in Western Europe, Japan and especially the USA, which switched to an accelerated economic growth program in the given period (UNCTAD, 1973).

The periods with the greatest shrinkage were observed for Dry Cargo, with a 5.8% decline from 2008 to 2009, for Crude Oil, with a 15.9% drop from 1981 to 1982, and for Other Tanker Cargo, with a 17.9% decrease from 1974 to 1975. The contraction in Dry Cargo can be interpreted as a natural consequence of the global financial crisis of 2008, which affected global demand. This financial crisis caused the sector to remain stagnant for a long time, even. In particular, the Baltic Dry Index (BDI), representing the dry bulk shipping sector, fell by approximately 94% in just two quarters and fell to 663 points on December 5, 2008 (Park et al., 2023). So, the contraction in Dry Cargo can be interpreted as a natural consequence of the financial crisis, which affected global demand. When it comes to the Crude Oil, although energy saving practices, discovery of alternative energy substitutes, production opportunities closer to consumer countries and the current world recession are among the reasons for the decline, it is assumed that a few pipelines that started operating in 1981-1982 also affected the decline (UNCTAD, 1982). When we examine the decline in the Other Tanker Cargo category, it is seen that the cheap oil concept, which was believed to have an infinite supply and always low price until 1973, the very low production costs in the Middle East, new oil production especially in the British and Norwegian sectors in the North Sea, and the belief in an infinite supply increased. However, in the fall of 1973, this understanding suddenly ended with the Yom Kippur War between Israel and the Arab world, and Arab oil producers realized that they had a powerful weapon in their hands. During the 1973 Arab-Israeli War, the Arab members of the Organization of the Petroleum Exporting Countries (OPEC) imposed an embargo on the US in retaliation for the US's decision to aid the Israeli army, and this significantly affected the world oil supply (Tenold, 2019). Therefore, it is evaluated that the decline in question refers to the 1975 Oil Crisis, which also has an important place in history.

An examination of the skewness values reveals that Dry and Other Tanker cargoes have positive skewness, while Crude Oil cargo has negative skewness. This indicates that for Crude cargo, extreme negative growth values have a greater impact than positive ones, leading to sudden declines during the period analyzed. Conversely, for Dry and Other Tanker cargoes, extreme positive growth values occur more frequently than negative ones, reflecting the tendency for these categories to experience sharp increases.

Table 1. Descriptive Statistics of the Variables

	DRY	CRUDE	O. TANKER	DLOG DRY	DLOG CRUDE	DLOG O. TANKER
Mean	3680.231	1539.000	636.7692	0.037860	0.006715	0.032970
Median	2616.000	1594.500	509.0000	0.038837	0.019231	0.027196
Maximum	8033.000	1881.000	1320.000	0.243855	0.136366	0.482098
Minimum	1162.000	1049.000	233.0000	-0.057974	-0.159419	-0.179341
Std. Dev.	2216.703	246.9175	338.4659	0.046421	0.058116	0.090387
Skewness	0.667280	-0.522720	0.815491	1.483570	-0.539942	2.690964
Kurtosis	2.025287	2.074033	2.154921	9.526269	3.839383	15.29807
Jarque-Bera	5.917420	4.225778	7.310898	109.2167	3.975268	382.9411
Probability	0.051886	0.120888	0.025850	0.000000	0.137019	0.000000
Observations	52	52	52	51	51	51

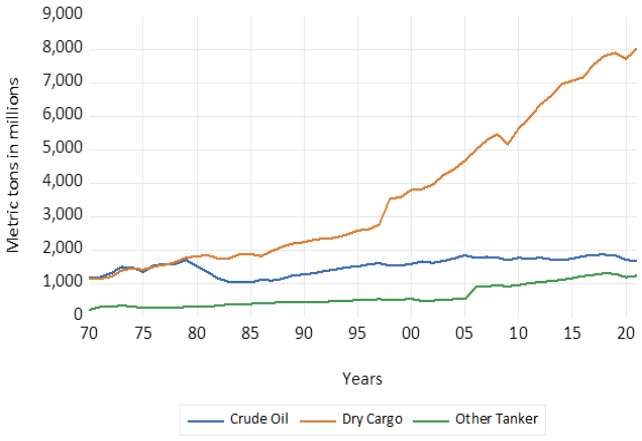
Source: UNCTAD (2024)

Figure 1 presents the trends of the variables considered in the study between 1970 and 2021. The observed patterns align with the insights derived from the descriptive statistics. In the 1970s, Crude Oil and Dry Cargo volumes were transported in nearly equal amounts. However, by 2021, a significant divergence is evident, with Dry Cargo being transported approximately 4.72 times more than Crude Oil. Additionally, the gap between Crude Oil and Other Tanker cargoes has narrowed over time. In 1970, Crude Oil was transported 5.18 times more than Other Tanker cargoes, but by 2021, this ratio had reduced to 1.35 times. These observations highlight the declining importance of Crude Oil in global transportation, reflecting its shrinking share in overall cargo volumes over time.

As observed, while total demand for maritime transportation has increased over time, the demand for different cargo types varies significantly. In this context, making accurate forecasts by cargo type is crucial for industry stakeholders,

policymakers, and investors. To address this need, we have decided to use the Autoregressive Integrated Moving Average (ARIMA) methodology to estimate the future volumes of Dry, Crude Oil, and Other Tanker cargoes through 2030. The method is usually associated with Box and Jenkins (1976).

Figure 1. Raw Data



Source: UNCTAD (2024)

The Box-Jenkins method allows the dependent variable Y_t to be explained by its past or lagged values, and by the current and lagged values of the error term u_t. In the ARIMA model, which follows the Box-Jenkins methodology, it is assumed that the series is stationary. If the series is not stationary, it can be made stationary by differencing it. When a series is already stationary, the ARIMA (p, d, q) model reduces to an ARMA (p, q) model (Aljandali and Tatahi, 2018: 111). The simple ARMA (p, q) model can be represented by the following equation:

$$Y_t = \beta_0 + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \cdots + \beta_p Y_{t-p} + C_1 u_{t-1} + C_2 u_{t-2} + \cdots + C_q u_{t-q} + u_t$$

where:

- Y_t is the dependent variable at time t
- β_i are the autoregressive (AR) parameters
- C_i are the moving average (MA) parameters
- v_t is the error term at time t

We used the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) (Kwiatkowski et al., 1992) stationarity test to determine the d value by assessing whether the variables are stationary. The null hypothesis of the KPSS test assumes that the series is stationary, and for stationarity to be confirmed, the null hypothesis must be accepted. The KPSS test stands out as a more robust option compared to other unit root tests, particularly when a deterministic trend is present in the series. ARIMA models are typically applied to stationary series without a trend (Shmueli and Polak, 2024: 157). However, given that our data is observed annually, and our goal is to make forecasts, we have chosen not to separate the trend from trend stationary series.

4. Results

In the results section, we first present the identification of the ARIMA (p, d, q) model, followed by the forecasting process using the selected model. The analyses were conducted using EViews econometric software.

4.1. Determination of the ARIMA Models

In the ARIMA methodology, the value of d is determined by testing the stationarity of the variables. To assess this, the KPSS stationarity test was applied to all variables, and the results are presented in Table 2. The findings indicate that the null hypothesis of stationarity is accepted at the level for all three variables at 10% significance level, meaning the d value is 0. The Dry Cargo and Other Tanker cargo series are trend stationary, indicating that these series fluctuate around a deterministic trend. In contrast, the Crude Oil series is both intercept and trend stationary, suggesting that it tends to revert to the mean over time. The stationarity of Crude Oil series at the level indicates that it tends to revert to the mean, fluctuating around a certain average in a statistical sense. In contrast, Dry Cargo and Other Tanker Cargo series exhibit trend stationarity, moving around a certain trend, which, as seen in the graphs, follows an upward trajectory. The stationarity of all variables suggests that the effects of shocks are temporary, and in the long run, they revert to their respective tendencies.

Table 2. KPSS Stationarity Test Results

	Level		First Difference		
	Intercept	**Intercept & Trend**	**Intercept**	**Intercept & Trend**	**Conclusion**
Dry Cargo	0.966	***0.155	*0.095	*0.097	I (0)
Crude Oil	***0.615	*0.096	*0.071	*0.067	I (0)
Other Tanker	0.922	**0.143	*0.048	*0.051	I (0)

Note: CVs are 0.739 for ***1%, 0.463 for **5%, 0.347 for *10% at Intercept, 0.216 for ***1%, 0.146 for **5%, and 0.119 for *10% at Trend and Intercept. Barlett kernel spectral estimation method is used. Bandwidth is selected automatically by using Newey-West.

After determining the d value in the model, the automatic ARIMA forecasting function in EViews software was used to identify the AR and MA values, with the maximum set at AR = 12 and MA = 12. The software was also permitted to apply logarithmic transformations to the variables when necessary. The AR and MA values that minimized the

Akaike Information Criterion (AIC), with a preference for logarithmic transformations, are presented in Table 3. As a result, the ARIMA (2, 0, 1) model for Dry Cargo, ARIMA (1, 0, 3) for Crude Oil, and ARIMA (2, 0, 1) for Other Tanker were identified as the optimal models. Since all series are stationary, their degrees of integration are set to 0. The identified models were then estimated using the Least Squares method.

Table 3. ARIMA Model Specifications

	Dry Cargo	Crude Oil	Other Tanker
AR	2	1	2
MA	1	3	1
Integration	0	0	0
AIC Value	-2.9575	2.8628	-1.6737

4.2. Forecast Results

Since the objective of this research is focused on forecasting rather than interpreting the model's coefficients, the individual significance of the AR and MA variables has been disregarded. Instead, insignificant variables suggested by EViews, which enhance the model's goodness of fit and prediction accuracy, have been retained. To ensure model validity, several checks were performed: the F-test to assess the overall significance of the model, confirmation that the AR and MA roots are inverted, and verification that no autocorrelation is present.

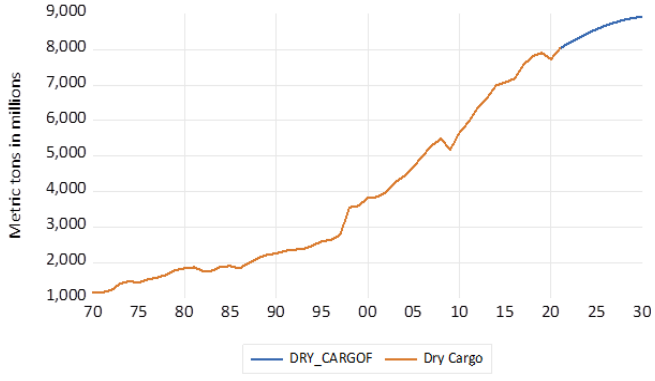
The results of the ARIMA (2, 0, 1) model estimated for Dry Cargo are presented in Table 4. The F-test confirms that the model is significant overall, the AR and MA roots are inverted, and the Ljung-Box test, applied with 7 lags, indicates no presence of autocorrelation.

Table 4. Estimation of the Dry Cargo Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8.005059	0.322602	24.81405	0.0000
AR(1)	1.996610	0.024575	81.24635	0.0000
AR(2)	-0.998285	0.022666	-44.04259	0.0000
MA(1)	-1.000000	2949.851	-0.000339	0.9997
SIGMASQ	0.002113	0.143490	0.014728	0.9883
R-squared	0.994203		**Mean dependent var**	8.030523
Adjusted R-squared	0.993710		**S.D. dependent var**	0.609670
S.E. of regression	0.048354		**Akaike info criterion**	-2.957555
Sum squared resid	0.109893		**Schwarz criterion**	-2.769936
Log likelihood	81.89644		**Hannan-Quinn criter.**	-2.885627
F-statistic	2015.126		**Durbin-Watson stat**	1.950244
Prob(F-statistic)	0.000000			
Inverted AR Roots	1.00+.04i		1.00-.04i	
Inverted MA Roots	1.00			

The results for Dry Cargo volume forecast from 2022 to 2030 are presented in Figure 3. Demand, which contracted slightly due to the pandemic in 2020, resumes the upward trend that began in 2021, reaching 8,927 million metric tons in 2030, up from 8,033 million metric tons, though with a decreasing growth rate. This situation indicates that demand will continue its upward trend, albeit at a slowing rate.

Figure 3. Forecast of Dry Cargo



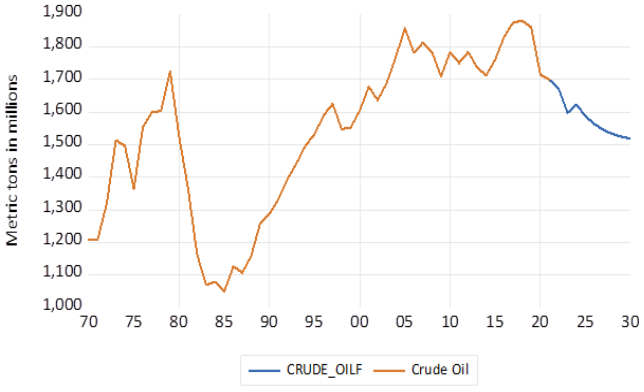
The results of the ARIMA (1, 0, 3) model estimated for Crude Oil cargo are presented in Table 4. The F-test confirms that the model is significant overall, and the AR and MA roots are inverted. The Ljung-Box test, applied with 7 lags, detects autocorrelation up to 2 lags at the 99% significance level, after which autocorrelation disappears. Additionally, the results of the autocorrelation test were disregarded because the residuals of the model passed the normality test, indicating a normal distribution.

Table 5. Estimation of the Oil Cargo Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.314860	0.065116	112.3361	0.0000
AR(1)	0.714926	0.119299	5.992711	0.0000
MA(1)	0.615054	351.4773	0.001750	0.9986
MA(2)	0.512758	236.6852	0.002166	0.9983
MA(3)	0.897694	946.4744	0.000948	0.9992
SIGMASQ	0.002285	0.388944	0.005876	0.9953
R-squared	0.920214	**Mean dependent var**		7.325172
Adjusted R-squared	0.911541	**S.D. dependent var**		0.170891
S.E. of regression	0.050826	**Akaike info criterion**		-2.862907
Sum squared resid	0.118833	**Schwarz criterion**		-2.637763
Log likelihood	80.43557	**Hannan-Quinn criter.**		-2.776592
F-statistic	106.1080	**Durbin-Watson stat**		1.916854
Prob(F-statistic)	0.000000			
Inverted AR Roots	.71			
Inverted MA Roots	.19-.93i	.19+.93i	-1.00	

The forecast results for Crude Oil Cargo for the period from 2022 to 2030 are presented in Figure 4. Transportation, which has not experienced an upward trend like other cargoes and has remained relatively stable in incoming cargo, is projected to continue the downward trend that began after 2018, reaching 1,518 million metric tons by 2030. The rate of decline, which initially started sharply, is expected to follow a slightly more gradual course, as significantly reducing the demand for oil is a process that can take decades and cannot be accomplished in a short period.

Figure 4. Forecast of Crude Oil Cargo



The results of the ARIMA (2, 0, 1) model estimated for Other Tanker Cargo are provided in Table 4. The F-test verifies that the model is statistically significant overall, the AR and MA roots are properly inverted, and the Ljung-Box test with 7 lags confirms that there is no evidence of autocorrelation.

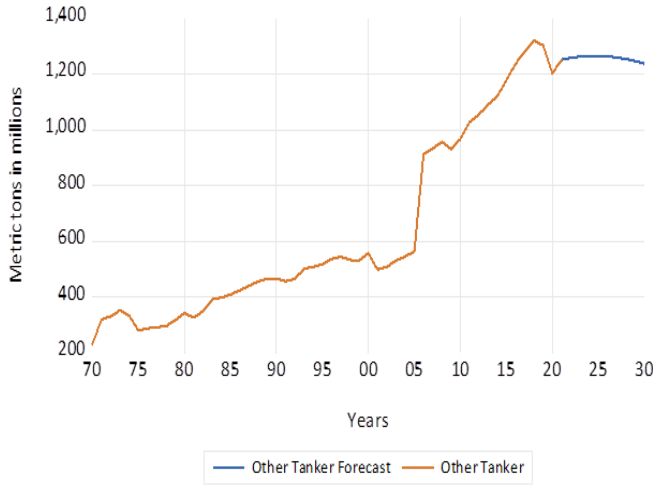
Table 6. Estimation of the Other Tanker Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.263814	0.543424	11.52658	0.0000
AR(1)	1.988725	0.066608	29.85720	0.0000
AR(2)	-0.990503	0.065095	-15.21622	0.0000
MA(1)	-0.999834	40.58679	-0.024634	0.9805
SIGMASQ	0.008117	0.369018	0.021996	0.9825
R-squared	0.967405	**Mean dependent var**		6.327725
Adjusted R-squared	0.964631	**S.D. dependent var**		0.503893
S.E. of regression	0.094765	**Akaike info criterion**		-1.673740
Sum squared resid	0.422082	**Schwarz criterion**		-1.486120
Log likelihood	48.51724	**Hannan-Quinn criter.**		-1.601811
F-statistic	348.7352	**Durbin-Watson stat**		2.054256
Prob(F-statistic)	0.000000			
Inverted AR Roots	.99+.04i	.99-.04i		
Inverted MA Roots	1.00			

The forecast result for Other Tanker Cargo from 2022 to 2030 is presented in Figure 5. It is estimated that this cargo will also begin a downward trend following a period of smooth growth. The transportation volume, which was

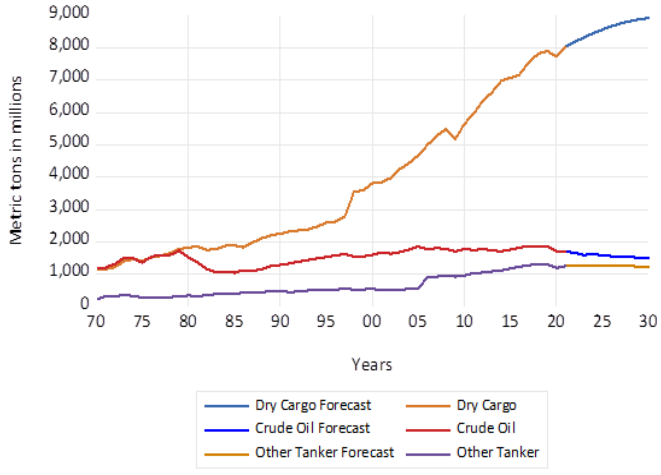
1,251 million metric tons in 2021, is projected to decrease to 1,237 million metric tons by the 2030s.

Figure 5. Forecast of Other Tanker Cargo



To provide a comprehensive view of the maritime market, the forecast graphs for all three cargo types have been combined and are presented in Figure 6. As shown, while Crude Oil and Other Tanker cargo types remain close to each other, the Dry Cargo type diverges, with the gap between them widening over time.

Figure 6. Forecast of All Three Cargo Types



After developing the models and generating the forecasts, the estimates for 2030 and their percentage changes compared to 2021 are presented in Table 4. The results indicate that Dry Cargo is projected to grow by 11.1%, reaching 8.9 billion metric tons. In contrast, Crude Oil Cargo is expected to decline by 10.7%, reaching 1.5 billion metric tons, while Other Tanker Cargo is forecasted to decrease by 1.2%, reaching 1.2 billion metric tons. This indicates that for Dry Cargo, the demand will rise to the point where a 1 additional ship will be required for every existing 10 ships in operation. In contrast, for Crude Oil, there will be no need for 1 out of every 10 current ships, reflecting a significant decline in demand. Meanwhile, the demand for Other Tankers is expected to remain relatively stable, showing only a slight decrease. This is because Other Tanker Cargoes consist largely of processed petroleum products, meaning that a decrease in demand for crude oil will naturally lead to a decline in such cargoes. However, the increasing demand for LNG, biofuels, and other types of tanker fuels helps offset the severity of the negative impact from the reduction in oil demand. Thus, Other Tanker Cargoes follow a relatively more stable course.

Table 4. Estimated Changes of Demands in 2030

	2021 (Current)	2030 (Estimation)	% (Change)
Dry Cargo	8.033	8.927	11.1%
Crude Cargo	1.700	1.518	-10.7%
Other Tanker Cargo	1.252	1.238	-1.2%

5. Conclusion

Our findings include important policy recommendations for various industry stakeholders. For shipowners, since the demand for Dry Cargo is expected to increase by approximately 11.1% by 2030, shipowners in this sector should invest in expanding their fleets and upgrading their existing vessels. A competitive advantage can be achieved through economies of scale by opting for larger ships. On the other hand, with the anticipated 10.7% decrease in Crude Oil Cargo demand, shipowners in this sector should diversify their fleets to carry other types of cargo. For instance, given the expected growth in Dry Cargo demand, they could transition into that sector or invest in more flexible ship types to accommodate a wider range of cargoes. In addition, since the decline in demand for oil is largely driven by environmental regulations aimed at reducing environmental damage, shipowners across all cargo groups should transition to environmentally friendly, clean energy fuel types. In 2021, the European Commission (EC) launched its 'Fit for 55' legislation package, aiming to decrease the European Union's (EU) greenhouse gas (GHG) emissions by 55% by 2030. The European Commission recommends the inclusion of shipping in the European Emission Trading System (EU ETS). Notwithstanding advancements in recent years, the marine industry remains mostly dependent on fossil fuels, representing a substantial source of greenhouse gas emissions and other detrimental pollutants. The objective of the FuelEU maritime effort is to diminish the greenhouse gas intensity of energy used on ships by up to 80% by 2050. The revised regulations encourage the use of renewable and low-carbon fuels in maritime transport (European Council, 2024). Since January 2024, EU ETS has been expanded to include CO2 emissions from any big ships (with a gross tonnage of 5,000 or more) that visit EU ports, irrespective of the flag which they fly (European Commission, 2024). As regulations tighten, the pressure on shipowners still using fossil fuels will increase,

making it essential to adopt cleaner alternatives to remain compliant and competitive.

In addition to all these results, another important element that should not be ignored is that when the results obtained in the study and presented in Fig. 3, 4 and 5 are examined, there have been periodic fluctuations in demand amounts for all cargo types throughout history. When the reasons for these fluctuations are examined retrospectively, various reasons such as natural disasters (hurricanes), global financial crises, policy changes of the world's major powers, the discovery of alternative energy sources and wars emerge. It will always be possible for such difficult-to-predict risks, also called geopolitical risks in literature, to affect the estimated cargo demands on a local or global scale in the future as they did in the past. When monitoring the crude oil transportation process, the effect of the Iranian Revolution in 1979 is clearly evident. During this period, oil prices surged from $11 to $40, leading to a significant decrease in demand for oil. As a result, maritime crude oil transportation declined, and many tanker ships were laid up (Stopford, 2009:129).

For cargo owners, changes in demand affect future available capacity, making it essential to develop proactive policies. Dry Cargo owners can secure transportation capacity by entering into long-term contracts to avoid potential capacity shortages due to the anticipated increase in demand. Crude Oil cargo owners, on the other hand, should optimize their logistics and storage facilities to minimize costs during potential future downturns, thus avoiding the financial risks associated with excess or underutilized infrastructure.

For shipyards, the differentiation of demand for ship types is crucial in the policy development stages. As environmental regulations become increasingly stricter, shipyards should prioritize green shipbuilding and specialize in the production of alternative fuel-powered and energy-efficient ships. Additionally, with both expansion and replacement demand expected to be high due to the growing demand for Dry Cargo, shipyards should adjust their capacities to accommodate this type of vessel. Furthermore, they can explore expanding ship conversion options, enabling excess tankers to be repurposed for use in different sectors.

In addition, changes in demand have significant implications for economies that are heavily reliant on a particular type of cargo. Countries whose economies depend heavily on oil exports should invest in diversifying their export portfolios, as they are likely to be negatively impacted by declining oil demand and prices. To ensure a smooth economic transition, these countries should focus on increasing the share of other goods and services in their economies. Additionally, they could prioritize exporting higher value-added petroleum products by investing in refining capacity, rather than relying solely on crude oil exports. Similarly, countries whose economies rely on Dry Bulk products can mitigate the risk of being unable to meet future demand by increasing investments in infrastructure and equipment. These investments will enable them to handle the expected rise in demand more efficiently and ensure that they can capitalize on the growing market opportunities.

In our study, we utilized univariate ARIMA models to estimate the transportation rates of three different cargo types until 2030, based on the classification provided by UNCTAD. Our primary limitation lies in the fact that the heterogeneous diversity of cargo types is grouped into only three main classifications. This simplification stems from challenges related to limited data access, which restricted our ability to incorporate a more granular categorization of the various cargoes. As a result, some nuances in load diversity may not be fully captured in our analysis. For future research, estimates for sub-groups of cargo, such as dry bulk, container, LPG, and LNG, could provide more sector-specific insights. The ARIMA method we employed estimates future values by relying solely on past data from a single variable, which inherently disregards the potential influences of other factors that may affect the variable under estimation. This limitation highlights the importance of exploring alternative methods that account for the effects of multiple variables, providing a more comprehensive understanding of the relationships under investigation. Future studies would benefit from incorporating such multivariate approaches to offer deeper insights. Additionally, incorporating different methods that account for the effects of other variables, such as ship supply, oil prices, inflation, exchange rates, interest rates, commodity prices, and freight rates, could lead to more accurate and comprehensive forecasts.

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RESP

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Araştırma Makalesi ● Research Article

On The Interface Between AI and Energy Regulations in China

Çin'de Yapay Zekâ ve Enerji Düzenlemeleri Arasındaki İlişki Üzerine

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ANAHTAR KELİMELER

Yapay zekâ düzenlemeleri,
Enerji düzenlemeleri
Çin
Yenilenebilir enerji hedefleri

ÖZ

Çin, enerji mevzuatında yeni bir reforma gitmektedir. Önerilen yasa, mevcut kaynakların temiz, verimli, yoğun kullanımını teşvik ederek Çin'de enerji kullanımını optimize etmeyi amaçlıyor. Teklif, enerji tedarikçilerinin güvenilir ve istikrarlı hizmetler sunmaları, enerji nakil hatlarında operasyonel güvenlik önlemleri almaları, enerjiye erişimde eşitlik sağlamaları, enerji acil müdahale sistemi kurmaları için teşvikleri içermektedir. Çin'in yapay zekâ standartları da aynı süreçten geçmekte, düzenlemeler benzerlik göstermektedir. Geçtiğimiz yıllarda, Algoritma Tavsiye Hükümleri, Etik İnceleme Önlemleri, Derin Sentez Hükümleri, Üretken Yapay Zekâ Önlemleri gibi önemli yasal değişiklikler birçok kural ve düzenlemeyi etkilemiştir. Bu çalışma kapsamında enerji ve yapay zekâ kurallarının benzer yanları, uygulamada güvenlik ve istikrarı korumanın önemi ele alınmıştır. Ek olarak yapay zekânın enerji dağıtımını nasıl iyileştirebileceği ve yeşil enerji girişimlerini nasıl destekleyebileceği tartışılmıştır.

KEYWORDS

AI regulations
Energy regulations
China
Renewable energy targets

ABSTRACT

China is undergoing new reform of its energy regulations. The proposed law aims to optimize energy use in China, encouraging clean, efficient, intensive use of existing resources. The proposal includes incentives for reliability and stability in energy supply, operational safety in transmission lines, equity in access to energy, and emergency response system. China's energy and AI regulations are similar. In the past, significant legislative changes such Algorithm Recommendation Provisions, Ethical Review Measures, Deep Synthesis Provisions, Generative AI Measures etc. have affected many rules and regulations. The article discussed how energy and artificial intelligence rules are becoming more intertwined, how important it is to maintain security and stability, how AI can improve energy distribution and support green energy initiatives.

1. Introduction

The first primary and leading draft law in China's energy sector was unveiled. On April 26, the ninth meeting of the 14th National People's Congress Standing Committee closed in Beijing. The Chinese People's Congress website subsequently announced the "Energy Law of the People's Republic of China (Draft)" and solicited opinions from the public from April 26 to May 25. During the meeting, the new law was reviewed by the Standing Committee of the National People's Congress for the first time. In January 2024, the State Council Executive Meeting reviewed and approved the "Draft" and submitted it to the Standing Committee of the National People's Congress for review.

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The National People's Congress and its Standing Committee exercise the state's legislative power. The "Legislation Law" stipulates that the bills included in the agenda of the Standing Committee meeting shall generally be submitted for voting after being reviewed at three Standing Committee meetings. The first review of the bill will listen to the proposer's explanation at the plenary meeting, and the group meeting will conduct the preliminary review (Harkavy, 2024).

On April 23, commissioned by the State Council, Li Chunlin, deputy director of the National Development and Reform Commission, explained the draft Energy Law. He pointed out that China has formulated several separate energy laws and regulations, including the Electricity Law, the Coal Law, the Energy Conservation Law, the Renewable Energy Law, and the Urban Gas Management Regulations. However, the energy field still lacks a basic and leading law. It is crucial to ensure national energy security and a significant step toward strengthening legislation in essential areas to base the Energy Law on distinct energy laws and regulations.

The Standing Committee of the National People's Congress usually meets every two months, meaning the Energy Law is expected to be officially issued within the year. The second review of the bill by the Standing Committee of the National People's Congress will hear a report on the revision of the draft law and significant issues by the Constitution and Law Committee at the plenary meeting and further review by the group meeting.

According to the "Explanation on the Energy Law of the People's Republic of China (Draft)," China's current energy development is still facing many problems and challenges, such as rapid increase in consumption, continuous increase in supply guarantee pressure, incomplete adjustment of energy structure, need to improve the level of clean and efficient utilization, inadequate energy market system, weak reserve system construction, and shortcomings in scientific and technological innovation. It is urgent to improve the legal energy system further. The draft has nine chapters and 69 articles, which provide for enhancing the energy planning system, improving the energy development and utilization system, strengthening the construction of the energy market system, improving the energy reserve system and emergency system, strengthening energy science and technology innovation, and strengthening supervision and management (Zhang et al., 2024).

Article 20 of Chapter 3 clearly states that priority should be given to the development of renewable energy, the rational development and clean and efficient use of fossil energy, and the orderly promotion of non-fossil energy to replace fossil energy and low-carbon energy to replace high-carbon energy. The energy department of the State Council will work with relevant departments to formulate medium- and long-term development goals for the development and utilization of non-fossil energy (McInerney, 2022).

In addition, the draft stipulates the basic policy orientation for the development and utilization of renewable energy, hydropower, nuclear power, coal, oil, and natural gas. It mentions that the energy department of the State Council will work with relevant departments to formulate and decompose the implementation of the minimum proportion of renewable energy in energy consumption. In the field of coal, the draft requires the state to optimize the layout of coal development and industrial structure, encourage the development of a circular economy in coal mining areas, optimize the coal consumption structure, promote the clean and efficient use of coal, and give play to the basic guarantee and system regulation role of coal in the energy supply system. In addition, it promotes the clean and efficient development of coal-fired power generation, reasonably lays coal-fired power generation construction according to the needs of stable operation of the power system and power supply guarantee, and improves the regulation capacity of coal-fired power generation (van der Vlist et al., 2024). The construction of the energy market system is also the focus of the draft, which is listed separately as the content of Chapter 4. Article 32 of the draft clearly states that the state encourages and guides various economic entities of ownership to invest in energy development and utilization, energy infrastructure construction, etc., in accordance with the law to promote the development of the energy market. The draft also stipulates that it will encourage the separation of natural monopoly businesses and competitive businesses in the energy sector, strengthen the supervision and regulation of natural monopoly businesses in the energy sector in accordance with the law, and support various entities to participate in competitive businesses in the energy sector somewhat following market rules. In addition, it will coordinate and promote the construction of a unified national coal, electricity, oil, natural gas, and other energy trading markets; require energy transmission pipeline facilities to be open to qualified entities in a fair and non-discriminatory manner; encourage upstream and downstream enterprises in the energy sector to develop in a coordinated manner and promote the coordinated advancement of the entire industrial chain; promote the establishment of an energy price formation mechanism mainly determined by market factors, and improve the energy price regulation system.

2. New Chinese Energy Regulations

After nearly 20 years, the draft Energy Law has stepped out of the State Council for the first time this year and entered the agenda of the Standing Committee of the National People's Congress. As early as 2005, the former Office of the National Energy Leading Group established the Energy Law Drafting Group, composed of 15 ministries and agencies, and began to draft the first draft of the Energy Law and first publicly solicited opinions in December 2007. Since then, the Energy Law has been in the process of revision, submission for review, inclusion in the legislative plan, and continued revision. In 2017, the National

Development and Reform Commission and the Energy Bureau organized an expert group and a working group to revise further and improve the revised draft of the Energy Law of the People's Republic of China (Draft for Review), forming a new Energy Law of the People's Republic of China (Draft for Comments), and again solicited public opinions in April 2020. From 2021 to 2023, the State Council has arranged in its annual work plan that the draft Energy Law will be submitted to the Standing Committee of the National People's Congress for deliberation. In January this year, the State Council's executive meeting reviewed and passed it and decided to submit it to the Standing Committee of the National People's Congress for deliberation. Li Jingyun of the Yinhu New Energy Strategic Research Center of the China (Shenzhen) Comprehensive Development Research Institute once wrote that energy issues involve the entire process from development and supply to utilization of many varieties, involving the interests of the government, industry, enterprises, and the public. At different stages of development, the volume, role, and status of various types of energy are also significantly different. Balancing the relationship between various energy varieties and market entities in different periods is one of the difficulties in formulating the energy law.

The Chinese legislature's National People's Congress (NPC) Standing Committee started examining two new proposals for legislation that would modernize the nation's energy industry and strengthen its nuclear power capabilities. While appreciating the nation's accomplishments in energy development, Li Chunlin, deputy head of the National Development and Reform Commission, also highlights ongoing obstacles. The proposed energy law prioritizes the promotion of non-fossil and low-carbon energy sources. A new legal framework was deemed necessary due to several factors, including low level, a weak reserve system, insufficient technical innovation, and inadequate structural adjustment. Creating the legislation is crucial to advancing superior energy development and guaranteeing the security of the country's energy supply.

The proposed law lays out a plan for streamlining China's energy mix and promoting the clean, efficient, and intensive use of the country's current energy resources while prioritizing the development of renewable energy sources like wind and solar power. Customers' need for solid energy services is prioritized, and energy providers must provide safe, consistent, and dependable services. Improved operational safety requirements for energy transmission pipeline systems are also recommended in the draft. In light of the differences in access to energy, the law promotes the construction of energy infrastructure in rural areas. It emphasizes the necessity of developing and fortifying an energy emergency response system to avert future emergencies. The draft places significant emphasis on technological innovation. Its suggestions promote research, development, and the broad use of state-of-the-art machinery and technology in essential energy areas. The NPC Standing Committee began reviewing a separate draft law, the first in China's history devoted to nuclear energy, on the same day that marked a turning point for the nation's nuclear power industry. The new law aims to streamline the ten or more current but disjointed rules and regulations governing nuclear concerns, according to Zhang Kejian, head of the China Atomic Energy Authority, who clarified the necessity of a comprehensive legal framework.

From a global standpoint, nuclear powers and nations involved in the peaceful development of atomic energy typically employ legal rules to control and encourage the exploration, creation, and application of atomic energy activities. The 53-article draft nuclear energy law seeks to balance safeguarding public safety and environmental and ecological preservation. It also calls for intense scientific research and technological advancement in the nuclear energy sector, promotes cutting-edge technologies, and supports talent development. The draft allows for the peaceful use of atomic energy for industrial and agricultural purposes, but it also places tight restrictions on nuclear reactors and related technology. According to state-run Chinese media, safety is still the top priority, and the draft forbids delaying, hiding, or misleadingly disclosing nuclear incidents.

Even if it is challenging to get unbiased reports from China, its officials seem committed to modernizing the energy sector. This is significant for the entire world, not just China. Data from Selectra, a climate consultancy, shows that in 2022, China, the world's biggest polluter, released 9.9 billion tonnes of carbon dioxide into the atmosphere, more than twice as much as the United States (4,4 billion tonnes). China accounted for just under a third of the world's 32 billion tonnes of carbon dioxide emissions. Although the raw data presents a problematic image, the per capita emissions estimates are pretty encouraging.

3. Methodology

A comparative legal research technique is used to determine the influence of AI legislation on energy regulations in China. The difficulty with comparative legal research is that there is often no agreement on the methodology type to use or even on which approaches could be used. Despite these problems, comparative legal research stems from comparative research methods, which involve examining more than two or more macro-level units to explain the variations and similarities between the units of analysis. The term 'comparative' indicates that a researcher wishes to compare one subject to another (Van Hoecke, 2013).

Some authors suggest that some degree of similarity, known as 'comparability' or 'construct equivalence', should exist at the heart of comparative research methodologies. Another claim is that a critical challenge in finishing comparative empirical research is ensuring equivalence, or the ability to obtain reliable, comparable data across diverse settings while avoiding biases in measurement, tools, and samples. However, in real-world circumstances, 'comparability' may not indicate similarities. Explaining equivalency is also

hampered by the simple fact that the meaning of any notion is contextual. There has been criticism that the concept of comparability, which requires that the entities being compared be comparable, is not realistic (Hill, 1989).

After one has understood what comparative legal research is, you must justify why you chose it. There has been the argument that the researcher in comparative law, as she progresses through the various stages of the comparative analysis, must establish her research parameters within the theoretical framework provided in the comparative law literature and justify the direction she chooses to take in terms of methodology. In sum, the researcher must acquire the art of justifying her decisions regarding why and how she applies comparative law.

In order to address the question of why comparative law is applied, it is essential to grasp the goals and theoretical basis of comparative research methodologies that strive to draw implications beyond individual cases. The primary objective of comparative analysis is to look for similarities and differences. Looking overseas at other legal systems has been hoped to benefit the observer's national legal system by making suggestions for future developments, warning of potential difficulties, and providing an opportunity to step back from one's national system and examine it more critically but not by removing it from first place on the agenda. The objective of the article is to compare the developing energy regulations in China and the new draft and the established AI regulatory framework in the country. Given the growing interconnectedness between AI and energy, it has been a cornerstone of development (Wilson, 2007).

4. Chinese Energy Regulations

China has embraced the civil law system, which emphasizes systematic legislation. In addition to the core energy law, Chinese scholars claim that the legislative system about energy consists of six subsystems. Coal, oil and gas, electricity, nuclear power, renewable energy, and energy conservation are the main topics of these subsystems. Laws about nuclear power, oil, natural gas, and basic energy still need to be made in China. The following are the four main legislative subsystems for energy at the moment. In December 1995, the 1995 Electricity Law came into effect. As China's first energy law, this one is a benchmark for the nation's energy laws. However, many of its provisions need to be updated and require immediate amendment because they were passed during China's economic transition phase when the government still directly governed the power industry (Zhao et al., 2011).

August 1996 saw the initial release of the 1996 Coal Law, which was later revised in April 2011. It controls the mining, extraction, and use of coal and the management and operations of the coal industry. As a result, it is crucial to the advancement and security of the coal sector. Nevertheless, there are still several serious issues with the 2011 Coal Law, namely, about the disjointed regulatory framework and the inconsistent enforcement authority of various agencies. For instance, six government agencies issue nine permits and one license necessary for coal mining operations. These are the Ministry of Land and Resources, the Administration of Work Safety, the Administration of Industry and Commerce, the State-Owned Assets Supervision and Administration Commission (SASAC), the Ministry of Environmental Protection, and the National Development and Reform Commission (NDRC). These organizations occasionally have divergent needs and even competing agendas. Therefore, conflicting authorities or the absence of a single regulator with ultimate decision-making authority compromises the efficacy of regulation. November 1997 saw the initial release of the 1997 Energy Conservation Law, which was later revised in October 2007. This all-encompassing energy rule aims to encourage energy conservation throughout societal domains. It contributes significantly to raising the economic advantages and efficiency of energy use. The amendment makes clear the relevant government power and attempts to improve the lack of enforcement. According to Article 10, the local people's government at or above the county level's energy conservation administrative department oversees and manages energy conservation initiatives within its administrative boundaries (Yang et al., 2019).

Within the parameters of their respective duties, the departments under the local people's government at or above the county level shall oversee and administer energy conservation. They shall also accept direction from the energy conservation administrative department at the same level. Additionally, the revised law has a strong emphasis on market mechanisms. It includes a chapter on incentive mechanisms that explains the nation's policies regarding energy conservation through government procurement, financing, taxation, pricing, and credit control. Lastly, the 2007 Energy Conservation Law is more enforceable because it outlines the consequences of noncompliance.

First released in February 2005, the 2005 Renewable Energy Promotion Law was revised in 2009. It is China's first renewable energy law, concentrating on the growth and application of renewable energy to enhance the nation's energy structure, guarantee a steady supply of energy, and avoid pollution and environmental harm resulting from the sharp rise in the use of fossil fuels. Its five main management procedures are total amount control, required grid connection, classified electricity pricing, cost allocation, and special funds. The government's development ambitions are outlined in the total amount control provision, which gives the market a clear signal and encourages the exploration and use of renewable energy sources.

The mandatory grid connection rule requires all power grid firms to purchase all the renewable energy accessible to them. It removes obstacles to entry into the market and lowers transaction costs for renewable energy. Different forms of renewable energy can establish their rates based on their average social costs according to the categorized

electricity pricing system. In order to prevent energy producers from bearing the entire cost of producing renewable energy, cost allocation mandates that each area distribute the increased cost of producing renewable energy equitably (Clarke, 2019).

The special funds aim to solve the excess costs of producing renewable energy. They offer financial support, in the form of subsidies, to certain renewable energy projects whose costs cannot be evenly distributed among market participants. The announcement of the Coal, Electricity, Energy Conservation, and Renewable Energy Promotion Law shows how the law is becoming increasingly essential in China's energy regulation. The establishment of energy laws is a significant advancement considering the nation's history of policy superseding legislation pertaining to energy regulation. There are still four areas of the national system that may use major improvement, though, compared to the more established energy laws and regulations in developed nations (Wang and Chang, 2014).

The way laws are designed is influenced by our knowledge of them. Except the Renewable Energy Promotion Law, most of China's energy legislation was passed during the country's transition from a planned to a market economy at the end of the 20th century. Since the energy supply was the main hindrance to development during that time, finding a solution to the energy shortfall brought on by rapid economic development took precedence. It was once believed that energy supply security and energy security were equivalent. Because of this, lawmakers thought that economic regulations about energy should only address energy production in order to guarantee an adequate, dependable, and continuous supply of energy. Stated differently, the ultimate objective of energy policy was to promote economic growth.

The notion that energy legislation should solely concentrate on energy production originated from the false belief that energy security equates to energy supply security. Therefore, in China, it was rare to challenge the idea that regulations pertaining to energy were also laws governing the economy. However, America has faced significant challenges regarding this understanding of energy security, and it is now thought that energy law needs to evaluate considerations other than economic rules. According to Richard J. Pierce Jr. and Ernest Gellhorn, social and economic regulations are becoming more intertwined. Energy institutions have been attempting to incorporate environmental costs into their legislation as environmental concerns become more prevalent in society (Yang et al., 2019).

According to Sidney A. Shapiro and Joseph P. Tomain, traditional energy regulations prioritizing economic control over environmental consideration will eventually end. To sum up, legislation pertaining to energy extends beyond economic regulating laws and encompasses environmental preservation. Therefore, environmental factors should be considered in energy regulatory legislation to meet the social regulatory purposes of energy laws.

Despite the above four energy-specific regulations, China's current regulatory framework must be revised and uniform. People are, therefore, quite optimistic about the impending Energy Law. On the regulatory framework for energy regulation, the draft of the Energy Law that was made available for feedback still needs to be clarified. Furthermore, the Ministry of Energy and the Energy Regulation Commission—which would have had unified jurisdiction to regulate energy-related issues—were established under the most recent administrative reform implemented by the State Council in March 2008. The lack of separation between political and regulatory authority, the overlap in the regulatory authority for electricity regulation, and the absence of regulatory authority for natural gas regulation are among the critical problems facing the nation's energy regulatory system (Xu, 2021).

These flaws should be fixed in upcoming energy regulatory legislation as they have significantly hampered effective regulation. The state still has some control over the energy industry in China due to the country's planned economic framework. The energy administrative management department typically has three major functions to control the nationalized energy industry. First and foremost, it is responsible for generating revenue for the state as the property's owner. Secondly, it is in charge of creating the macro energy policy because it is a department of macro-management. Thirdly, it oversees market regulation in its capacity as a micromanagement department. In contrast, governments in industrialized nations such as the United States and England typically emphasize the division of powers between macro-level policymaking and micro-level market regulation (Xu, 2021).

Though Chinese and American institutions are referred to as "regulatory commissions," the Chinese institution lacks the requisite independence in decision-making and execution due to the lack of a clear division between political and regulatory authority; numerous policymaking bodies are also in charge of regulating the market. One illustration is that the NDRC, China's primary policy-designing organization, continues to have control over the authority to set prices. The primary issue resulting from the political and regulatory branches' need for separation is that market regulation is frequently disrupted for political purposes, weakening the goals of energy regulation and sometimes even lowering market efficiency to achieve political concessions. For example, the NDRC is in charge of China's macroeconomic policies, but it also manages the energy sector's price controls and market entry. It has the authority to regulate energy prices, including price control and price intervention. Energy prices are purposely distorted and depressed to manage inflation, preserve internal social stability, and increase the price competitiveness of Chinese exporting goods. The inability to remedy the issues of waste and overconsumption of energy results from energy prices being below their worth. The lack of distinction between

political and regulatory authority also brought about the issue of regulatory authorities in one sector overlapping. Separating the two authorities aims to minimize authority overlap and specialize the responsibilities of formulating policy and carrying it out. The NDRC, the Ministry of Finance (MOF), certain provincial Economic and Trade Commissions, the SASAC, and other macro policymaking departments still retain control over many industrial regulatory authorities, meaning that the SERC lacks full regulatory authority in the field of electricity regulation because of the incomplete separation of these two authorities. As the creator of macroeconomic policies, the NDRC is responsible for designing energy policies, which include demand estimation and long-term strategic planning for the electrical sector. Meanwhile, it is responsible for a wide range of micro-regulations, including price-setting and market entrance, which are the two most significant markets. Additionally, the MOF sets the financial requirements, cost standards, and other matters pertaining to energy firms, while the SASAC is responsible for managing changes to top staff in state-owned electrical enterprises. Because of this, the SERC's authority over market regulation is limited to certain segments. In conclusion, the SERC, the body in charge of regulating electricity in China, lacks the essential authority to do so. This presents a significant issue (Schuman and Lin, 2012).

To put it another way, China's existing system of separating political and regulatory authority is insufficient since numerous agencies involved in policymaking continue to have the authority to carry out a number of market regulatory actions, which is far from "independent regulation." As the organization in charge of regulating the electrical sector, the SERC merely has symbolic authority because it cannot control market entry and pricing. As a result, the SERC is frequently perceived as an incompetent judge. Because of the tight linkages between the energy, oil, and natural gas industries, the regulatory bodies of many nations are also in charge of mixed regulation. For instance, in the United States, FERC concurrently oversees oil transfer through pipelines, the natural gas business, and the electricity industry (Gordley, 1995).

This is because the various sectors that make up the energy sector share characteristics. For example, the three industries mentioned above are all involved in the production and distribution of energy and have natural monopolies on the market. These industries typically have related regulatory processes and needs, such as pricing control and market entry. The regulatory gap can be avoided, redundant efforts can be avoided, regulatory expenses can be decreased, and regulation efficiency can be improved by having the same regulator for various businesses. China's energy regulations, however, differ depending on the industry. Due to the complicated industrial interests involved, a regulator has yet to be established to oversee the natural gas or oil industries. Instead, the electricity regulator is solely responsible for the electricity industry. Consequently, these businesses need to be sufficiently regulated by the state.

Because energy products are essential to people's daily lives and a cornerstone of national security, they are subject to strict controls from the state. Nonetheless, while reforms in other areas have advanced quickly, China's market reform for the energy sector has lagged. The transformation of the energy regulating laws from a planned economy to a market economy is ongoing. Because of this, many regulations are created with a planned economy in mind, which leads to excessive regulation of the energy sector relative to free market principles. Market entrance regulations mandate that specific activities within a company's relevant market practices be investigated beforehand to safeguard the public interest and determine whether the enterprise can fulfill the standards for energy services (Geng et al., 2016).

This is a crucial component of the system of economic regulation. On the one hand, the market develops upon the achievement of individual interests, private rights, and the aspirations of economic beings while also demanding independence and autonomy. Conversely, "market entrance" refers to a state-performed measure of market control and is predicated on the right of the public to intervene in the market. Consequently, governmental regulation of entry into the energy market infringes private rights. More accurately, market entrance regulation limits the freedom of private enterprise. This is typically achieved by administrative licensing, carried out by the government granting permits to energy businesses (Zhang et al., 2024).

Administrative licensing can be classified into two categories under Chinese administrative law: ordinary licensing and special licensing. Regular licensing seeks to mitigate risks; often, there is no cap on the number of licenses that may be issued, provided that the prerequisites are satisfied. In order to prevent resource waste and duplicate construction, special licensing regulates the costs and quality of monopolized goods and services. Typically, a maximum number of licenses can be granted. Distinguishing between regular and special licensing is crucial for managing the strictness of market entry for various market procedures within the energy sector.

In the energy sector, it is common practice to apply special licensing in areas where there is a natural monopoly and the regular licensing method in areas without such a monopoly. It is customary to deregulate and introduce competition into industries like energy generation and sales that do not already have a natural monopoly. As long as they can meet the technical safety standards and environmental protection regulations, the market players should be able to obtain a license. Regular licensing should be implemented, and the market entrance regulation should focus on technology, safety, and environmental criteria rather than the economic soundness of the investment (Zhang et al., 2024).

On the other hand, it is customary to limit competition for financial gain in industries where there is a natural monopoly, such as the transportation of natural gas through

pipelines and the transmission of electricity. Since it can be seen as the government's right to distribute limited resources by giving license holders special permission, the government should implement special licensing, and a quantity limit. Owing to this limitation, these special permits are typically only issued to current market participants and come with stricter requirements regarding quality and pricing. Nonetheless, entry into the energy market in China is subject to stringent administrative constraints, irrespective of the sector's inherent monopoly status. Consider the market for electricity generation.

Since electricity production lacks a natural monopoly, competition ought to be permitted. In theory, investors should be permitted to enter the market as long as the construction and operation of a power plant can satisfy the technical and environmental requirements. The government does, however, put several limitations on investors in the production of energy, including limitations on generation capacity, construction location and timing, investment size, operating hours, wholesale pricing, and more. Because of this, market entry barriers are extremely high, particularly for initiatives using private funds (Roberts et al., 2021).

According to China's 1996 Electricity Law, all aspects of building, producing, supplying, and using electricity must respect environmental regulations, implement new technologies, reduce the amount of toxic waste released into the environment, and avoid pollution and other risks to the public. The state promotes and supports the use of clean, renewable energy sources to generate electricity. However, the renewable energy sector had not advanced significantly since no specific implementation standards existed. The first special law on fostering the growth of renewable energy was passed by China in 2006. It is known as the Renewable Energy Law. The SERC released the Regulatory Rules on Grid Enterprises Purchasing All Electricity Generated by Renewable Energy by the provisions of the 2006 Renewable Energy Law (Song et al., 2022).

In order to guarantee that renewable energy may connect to the grid in a timely and safe way, these Rules first mandate that the SERC keep an eye on the power generation, operation, grid connection, and network of the renewable energy projects. The requirement to purchase all electricity produced by renewable energy sources is contingent upon this. According to the NDRC 2007 Mid- and Long-Term Plans for Renewable Energy, 10% of the nation's energy should come from renewable sources (Ming et al., 2013).

The capacity of renewable energy plants increased by 3.6 million kW, or 30.6%, nationally between the end of 2005 and the end of 2007. Hydroelectricity, wind, and bioelectric power all had increases in capacity of 26.3%, 444%, and 429%, in that order (Qiu and Li, 2012).

China surpassed all other countries in 2009 as the global leader in renewable energy investment. The nation's renewable energy objective is unclear, though, as the mandatory purchase model does not specify how much renewable energy each energy provider must create or buy. In order to address this, Article 14 of the 2009 Renewable Energy Law mandates purchases and lays the groundwork for future quantity restrictions. According to Article 14, the state implements a mechanism that guarantees the purchase of electricity from renewable energy resources. Alongside the State Electricity Regulatory Commission and the State Council's public finance department, the energy department will work out the specific measures that power grid enterprises need to take in order to first schedule the generation of electricity using renewable energy resources and then purchase the full amount of electricity generated by using renewable energy resources. These measures will be determined per the national plan for developing and utilizing renewable energy resources. The target proportion between the electricity generated by using renewable energy resources and the total electricity generated will be realized during the planning period. Such actions should be promoted for implementation in the planning years by the State Council's energy department and the State Electricity Regulatory Commission. Grid connection agreements must be reached between power grid enterprises and businesses that use renewable energy resources to generate electricity. These businesses must also have completed the administrative licensing or archive-filing procedures in accordance with the plan for the development and utilization of renewable energy resources. Power grid enterprises must also purchase all the on-grid electricity from grid-connected power generation projects that comply with grid-connection technical standards within their respective coverage areas. Businesses that generate electricity have an obligation to work with businesses that manage the power system to safeguard grid security. Power grid firms are required to enhance the development of the power grid, broaden the areas in which electricity produced through renewable energy resources is supplied, and develop and implement energy storage and intelligent power grid technology (Zeng et al., 2013).

In addition, they enhance power grid administration and operation, boost the capacity to absorb electricity produced from renewable energy sources, and offer services for integrating renewable energy-generated electricity into the grid. China's mandatory purchase scheme for renewable energy is outlined in Article 14. Because renewable energy is less competitive than traditional energy in the present markets, mandatory purchase benefits the renewable energy industry in the areas of market access, pricing, and grid connection. The mandatory purchase model advances the renewable energy sector's growth and the nation's objectives for reducing emissions and energy use. Reforming the energy regulatory system is one of China's current legislative objectives regarding government regulation. Energy management requires energy control, which is also a basic fix for energy-related issues. Governments don't have to manage output on their own; if they can set up a sensible framework, productivity will rise quickly. China should pass the Energy Law or a separate Energy

Administrative Organic Law to address issues with energy regulation, such as the absence of regulatory authority, overlapping regulatory authority, and the lack of separation between political and regulatory authorities. Future energy laws in China ought to be based on the idea of "the super ministry," which calls for creating an all-encompassing Energy Regulatory Commission, a unified Ministry of Energy, and the division of political and regulatory authority. The term "Super Ministry" describes an administrative management structure consolidating multiple departments with comparable duties into a single department, coordinating coordinated efforts. China is far from having a "super ministry," though, given its existing state of overlapping regulations and a lack of separation of political and regulatory authorities (Zhao et al., 2011).

5.Chinese AI Regulations

China's AI market, valued at $23.196 billion in 2021, is projected to triple to $61.855 billion by 2025, with the Chinese government projecting that AI will generate $154,638 million in income annually by 2030. However, China is not just interested in AI spreading and its creative applications. It has also been quietly setting the standard and leaving its stamp on the regulatory landscape for AI. China enacted and implemented three separate regulatory measures at the municipal, regional, and national levels in 2022. This trend continued into 2023 when China enacted national-level laws to crack down on deepfake and generative technology in just January (Roberts et al., 2021).

China's Deep Synthesis Provisions became operative on January 10, 2023, as a component of the government's endeavor to fortify its oversight of deep synthesis technology and services. The provisions cover "deep synthesis service users" (organizations and individuals that use profound synthesis to create, duplicate, publish, or transfer information) as well as "deep synthesis service providers" (companies that offer deep synthesis services and those that provide them with technical support). "Technologies utilizing generative and/or synthetic algorithms, such as deep learning and virtual reality, to produce text, graphics, audio, video, or virtual scenes" is how the regulations define profound synthesis (Smuha, 2021).

Because of these laws' extensive reach, the production of AI-generated material for 1.4 billion people will drastically alter. China's rule goes further than the UK's, which also plans to outlaw the production and distribution of deepfake videos without permission. The policy establishes guidelines for each step of the deepfake use process, including development, labeling, and distribution. Furthermore, the law allows for the possible suppression of naturally captured content. Being one of the first nations to impose a deepfake regulation, there are concerns about whether China will use this law to further police freedom of expression too extensively. Nevertheless, discussions about what can be done to address the harms advocated by this technology are reviving. Whatever your position on the matter, the legislation does establish a precedent that may be partially repeated in other legal systems. We will learn more specifics about implementing these laws this year (Tallberg et al., 2024).

On March 1, 2022, the Internet Information Service Algorithmic Recommendation Management Provisions came into force. This law is comparable to the DMA and DSA laws passed by the EU. The guidelines, which China's Cyberspace Administration drafted, mandate that companies offering AI-based tailored suggestions in mobile applications respect user rights, such as shielding children from damage and enabling users to add or remove tags related to their traits (Erdélyi and Goldsmith, 2018).

The three primary categories of the regulation's requirements are information service norms, user rights protection, and general provisions. Because they are already expected to comply, the regulations impact US and foreign businesses that utilize algorithms and/or machine learning in their websites or applications that operate in China. Several important clauses have to be taken into account (Sheehan, 2023).

Online service providers who also engage in online news must apply for special licensing under Article 13, which forbids the algorithmic creation of false information. Because it mandates that online service providers attend to the interests of senior consumers, particularly about fraud prevention, Article 19 provides additional protection for the elderly. Among many other things, the rule forbids phony profiles, faking traffic figures, and promoting material that is addicting. Other less apparent clauses, which represent China's stance on AI ethics, require businesses to maintain conventional wisdom, spread good vibes with vigor, and prevent or lessen disagreements or conflicts.

Like the DSA, China's recommender law requires more audits and openness for recommendation algorithms. As part of this regulation, China has established an algorithm registry to help learn about algorithms and ensure they operate within reasonable bounds. The security evaluation of registered algorithms is part of the registry; nevertheless, it is unclear how much useful information on bl ck box technologies this registry will be able to offer. In the interim, such documentation and comprehension efforts are akin to those of the DSA and other EU laws, such as the EU AI Act. More recently, China approved temporary generative AI regulations on May 23, 2023, effective on August 15, 2023. The regulations are founded on five main tenets that aim to balance innovation and legal governance. China's essential socialist ideals must be upheld by generative AI, which cannot jeopardize national security or interests, encourage discrimination and other forms of violence, or spread false information (Hine and Floridi, 2024).

It is vital to take action to stop discrimination originating from generative AI based on race, religion, country, area, gender, age, employment, and health. Generative artificial

intelligence must uphold intellectual property rights and corporate ethics to prevent unethical competition and the disclosure of trade secrets. It is also necessary to take action to increase dependability, accuracy, and transparency. In order to facilitate this, the regulations mandate that generative AI providers perform data processing operations in a manner that maximizes the authenticity, accuracy, objectivity, and diversity of training data while adhering to legal data sources, protecting intellectual property rights, and obtaining consent for the use of personal information.

China's Personal Information Protection Law (PIPL), a government data privacy law aimed at protecting personal information and addressing issues with personal data leakage, has ramifications for automated decision-making technology in addition to these laws that directly target AI. Adopted on August 20, 2021, and coming into effect on November 1, 2021, the PIPL imposes requirements on international firms operating in China and Chinese organizations to safeguard Chinese residents' privacy and personal information (Calzada, 2022).

According to the law, any type of information, whether electronically or otherwise recorded, pertaining to a known or identifiable natural person within the People's Republic of China is considered "personal information" (PI). Similar to the EU's GDPR, PI does not include anonymized data that is non-reversible once anonymized and cannot be used to identify a specific natural person. The following are some of the primary contributions made by the PIPL, together with guidelines about impact assessments and automated decision-making.

More rights are granted to data subjects on how their data is used. They can ask to have their data edited or removed, have its usage restricted, or have their prior consent revoked. Stricter guidelines for data transmission and sharing, which your company and any joint data controllers from outside parties may need to meet to pass data evaluations. Required security measures must be used when processing and storing the PI, and authorized staff members handling the PI must get training; when the amount of PI is above the threshold established by the Cybersecurity Administration of China (CAC), mandatory data localization is required (Feng, 2019).

The following regulations apply to companies and people who process personal data in China or outside the country, provided the following requirements are met. It provides goods or services to natural persons in China, or personal information is processed. Furthermore, the analysis and evaluation of the behavior of natural persons in China or other situations specified by laws and administrative rules is granted. The processing of personal information by natural persons for domestic or personal purposes is exempt from the law. This covers situations requiring immediate action to safeguard people's lives, health, or property. Aside from these exceptions, personal information handlers who violate the PIPL may be fined up to 50 million RMB, have their money confiscated (up to 5% of their yearly revenue), or shut down their firm (Cui and Qi, 2021).

The PIPL is important in regulating AI since it controls data, which is essential to AI. The PIPL operates in China like recent instances that demonstrate how the GDPR applies to AI in the EU. This is seen in China's deepfake regulation, which stipulates that organizations using deepfakes must abide by the country's current PIPL rules.

China's Ministry of Science and Technology also released a New Generation Artificial Intelligence Code of Ethics on September 21, 2021, in addition to these rules. The National New Generation Artificial Intelligence Governance Professional Committee released the Ethics Code, which was formed by the Chinese Ministry of Science and Technology to investigate policy recommendations for AI governance. It offers guidance for natural and legal persons and other pertinent institutions and covers the entire life cycle of AI. The following are the primary contributions made by the Specification's general provisions. The first one is the enhancement of human well-being. This implies that AI systems ought to adhere to shared ideals, respect human rights and the core interests of society, foster harmony, enhance livelihoods, and adopt a sustainable strategy for the growth of the economy, society, and environment (Calzada, 2022).

The second is the promotion of justice and fairness. In order to advance equality of opportunity and justice, AI systems should be inclusive, effectively safeguard the rights and interests of those who engage with them, and distribute the advantages of AI throughout society. Respecting vulnerable populations and making accommodations where needed are important.

The third is security and privacy protection. AI systems should respect user privacy and make sure that consent is sought before processing personal data. Data handling should be done safely, and personal privacy should be legally safeguarded. As seen above, the verticals of safety, privacy, and fairness are at the center of the Specification's general provisions. Management standards are urged to concentrate on the proper governance and use of authority in order to minimize AI hazards. The Specification also includes supply specifications that emphasize observing market regulations and making sure emergency plans are in place, as well as R&D specifications on data storage and use that center on security measures and equity.

Additionally, organizational management is encouraged to expand upon the Ethics Code and create policies that align with the requirements of the systems they employ by the organization and implementation rules. The federal government is not the only entity focusing on AI legislation; provincial and local governments are also involved. In contrast to national measures that are more restrictive, regional rules in China have offered a better balance between support for innovation and regulation. Regional laws seem to endorse industry and government best practices for advancing AI development. The province and

local AI law in Shanghai and the Shenzhen Special Economic Zone are examined in this section (Dixon, 2023).

The provincial-level Shanghai Regulations, passed in September 2022 and enacted on October 1 of the same year, are intended to foster the growth of the AI industry. Regarding the creative advancement of AI, the rule is seen as industry promotion law. But in light of AI's potential future effects, the law also establishes a graded management system. It implements sandbox supervision, which gives businesses a dedicated area to test and investigate new technologies.

The Shanghai AI Regulation is unique because it allows for certain leeway in the case of minor violations. This demonstrates a more significant commitment to promoting innovation and aims to continue encouraging the development of AI without burdening businesses or developers with the dread of strict regulation. This is accomplished by including a disclaimer language that states that no administrative penalties will be applied for small infractions and that relevant municipal offices will be in charge of compiling a list of infraction behaviors. The rule also creates an Ethics Council to raise ethical awareness in this area and act as a check and balance to the innovation-center strategy (Cheng and Zeng, 2023).

Like the Shanghai Regulations, the Shenzhen AI Regulation was passed in September 2022 and became operative on November 1, 2022, with the goal of advancing the AI sector. By providing more funding for these initiatives, the rule seeks to incentivize Chinese governmental organizations, more especially those in the Shenzhen Special Economic Zone, to be at the forefront of AI adoption and development.

The policy takes a risk-management approach to AI to support this expansion. It does this by permitting Shenzhen-based AI services and products deemed to be "low-risk" to continue their trials and testing in the absence of local regulations as long as international criteria are met. The regulation's Article 72 highlights the value of AI ethics and promotes risk assessments to find unfavorable consequences in systems and goods. The risk classification system will be developed and administered by the Shenzhen government. This is a significant development even though it's a local rule because Shenzhen is home to a lot of AI and tech-related companies, and between 2021 and 2025, $108 billion USD is expected to be invested in this industry (Cheng and Zeng, 2023).

According to one perspective, China has observed how rules are increasingly being used to establish international norms and standards. In fact, China has been involved in some of the world's earliest enforcement of AI regulation, wanting to set that precedence for itself. However, there is disagreement about whether China's approach to AI regulation is a ploy for political advantage or a sincere attempt to limit the negative effects of AI system research and implementation. However, interpreting China's intentions in the AI regulatory arena in such a binary manner would be incorrect. China's efforts are undoubtedly driven by a desire to establish international norms, but they also incorporate a multifaceted strategy aimed at regulating the negative effects of AI and comprehending "high-risk" algorithms rather than merely cataloging them. For instance, China is concentrating on the technical ramifications of digital services, whereas other regions of the world have prioritized bias and transparency, which is comparable to the goals of the DSA. Making a head start in this regard by trying to delve into the intricacy of black box technology and recommender systems through its algorithmic registry. It is becoming increasingly obvious that enterprises need to be able to keep up with the changing regulatory landscape surrounding them. Given that China seems to be ahead of the curve, it will be intriguing to observe who sets the gold standard for AI in the East, how others may be able to learn from China's example, and how East-West relations on AI continue to converge. Even if your business operates outside of China, the country's worldwide influence suggests that the laws they have proposed might be adopted in other countries (Clarke, 2019).

6. Conclusion

China is experiencing a newer energy regulatory overhaul. The proposed law lays out a plan for streamlining China's energy mix and promoting the clean, efficient, and intensive use of the country's current energy resources while giving priority to the development of renewable energy sources like wind and solar power. Customers' need for solid energy services is prioritized, and energy providers are clearly required to provide safe, consistent, and dependable services. Improved operational safety requirements for energy transmission pipeline systems are also recommended in the draft. In light of the differences in access to energy, the law promotes the construction of energy infrastructure in rural areas and emphasizes the necessity of developing and fortifying an energy emergency response system in order to avert future emergencies.

When it comes to implementing AI rules, China is advancing similarly, which creates a significant overlap between these new energy and AI regulations. The Interim Measures for Administration of Generative AI Services (Generative AI Measures), the Administrative Provisions on Deep Synthesis of Internet-based Information Services (Deep Synthesis Provisions), the Trial Measures for Ethical Review of Science and Technology Activities (Ethical Review Measures), and the Administrative Provisions on Algorithm Recommendation for Internet Information Services (Algorithm Recommendation Provisions) are just a few of the significant legal developments over the last few years that have affected a variety of policies and regulations.

The article outlined the growing interlinkage between energy and AI regulations, and the growing focus on ensuring both security and stability as well as the role that AI may play in optimizing delivery of electricity as well as strengthen renewable energy efforts.

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RESP

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Araştırma Makalesi ● Research Article

Preservation of Marine Resources and Sustainable Fisheries: Analyzing the Stochastic Dynamics of Fishing Grounds Footprints in the Nordic Countries

Deniz Kaynaklarının Korunması ve Sürdürülebilir Balıkçılık: İskandinav Ülkelerinde Balıkçılık Alanlarının Ayak İzlerinin Stokastik Dinamiklerinin Analizi

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A N A H T A R K E L İ M E L E R

Çevresel Bozulma
Sürdürülebilir Balıkçılık
Stokastik Analiz
Nordik Ülkeleri

Ö Z

Günümüz toplumlarının daha iyi bir yaşam alanı ve bu koşulların sürdürülebilirliğine odaklanmaya başladıkları görülmektedir. Dünya ekosisteminin kritik ve önemli bir paternini oluşturan denizler, trofik basamaklarda birçok canlı türünün yaşam alanını oluşturmaktadır. Buradaki ekosistem paterninde meydana gelecek bozulma tüm ekolojik dengenin bozulmasına yol açabilir. Bu nedenle su alanlarında yanlış avlanma yöntemleri, kaçak avcılık, trol avcılığı ve aşırı avlanma gibi birincil sucul çevresel bozulma etkenlerinin yanı sıra daha büyük ancak ikincil etkenler plastik kirliliği, aşırı tüketim, küresel ısınma, sanayileşme vb. olaylar biyolojik çeşitliliğin yok olmasına deniz ekosisteminin bozulmasına neden olmaktadır. Sürdürülebilir kalkınma amaçlarının (SDG) "sudaki yaşam" olarak etiketlenen SDG14 amacı söz konusu sucul ekosistemin korunmasına yönelik bütüncül bir perspektif sunmaktadır. Çalışma deniz ekosisteminde önemli bir konuma sahip olan Nordik ülkelerinin sucul alanlarının çevresel göstergesi olarak kişi başına FGF'leri ele alınmış ve bu verilerin stokastik davranışları incelenerek politika yapıcılara içgörü sunulması amaçlanmıştır. Çalışmanın sonuçları ise Nordik ülkeleri gibi birbirine benzer gelişmişlik düzeyi ve coğrafi alanda olan ülkelerin ulusal boyutta politika tercihlerinin ve bu politikanın etkilerinin farklı olabileceğini göstermesi açısından literatüre özgün bir katkı sunmaktadır.

K E Y W O R D S

Environmental Degradation
Sustainable Fisheries
Stochastic Analysis
Nordic Countries

A B S T R A C T

Today's societies have started to focus on a better living environment and the sustainability of these conditions. The seas, which constitute a critical and important pattern of the world ecosystem, constitute the habitat of many species at trophic levels. Any disruption in the ecosystem pattern here can lead to the disruption of the entire ecological balance. For this reason, in addition to primary aquatic environmental degradation factors such as improper fishing methods, poaching, trawling, and overfishing in water areas, larger but secondary factors such as plastic pollution, overconsumption, global warming, industrialization, etc., cause the destruction of biodiversity and the deterioration of the marine ecosystem. SDG14 of the Sustainable Development Goals (SDGs), labeled as "life in water," provides a holistic perspective for the protection of this aquatic ecosystem. The study focuses on FGF per capita as an environmental indicator of the aquatic areas of the Nordic countries, which have an important position in the marine ecosystem and aims to provide insights to policymakers by examining the stochastic behavior of these data. The results of the study make a unique contribution to the literature in terms of showing that countries with similar development levels and geographical areas, such as the Nordic countries, may have different policy preferences at the national level and the effects of this policy.

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1. Introduction

The seas, which have the richest biodiversity in the world, are the habitat of millions of species in trophic levels that form complex food webs. Disruptions in trophic levels in the marine ecosystem can decrease biodiversity and damage the ecological balance (Myers et al. 2007; Estes et al. 2011). One of the most important reasons for the deterioration of trophic levels has been fishing activities, which are considered important in terms of food security and economic importance. Improper fishing methods used in fisheries, poaching, trawling, and overfishing cause degradation in marine ecosystems and destruction of biodiversity (Aish et al., 2003; Dammannagoda, 2018; Worm et al., 2009). In addition, the effects of drought, plastic pollution, overconsumption, global warming, industrialization, etc., on marine ecosystems have been determined by many studies (Scavia, 2002; Gao et al., 2016; Li et al., 2016a; Ivleva et al., 2017; Ullah et al., 2023). For this reason, studies supporting the protection of marine ecosystems directly contribute to the goal of "life in water" (SDG14), which is among the Sustainable Development Goals (SDGs).

Fisheries and aquaculture are seen as important sources of income and jobs worldwide. For the first time in 2022, aquaculture surpassed capture fisheries with a production of 130.9 million tons. Of this production, 89% was for human consumption, demonstrating the growth of aquaculture to meet growing global demand. In addition, the fisheries sector produced a total of 92.3 million tons in 2022, 11.3 million tons from inland catch, and 81 million tons from marine catch. Despite growing aquaculture, capture remains the main source of aquatic animal production (FAO 2024). Unplanned management practices in the fisheries catching sector and increased demands with the growing population have serious environmental impacts on marine and inland water ecosystems. In order to identify and control these environmental impacts and to maintain aquatic sustainability, the "ecological footprint" model has come to the forefront of current studies.

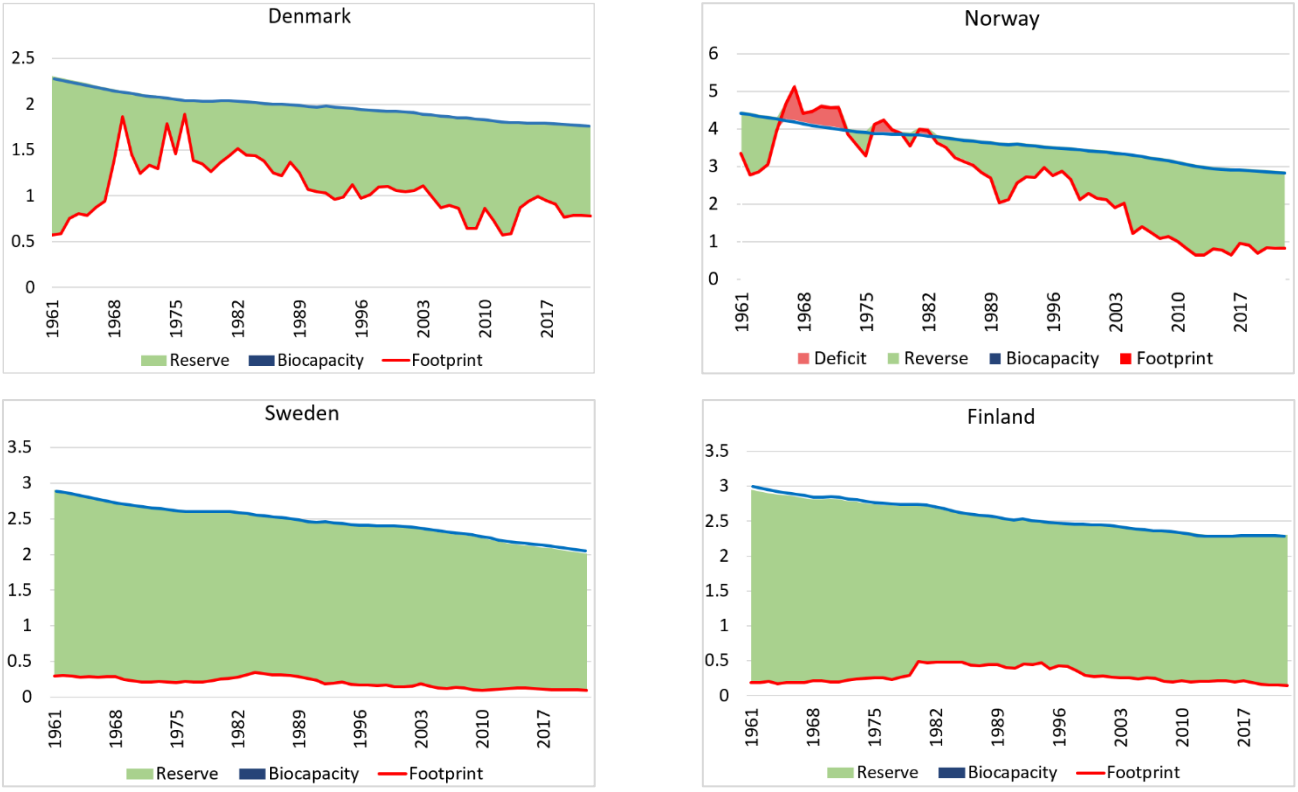
Ecological footprint (EF) is an important tool that can evaluate countries' or regions' economic growth and development by determining the production and consumption of resources in terrestrial and aquatic ecosystems (Gao and Tian, 2016; Solarin et al., 2021). In addition, EF is an important determinant of sustainable development, as it shows the ecological losses in the world's ecosystem (Kong et al., 2021). Researchers have made progress in this field by developing model volution, application scale, and subcomponents and conducting many studies related to EF. They have utilized indicators such as EF or carbon footprint to measure the sustainability of ecosystems, using the consumption of natural resources available for human services and waste data (Bastianoni et al., 2012; Bi et al., 2020; Wang et al., 2021). In addition, with EF, carbon and water footprint indicators, the environmental impacts of countries' economic growth have been evaluated and the relationship between environmental changes and economic development has been tried to be revealed in line with sustainable development goals (Salvo et al., 2015; Sanyé et al., 2019; Galli et al., 2012). In addition to issues such as EF trade and tourism, the relationship between resource use and foreign trade (Wiedmann, 2009; Gao and Tian, 2016) has been used to evaluate the relationship between tourism and ecosystem carrying capacity (Zhang and Yang, 2009; Yang and Li, 2007).

While these developments continue, new research on the fishing ground footprint (FGF) is being conducted. The fishing ground footprint, one of the components of EF, reveals the current conditions of aquatic ecosystems and defines the area of water used to consume marine fish (Solarin et al., 2021). Factors affecting marine ecosystems and biodiversity negatively affect FGF (Adalı et al., 2023). Studies on FGF in the literature have remained limited. Jennik et al. (2012) found that only a small fraction of the total trawl area and effort greatly impacts FGF management. Ulucak and Lin (2017) examined the effects of policy shocks on EF components in the United States and found that FGF is non-stationary. Clark and Longo (2019) argue that FGF strongly impacts economic development in less rich countries, while rich countries are unaffected. Yilanci et al. (2019), In 25 OECD countries, EF and its six subcomponents were used as ecological indicators, and it was stated that the effects of policy shocks on FGF were persistent in the long run, which was non-stationary only for FGF. Solarin et al. (2019) identified ten convergence clubs for EF and two convergence clubs for FGF using the club convergence approach for EF and its six subcomponents, including FGF, in 92 countries. Ulucak et al. (2020) examined the ecological footprint and its subcomponents and the club integration approach for Sub-Saharan Africa. Solarin et al. (2021) determined that most of the series were non-stationary and did not revert to the mean using fractional integration in the FGF analysis of 90 countries with upper-middle and high-income groups. Kassouri (2021) investigated the FGF dynamics in the Gulf of Guinea and Congo Basin region and recommended that a common areal fisheries policy could be implemented as the convergence structure is not uniform and the capture effect is partial. Karimi et al. (2022) stated that monetary freedom, business freedom, government integrity, and tax burden indices among economic factors in Asia-Pacific countries increase FGF, while investment freedom and trade freedom indices have negative effects on FGF. Yıldırım et al. (2022) proved that human capital reduces FGF and human capital reduces environmental pollution in Mediterranean countries. Amin et al. (2022), By analyzing data from 17 Asia-Pacific countries between 2000-2017, found that cumulative effects in the form of aggregate economic freedom index have a positive effect on FGF and lead to increased extraction from fisheries resources. Adalı et al. (2023) analyzed the stochastic behavior of the FGF of the top 10 fish-producing and catching countries using unit

root tests (URT) and found that the FGF of Bangladesh, China, India, and the Philippines deviated from any changes due to fisheries and maritime policies.

Fisheries and aquaculture are important sectors in the Nordic countries (Denmark, Faroe Islands, Finland, Iceland and Sweden). These countries are ahead of other countries in terms of their sustainable fisheries strategies and management policies. Although Asian countries account for most of the production in terms of aquaculture and capture, Norway is particularly prominent with its Atlantic salmon production. According to data from the FAO (2022), Norway ranks 9th among other countries with 2.4 million tons of aquaculture and 7th with 1.5 tons of aquaculture. Denmark, which stands out with its herring and haddock fisheries in the Baltic Sea, plays an active role in commercial fishing. Although Sweden and Finland have small-scale fisheries, deep management policies are implemented to protect biodiversity and natural resources. In Nordic countries, it is important to monitor biological capacity (BC), which shows ecological sustainability as well as FGF per capita. Graph 1 shows the time path graphs of FGF per capita and BC, deficit, and/or reserve per capita of FGF per capita for the Nordic countries. Denmark has a per capita biocapacity reserve of FGF, while Norway had a biocapacity deficit of FGF in the 1960s and early 1970s. Finland and Sweden have consistently maintained a biocapacity reserve per capita of the FGF.

Graphic 1. Fishing grounds footprint per capita, biocapacity (gha) per capita, biocapacity deficit, and/or reserve per capita for the Nordic countries



In order to optimize ecosystem sustainability, well-thought-out fisheries management policies need to be developed. For this reason, it is important to evaluate the ecological resources of the Nordic countries, which are making rapid progress in aquaculture, and to determine development strategies based on these evaluations in order to maintain their sustainability. For these reasons, when the literature was examined, several studies were found using criteria such as ecological footprint and carbon footprint of these countries (Ziegler et al., 2013; Li et al., 2016b; Nielsen et al., 2017; Georgescu et al., 2024; Eriksson et al., 2015). In this respect, this study will be the first study to reveal the FGF stochastic dynamics of marine resource conservation and sustainable fisheries in the Nordic countries.

The aim of the study is to examine the stochastic properties of the ecological footprint of fishing grounds in Nordic countries, which can play a key role in reducing ecological problems and providing insights into the dynamics of sustainable development. Thus, it will be sufficient for policymakers to put forward micro-practices for environmental regulations and restrictions, first from a regional and then a global perspective. Following the introduction, the second section provides a brief overview

of the empirical findings in the literature. The third section defines the scope of the study and introduces the dataset, followed by a methodology section summarizing the empirical process. The fourth section reports and discusses the empirical findings. The last section presents the conclusions and policy recommendations of the study.

2. Literature Review

Upon reviewing the relevant literature, it is evident that a limited number of studies are available. Clark and Longo (2019) investigated how economic growth, geography, and historical periods impacted countries' fisheries footprints. The study's data was examined from 1961 through 2010. To better understand how the impact of economic development differs depending on the degree of national economic prosperity, the geography, and the time period, they concentrate their investigation on the fisheries footprint of less developed countries. According to the study's findings, the fisheries footprint in less developed countries is gradually driven more by economic growth.

The stochastic behavior of the fishing grounds footprint of the top 10 fishing nations was evaluated by Adalı et al. (2023). The series on China, Indonesia, India, Peru, Japan, the Philippines, Vietnam, and the United States spanned 1961–2018, while the series on Bangladesh and Russia covered 1992–2018 and 1971–2018, respectively. Due to data availability, the series' time periods vary. Most URTs verify the presence of stationary patterns for Russia, while the fishing grounds footprint of China, India, and the Philippines was rigorously shown to exhibit non-stationarity stochastic patterns when all URT findings were considered.

Fractional integration was used by Solarin et al. (2021) to examine the fishing ground footprint in 89 nations. Although they discover that the majority of the series are nonstationary and non-mean reverting, their findings vary greatly throughout nations, with the majority falling into the upper-middle and high-income ranges.

The dynamics of fishing footprints in the Congo Basin and Gulf of Guinea area were investigated by Kassouri (2021). Between 1990 and 2017, they track the changes in fishing ground footprints in twelve nations in the Congo Basin and the Gulf of Guinea. In fishing ground imprints, they discover modest evidence of convergence, suggesting that the catching-up effect is only partially present.

Kong et al. (2021) investigated the spatial-temporal variation characteristics of marine fishery ecological footprint and decoupling effects associated with the fishing economy of 11 coastal provinces in China from 2010 to 2019 using the Tapio elastic decoupling model and the modified ecological footprint model. The findings demonstrated that the ecological footprint of marine fisheries in 11 Chinese coastal provinces rose sporadically between 2010 and 2019.

Karimi et al. (2022) looked at the economic aspects affecting the fishing industry's ecological footprint using 17 collections of data from Asia-Pacific nations between 2000 and 2017. Although its squared form coefficient is negative, the results support the EKC hypothesis in the fishing grounds footprint, showing that GDP per capita increase has a positive and substantial impact.

The convergence hypothesis of the ecological balance of fisheries in 20 African nations between 1961 and 2018 was studied by Adalı et al. (2024). Different nations have different results from the panel URTs on the stochastic features of the fishing balance.

In their study, Solarin et al. (2019) looked at the convergence of fishing ground footprints across 92 nations between 1961 and 2014. The results show that two convergence clubs for fishing ground footprint can be observed.

Caglar et al. (2021) investigated the fishing ground footprint's resilience to shocks (political, economic, epidemics, etc.) in the EU-5 nations between 1961 and 2016. They used the newly developed SOR URT, which takes into account both sharp and smooth breaks to provide reliable findings, after first using the conventional and one-break URTs to accomplish their goal. The econometric results show the presence of unit roots in fishing ground footprints.

Pata et al. (2024) assessed how Malaysian fishing grounds are impacted by democracy, economic growth, and the use of fisheries products. The research used data from 1961 to 2018 to do an ARDL analysis. As a result of the analysis, it was determined that the EKC is not valid for the footprint of Malaysian fisheries. Additionally, the fishing footprint is increased by economic expansion and the consumption of fisheries products. Democracy doesn't affect fishing footprints.

Whether the impact of shocks on the fishing grounds footprint in the Big Ten developing economies is temporary or not was the goal of Yilanci et al. (2022). On yearly data from 1961 to 2017, they used the newly developed fractional URT with a Fourier function (FUR) and the Fourier augmented Dickey-Fuller URT with a fractional frequency (FADF). According to their research, this is not the case for the Big Ten nations, and changes to fishing ground footprint policies will only have short-term impacts.

3. Data and Methodology

3.1. Data

This study aims to investigate the stochastic dynamics of the ecological footprint of the fishing grounds of the Nordic countries from a sustainability perspective. For this purpose, the fishing grounds of the Nordic countries are spread over a large geographical area, including the North Sea, the Barents Sea, the Baltic Sea, and parts of the Atlantic Ocean. The fishing grounds of these countries are fertile and food-rich, with cold sea waters and freshwater

resources. In addition, thanks to national and regional cooperation in this region, seasonal restrictions, quotas, and Marine Protected Areas (MPAs) are aimed at sustainable management with a focus on conserving fish stocks and ecological balance. The Nordic countries included in the study are Denmark, Finland, Iceland, Norway, and Sweden (Iceland and the Faroe Islands were excluded from the empirical analysis due to the lack of data on these countries). Global hectares of FGF per capita (gha) covering the data range 1961-2022 were used. The FGF data of the countries are taken from the Global Footprint Network and several URTs are used to investigate the stationarity of these series.

Graphic 2 presents historical per capita FGF data for four countries. Norway's FGF per capita was higher by far for most of the data period but has shown a significant downward trend in recent years. Following Norway, Denmark has a higher FGF per capita. On the other hand, Finland and Sweden have similar levels of FGF per capita. For more information on the series of countries, descriptive statistics are given in Table 1.

Graphic 2. FGF (gha) series per capita for the Nordic countries

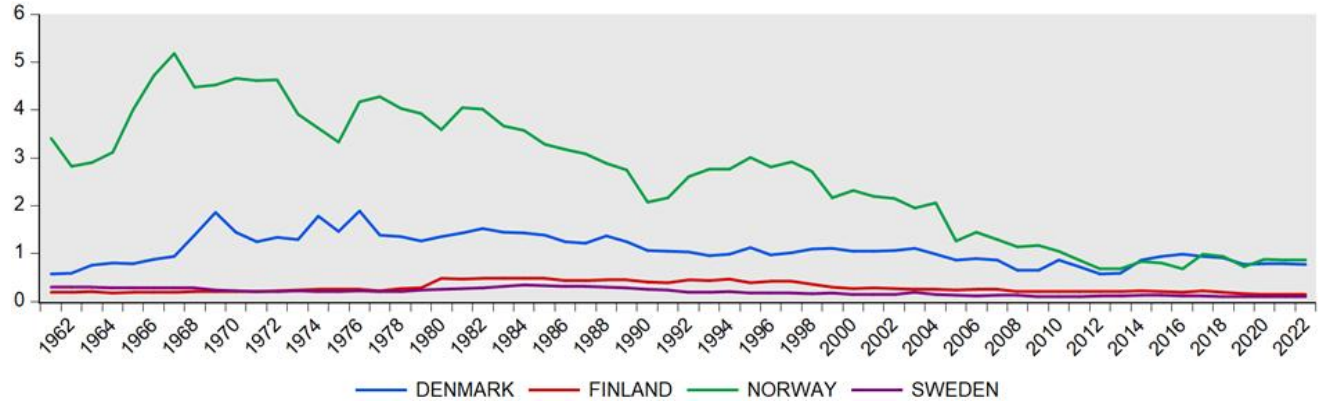


Table 1. Descriptive Statistic

Country	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	JB	JB Prob	Obs.
Denmark	1.077	1.036	1.890	0.570	0.312	0.531	2.917	2.931	0.231	62
Finland	0.287	0.246	0.488	0.149	0.110	0.684	1.909	7.912	0.019	62
Norway	2.649	2.785	5.185	0.675	1.319	-0.033	1.813	3.653	0.161	62
Sweden	0.201	0.205	0.344	0.094	0.074	0.165	1.731	4.439	0.109	62

Table 1 presents descriptive statistics for the FGF per capita series. The country with the highest average FGF per capita is Norway, followed by Denmark. The countries with the lowest average FGF per capita are Sweden and Finland, respectively. Except for the Finnish series, the series is normally distributed according to the JB test statistic.

3.2. Methodology

In this study, determining the stochastic structure and linearity of the series is an important point in investigating the stationarity of the series. This is because incorrect identification of the stochastic structure of the series and the use of tests that do not consider nonlinearity may lead to erroneous results regarding the UR process. For this reason, it would be appropriate to test linearity in the first step of the empirical strategy. To test linearity, Harvey et al. (2008) proposed a linearity test when stationarity is unknown.

$$y_t = \beta_0 + \beta_1 y_{t-1} + \beta_2 y_{t-1}^2 + \beta_3 y_{t-1}^3 + \beta_4 \Delta y_{t-1} + \beta_5 (\Delta y_{t-1})^2 + \beta_6 (\Delta y_{t-1})^3 + \varepsilon_t \quad (1)$$

$$H_0: \beta_2 = \beta_3 = 0$$

$$H_1: \beta_2 \neq \beta_3 \neq 0$$

Equation 1 estimates the AR process and tests the joint significance of the nonlinear terms β_2 and β_3 with the null hypothesis H_0 representing linearity and the alternative hypothesis representing nonlinearity.

In the stochastic structure of the series, three structures emerge according to the presence or absence of intercept and deterministic trend. There are three structures in the series: (i) no intercept term and deterministic trend, (ii) no deterministic trend in the presence of an intercept term, and (iii) the presence of intercept and deterministic trend terms. When the truncation and/or deterministic trend is modeled

incorrectly in the data-generating process of the series before applying the URT, a specification error is made in the URT, and the power of the test is reduced. In this case, the URT will tend to fail to reject the null hypothesis. Sims et al. (1990) proposed a method that investigates the stochastic structure of the series by testing the AR(1) process, which includes the intercept and trend term in the data-generating process of the series, using standard t-test and F-test. Accordingly, by testing from the most general model (with intercept and trend) to the most specific model (without intercept and trend), which is defined as a sequential process approach, a practical approach is presented to determine whether the stochastic structure of the series includes intercept and deterministic trend in the data generating process. Therefore, in the second stage, the stochastic structure of the series will be determined and URT models appropriate to the stochastic structure will be applied.

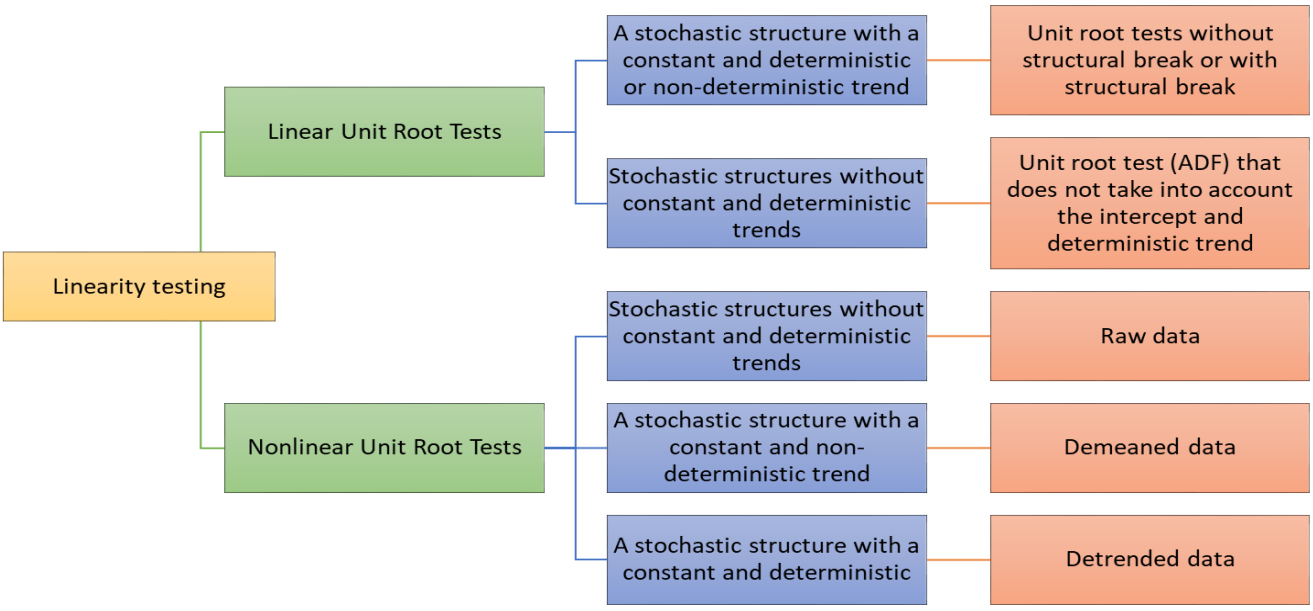


Figure 1. Empirical Process

As can be seen in Figure 1, which summarizes the empirical process, linear or nonlinear URTs will be applied to the series as a result of the linearity tests. In linear URTs, if the stochastic structure of the series includes intercept and trend, three different URTs are applied. The first one is the LM test proposed by Schmidt & Phillips (1992), which investigates the presence of a unit root in the presence of deterministic trends.

$$u_t = \rho u_{t-1} + \varepsilon_t \quad (2)$$

$H_0: \rho = 1$

$H_1: \rho < 1$

The u_t series in Equation 2 is the residuals obtained from the y_t series with deterministic components. For the LM test statistic obtained here, the null hypothesis is the unit root, and the alternative hypothesis is stationarity.

The model estimated according to the LM principle of the minimum LM URT under one structural break proposed by Lee & Strazicich (2013) and the URT under two structural break proposed by Lee & Strazicich (2003);

$$y_t = \delta' Z_t + \varepsilon_t \quad (3)$$

$$\Delta y_t = \delta' Z_t + \phi \tilde{S}_{t-1} + \varepsilon_t \quad (4)$$

$H_0: \phi = 1$

$H_1: \phi < 1$

The Z_t series here refers to breaks as a vector of exogenous variables. These breaks are $Z_t = [1, t, D_t]$ for a single break in the intercept and $Z_t = [1, t, D_t, DT_t]$ for a break in the trend as suggested by Lee & Strazicich (2013). For the Lee & Strazicich (2003) test, Z_t is constructed as a two break, where $Z_t = [1, t, D_{1t}, DT_{1t}]$ for two break in the constant and trend, and $Z_t = [1, t, D_{1t}, D_{2t}, DT_{1t}, DT_{2t}]$ for a double break in the trend. The null hypothesis H_0 indicates a unit root and the alternative hypothesis indicates stationarity.

Finally, if there are no deterministic components of truncation and trend under linearity in the data-generating process of the series, the Augmented Dickey-Fuller (ADF) test proposed by Dickey & Fuller (1979, 1981) is used as a conventional URT.

$$\Delta y_t = \delta y_{t-1} + \sum_{i=1}^{k} a_i \Delta y_{t-i} + \varepsilon_t \quad (5)$$

$$\Delta y_t = \mu + \delta y_{t-1} + \sum_{i=1}^{k} a_i \Delta y_{t-i} + \varepsilon_t \quad (6)$$

$$\Delta y_t = \mu + \beta T + \delta y_{t-1} + \sum_{i=1}^{k} a_i \Delta y_{t-i} + \varepsilon_t \quad (7)$$

$H_0: \delta = 0$

$H_1: \delta < 0$

The ADF tests in Equations 5, 6, and 7 represent models without intercept and trend, with intercept and trend, and with intercept and trend. While the null hypothesis states the presence of a unit root, the alternative hypothesis states the absence of a unit root, in other words, stationarity.

As a result of the Harvey et al. (2008) test, two different nonlinear URTs were applied in the study against the weakness of linear URTs in case the data generation process of the series exhibits nonlinear characteristics. The first one is the first Taylor expansion under the assumption of the first-order exponential smooth transition autoregressive process (ESTAR) proposed by Kapetanios et al. (2003), and the following test regression is proposed.

$$\Delta y_t = \delta y_{t-1}^3 + \sum_{i=1}^{k} a_i \Delta y_{t-i} + \varepsilon_t \quad (8)$$

$H_0: \delta = 0$

$H_1: \delta < 0$

The null hypothesis of the test proposed by Kapetanios et al. (2003) is a unit root and the alternative hypothesis is nonlinear ESTAR stationarity. Kruse's (2011) test is an improved version of the Kapetanios et al. (2003) test. Accordingly, the test regression is proposed as follows.

$$\Delta y_t = \delta_1 y_{t-1}^3 + \delta_2 y_{t-1}^2 + \sum_{i=1}^{k=1} a_i \Delta y_{t-i} + \varepsilon_t \quad (9)$$

$H_0: \delta = 0$

$H_1: \delta < 0$

Similarly, this test's null and alternative hypotheses are unit root and nonlinear ESTAR stationarity, respectively. In nonlinear URTs, components such as constant and deterministic trends are not included. Instead, depending on the data-generating process of the series, raw data is used if there is no truncation and trend; demeaned data is used if there is a truncation and trendless component; and detrended data is used if there is a truncation and trend component.

3. Empirical Results

Empirical results before investigating the stationarity of the FGF series of the Nordic countries Denmark, Finland, Norway, and Sweden, the series' deterministic components and linearity tests were performed by following the empirical process in Figure 1. Table 2 shows that according to the sequential process approach, the deterministic components of the series have intercept and trend components for Denmark and Norway, while there are no intercept and trend deterministic components for Finland and Sweden.

Table 2. Deterministic component structures of series

Country	Deterministic Structure of the Series
Denmark	C+T
Finland	non(C+T)
Norway	C+T
Sweden	non(C+T)

In the process of making the series' data, C+T, C+nonT, and non(C+T) stand for the deterministic structure with a constant and a trend, a constant and no trend, and a structure without a constant and no trend, accordingly.

Table 3 presents the linearity test results of Harvey et al. (2008). Accordingly, the linearity test results for Denmark, Finland, and Norway W_λ Since the test statistic is smaller than the critical values, the null hypothesis cannot be rejected. It is understood that the series for these countries exhibit linear behavior in the data generation process. Therefore, linear URTs should be applied to investigate the stationarity of the FGF series for these countries. On the other hand, the results for Sweden W_λ Since the test statistic is greater than the critical value at least at the 1% probability level, the null hypothesis of linearity is strongly rejected. The Swedish FGF series exhibits nonlinear behavior in the data-generating process. Hence, it would be appropriate to apply URTs that consider nonlinearity.

Table 3. Linearity Test Results

Seri	W_λ	Decision
Denmark	0.14	Linearity
Finland	0.4	Linearity
Norway	0.21	Linearity
Sweden	18.62^{***}	Nonlinearity

Table 4 presents the results of the LM URT without structural breaks, with one and two structural breaks for the Danish FGF series. The URT equations appropriate to the truncated and trended structure identified as the deterministic component of the Danish FGF series were used. For all three tests, the alternative hypothesis is against the existence of a URT stationarity. The alternative hypothesis indicates stationarity under structural breaks in the tests with structural breaks. While the FGF series contains a unit root according to the test result without structural breaks, the null hypothesis expressing the existence of a unit root is rejected in the one-break and two-break tests, and the series is stationary under structural breaks.

Table 4. Unit Root Results for the Denmark FGF Series

Tests	statistics	critical values			Date Break(s)
		1%	5%	10%	
Schmidt & Phillips (1992)	-0.728	-3.507	-2.904	-2.616	
Lee & Strazicich (2013)	-4.350***	-4.236	-3.639	-3.358	[1984]
Lee & Strazicich (2003)	-6.600***	-5.176	-4.444	-4.088	[1976] [2010]

Symbols *, **, and *** denote the rejection of the null hypothesis at significance levels of 10%, 5%, and 1%, respectively, while the numbers in brackets represent the break dates.

Table 5 shows that the stationarity of the Finnish FGF series is investigated. Since the Finnish series exhibits linear behavior in the data-generating process and there are no intercept and deterministic trend components, and therefore investigating structural breaks in the absence of deterministic components would yield erroneous results, the traditional ADF test is used as a linear URT without deterministic components. According to the results of the ADF test, the null hypothesis expressing the existence of a unit root cannot be statistically rejected at a probability level of at least 5%. Accordingly, it is concluded that the Finnish FGF series is non-stationary.

Table 5. Unit Root Result for the Finland FGF Series

Tests	statistics	critical values		
		1%	5%	10%
ADF	-0.533	-2.603	-1.946	-1.613

Table 6 presents the URT results for the Norwegian FGF series. As in the Danish series, the Norwegian FGF series exhibits linear behavior and has intercept and deterministic trend components, so the intercept and trend models of the LM URTs were used. According to the LM test results without structural breaks, the series contains a unit root, but when structural breaks are considered, it is concluded that the series is stationary under structural breaks.

Table 6. Unit Root Results for the Norway FGF Series

Tests	statistics	critical values			Date Break(s)
		1%	5%	10%	
Schmidt & Phillips (1992)	-1.476	-3.560	-2.957	-2.668	
Lee & Strazicich (2013)	-4.633**	-4.777	-4.207	-3.915	[1981]
Lee & Strazicich (2003)	-4.937**	-4.988	-4.360	-4.071	[1978] [2008]

Symbols *, **, and *** denote the rejection of the null hypothesis at significance levels of 10%, 5%, and 1%, respectively, while the numbers in brackets represent the break dates.

Table 7 displays the URT results for the Swedish FGF series. Tables 2 and 3 indicate that this series demonstrates nonlinear characteristics in the data generation process and is devoid of deterministic elements such as intercept and trend. Consequently, the nonlinear URTs are incorporated. Raw data is utilized for both tests due to the absence of an intercept and trend as the deterministic component of the series. The URT in the test proposed by Kapetanios et al. (2003) is lower than the critical values in absolute terms and the null hypothesis of the existence of a unit root cannot be rejected. Similarly, in the Kruse (2011) test, the null hypothesis cannot be rejected since the test statistic is smaller than the critical values. Accordingly, it is concluded that the Swedish FGF series is non-stationary.

Table 7. Unit Root Result for the Sweden FGF Series

Tests	statistics	critical values		
		1%	5%	10%
Kapetanios et al. (2003)	-1.296	-2.82	-2.22	-1.92
Kruse (2011)	2.752	13.15	9.53	7.85

As reported in Tables 4, 5, 6, and 7, several conclusions have been reached over different URTs. Table 8 summarizes the findings obtained in three stages in accordance with the empirical process. The URT results for the FGF series are statistically conclusive at the 5% probability level in testing the null hypotheses. Accordingly, while Denmark and Norway are stationary in the FGF series of the four Nordic countries, Finland and Sweden exhibit non-stationary behavior.

Table 8. Summary URT Results

Country	**URT Result**
Denmark	Stationary
Finland	Non-stationary
Norway	Stationary
Sweden	Non-stationary

4. Discussion and conclusion

Although countries' development level is associated with more production and consumption, today, opinion leaders in society, policymakers, and scientists have started to focus on a better living environment and the sustainability of these conditions. Discussions have increased over the last few decades at national and international meetings on environmental issues, climate change, and whether future generations will have a livable and sustainable world heritage. The main point is to combat climate change caused by development dynamics in developed and developing or underdeveloped countries and to implement policies and regulations that reduce greenhouse gas and carbon emissions. In this context, the sub-components of EF, as an important indicator of climate change, need to be carefully examined, and more micro-level regulations, restrictions, quotas, and policy constructions should be made from the perspective of these sub-components as well as macro-level policies.

The seas, which constitute a critical and important pattern of the world ecosystem, constitute the habitat of many species in trophic levels. Any disruption in the ecosystem pattern here can lead to the disruption of the entire ecological balance. For this reason, in addition to primary aquatic environmental degradation factors such as improper fishing methods, poaching, trawling, and overfishing in water areas, larger but secondary factors such as plastic pollution, overconsumption, global warming, industrialization, etc., cause the destruction of biodiversity and the deterioration of the marine ecosystem. SDG14, labeled as the SDG for life in water, provides a holistic perspective for the protection of this aquatic ecosystem.

In this study, FGFs per capita as an environmental indicator of the aquatic areas of the Nordic countries, which have an important position in the marine ecosystem, are considered, and it is aimed to provide insights to policymakers by examining the stochastic behavior of these data. In the empirical process of analyzing the stochastic structures of time series, it is important to determine the linearity and deterministic component structures of the series correctly according to the purposes and advantages of the URTs in the literature in order to reach the correct results. For this purpose, the URT results obtained in three stages provide statistically robust evidence without any specification error.

The stochastic behavior of FGF in the data generation process in the Nordic countries seems to provide important clues to policymakers and researchers in understanding the short-term and long-term responses of FGF to policy shocks as an indicator of environmental degradation in aquatic areas and in forward projections. Accordingly, among the four Nordic countries analyzed in this study, the FGFs of Denmark and Norway are stationary, while the FGFs of Finland and Sweden are non-stationary. Accordingly, policy shocks in Denmark and Norway tend to return to their long-run averages and trend path. It is understood that policy shocks to reduce the FGF in these countries will be ineffective in the long run despite their short-run effect. On the other hand, the non-stationary behavior of the FGFs of Finland and Sweden indicates that policy shocks will occur in these countries.

Have long-run effects. The URT results for these countries do not show a tendency for policy shocks to revert to the mean. Although Finland and Sweden have smaller fisheries than the other two countries, their fisheries governance and strategies are more developed. Therefore, there is no need to develop additional policies to reduce environmental degradation in aquatic areas. However, the stochastic structure of the FGF suggests that a negative policy shock - a policy change that increases environmental degradation - may be effective in the long run.

The fight against environmental degradation is certain to be a topic of conversation and policymakers' policy choices for decades to come. States that are actors of environmental degradation need to implement more international cooperation and global regulations. The results of this study make a unique contribution to the literature in terms of showing that countries with similar development levels and geographical areas, such as the Nordic countries, may have different policy preferences at the national level and the effects of this policy. We highlight the significance of micro-scale policies and practices within the sub-dimensions of the SDGs. Furthermore, we note that global paradigms for addressing environmental degradation may vary from the policy design and nature of efforts at the national level.

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The Impact of AI on ECOWAS Energy Regulation Development

Yapay Zekanın ECOWAS Enerji Düzenlemelerinin Gelişimine Etkisi

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ANAHTAR KELİMELER

Enerji düzenlemeleri
Yapay zeka
Bölgesel elektrik otoritesi
Çin YZ düzenlemeleri

ÖZ

ECOWAS Bölgesel Elektrik Düzenleme Kurumu (ERERA), Batı Afrika'daki sınır ötesi elektrik bağlantılarını denetlemekten sorumlu bölgesel kurumdur. ECOWAS üyesi devletlerin, bölgenin enerji kaynaklarının işbirliği içinde uygulanması ve paylaşılması yoluyla elektrik enterkoneksiyonlarını gerçekleştirme arzusu, Batı Afrika'nın elektrik endüstrisinin büyümesi için uygun kurumsal ve yasal çerçeveyi oluşturmayı amaçlayan bir Enerji Protokolü'nün kabul edilmesiyle kendini göstermiştir. Enerji Protokolü ve Batı Afrika Güç Havuzu (WAPP) Programı kapsamında ECOWAS Üye Devletleri, Ocak 2008'de ECOWAS'ın uzmanlaşmış bir kurumu olarak ECOWAS Bölgesel Elektrik Düzenleme Kurumu'nu (ERERA) kurmuştur. Yapay zekanın enerji sektörüne uygulanması, hem zorlu düzenleyici engeller hem de şimdiye kadar gerçekleşmemiş beklentiler sunmaktadır. YZ, akıllı şebekeleri geliştirirken ve petrol sondajında devrim yaratırken, hesap verebilirlik ve suçlulukla ilgili soruları da gündeme getirmektedir. YZ güdümlü bir geleceğe doğru ilerlerken, yasal, teknolojik ve etik konuların entegre edilmesinde işbirliği şarttır. Bu planı uygulayarak, YZ'nin enerji sektöründeki yıkıcı potansiyelinden yararlanabilir, riskleri azaltabilir ve adil ve sürdürülebilir bir enerji geleceği sağlayabiliriz.

KEYWORDS

Energy regulations
Artificial intelligence
Regional electricity authority
Chinese AI regulations

ABSTRACT

The ECOWAS Regional Electrical Regulatory Authority (ERERA) is the regional body responsible for overseeing cross-border electrical interconnections in West Africa. The desire of ECOWAS member states to realize electricity interconnections through the cooperative implementation and sharing of the region's energy resources is manifested in adopting an Energy Protocol, which aims to establish the proper institutional and legal framework for the growth of West Africa's electricity industry. Within the Energy Protocol and the West African Power Pool (WAPP) Program scope, the Member States of ECOWAS formed the ECOWAS Regional Electricity Regulatory Authority (ERERA) in January 2008 as a specialized institution of ECOWAS. Applying AI to the energy sector presents both challenging regulatory barriers and hitherto unrealized prospects. While AI enhances smart grids and revolutionizes oil drilling, it also raises questions about accountability and culpability. As we move toward an AI-driven future, collaboration in integrating legal, technological, and ethical matters is essential. By implementing this plan, we can leverage AI's disruptive potential in the energy sector, reduce risks, and ensure a fair and sustainable energy future.

1. Introduction

Artificial intelligence (AI) is driving a massive shift in the energy sector. Even though artificial intelligence (AI) has enormous potential to optimize energy production, delivery, and consumption, its integration presents significant legal issues. The energy business continually develops, making navigation more difficult due to its complex regulatory

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environment. In the legal energy business, artificial intelligence has surfaced as a viable remedy to tackle this issue. Smart grids, which are electrical supply networks that employ digital communications to monitor and respond to local variations in demand, can be significantly aided by AI technology. AI systems can forecast consumption patterns by evaluating past and current data, which helps utilities use resources more effectively (Niet, 2022). AI can also aid in efficiently distributing resources, especially in times of unexpectedly high demand. In these situations, artificial intelligence (AI) can enhance power distribution, directing it where it is most needed and reducing the chance of blackouts. However, the application of AI in smart grids brings up concerns about data security and privacy and accountability for AI-driven decisions that may result in outages (Ahmad, et al., 2021).

AI can be used by energy businesses to forecast when their equipment will break down or need maintenance. Machine learning can forecast probable malfunctions before they happen by evaluating vast volumes of data from many sources, including usage statistics, meteorological data, and previous maintenance records. This strategy lowers repair costs, minimizes downtime, and raises the overall dependability of the energy system. However, using AI algorithms to make crucial maintenance choices creates liability issues. The energy industry uses AI to evaluate real-time pricing, supply, and demand data to make lucrative trading decisions (Clarke, 2019). Because AI evaluates market volatility and uncertainty proactively, it is also very effective at risk management. AI-powered algorithmic trading is high-speed, completing many trades in milliseconds. It automates processes, simulates market situations, assesses sentiment, optimizes energy portfolios, and continuously adjusts to shifting market conditions. AI is invaluable in navigating the volatile energy market because of its remarkable pattern recognition capabilities, which allow it to spot patterns and trends in massive datasets (Pan, Ai, Li, Pan, & Yan, 2019). It can identify hazards and market opportunities that human traders might miss. AI has a big impact on the oil and gas exploration industry. Artificial intelligence (AI) can accurately evaluate enormous volumes of geological data, which allows it to find possible oil and gas reserves that conventional approaches could have overlooked (Kőkuti, 2023). It also evaluates these deposits' viability, focusing exploration efforts on the most promising opportunities. This lowers needless expenses and prices while simultaneously increasing efficiency and the success rate of exploration activities. Because artificial intelligence (AI) differs from previous technologies in a number of essential ways, AI regulation creates particular issues. These difficulties make it more challenging to develop efficient legal frameworks to control the risks associated with AI (Dhabliya, 2024).

The ability of AI to function independently is one of its most unique characteristics. Without human assistance, AI systems can carry out complicated jobs like maintaining investment portfolios and operating automobiles. There are important questions about accountability and control raised by this growing autonomy. The legal system needs to change to meet the challenges presented by these autonomous activities as AI systems assume increasingly complex functions. A critical concern about AI autonomy is predictability. Even the architects of AI systems cannot predict the behaviors and solutions these systems will create. For example, to optimize energy distribution and usage, Google's AI startup DeepMind announced in 2019 that it would be working with the UK National Grid (Fan, Ai, & Piao, 2018).

In an effort to boost productivity and cut expenses, the AI system employed machine learning to forecast power consumption and modify supply accordingly. In the process, the AI developed an amazing but efficient grid-balancing method. The AI system picked up on subtle patterns in energy consumption that human operators had missed (Baş & Demirtaş, 2022). In that instance, it made more accurate adjustments to power generation and distribution by discovering correlations between seemingly unrelated phenomena, such as weather patterns and energy use. As a result, energy waste was significantly reduced, and overall grid stability was increased. Furthermore, C-Path, an AI for cancer pathology, found surprising prognostic indications for breast cancer that went against accepted medical wisdom. These illustrations show how AI systems' computational capability and lack of cognitive biases enable them to produce solutions beyond human imagination (Shimizu & Nakayama, 2020). Because AI is unpredictable, it is challenging to predict its behavior, which makes determining who is responsible for harm caused more difficult. Legally speaking, the principles of foreseeability and causality are complicated by the unpredictable nature of AI acts (Stuurman & Lachaud, 2022). It becomes difficult to hold AI system creators accountable for any harm when the system behaves in ways the designers did not expect. This problem is made more difficult by the AI's ability to learn and adapt since its behavior may alter due to experiences gained after design. It is possible to see this unpredictability as an overriding cause that releases designers from responsibility while depriving sufferers of compensation (Veale & Zuiderveen Borgesius, 2021).

2. Literature review

Lessons from China's approach to implementing AI could help Africa navigate this space. China's AI market, valued at $23.196 billion in 2021, is projected to triple to $61.855 billion by 2025, with the Chinese government projecting that AI will generate $154,638 million in income annually by 2030. However, China is not just interested in AI spreading and its creative applications. It has also been quietly setting the standard and leaving its stamp on the regulatory landscape for AI. China enacted and implemented three separate regulatory measures at the municipal, regional, and national levels in 2022. This trend continued into 2023 when China enacted national-level laws to crack down on deepfake and generative technology in just

January (Roberts, et al., 2021).

China's Deep Synthesis Provisions became operative on January 10, 2023, as a component of the government's endeavor to fortify its oversight of deep synthesis technology and services. The provisions cover "deep synthesis service users" (organizations and individuals that use profound synthesis to create, duplicate, publish, or transfer information) as well as "deep synthesis service providers" (companies that offer deep synthesis services and those that provide them with technical support). "Technologies utilizing generative and/or synthetic algorithms, such as deep learning and virtual reality, to produce text, graphics, audio, video, or virtual scenes" is how the regulations define profound synthesis (Smuha, 2021). Because of these laws' extensive reach, producing AI-generated material for 1.4 billion people will drastically alter. China's rule goes further than the UK's, which also plans to outlaw the production and distribution of deepfake videos without permission. The policy establishes guidelines for each step of the deepfake use process, including development, labeling, and distribution. Furthermore, the law allows for the possible suppression of naturally captured content. Being one of the first nations to impose a deepfake regulation, there are concerns about whether China will use this law to further police freedom of expression too extensively. Nevertheless, discussions about what can be done to address the harms advocated by this technology are reviving. Whatever your position on the matter, the legislation does establish a precedent that may be partially repeated in other legal systems. We will learn more specifics about implementing these laws this year (Tallberg, Lundgren, & Geith, 2024).

On March 1, 2022, the Internet Information Service Algorithmic Recommendation Management Provisions came into force. This law is comparable to the DMA and DSA laws passed by the EU. The guidelines, which China's Cyberspace Administration drafted, mandate that companies offering AI-based tailored suggestions in mobile applications respect user rights, such as shielding children from damage and enabling users to add or remove tags related to their traits. The three primary categories of the regulation's requirements are information service norms, user rights protection, and general provisions. Because they are expected to comply, the regulations impact US and foreign businesses that utilize algorithms and machine learning in their websites or applications operating in China. Several important clauses have to be taken into account (Sheehan, 2023).

Online service providers who also engage in online news must apply for special licensing under Article 13, which forbids the algorithmic creation of false information. Because it mandates that online service providers attend to the interests of senior consumers, particularly about fraud prevention, Article 19 provides additional protection for the elderly. Among many other things, the rule forbids phony profiles, faking traffic figures, and promoting material that is addicting. Other less apparent clauses, which represent China's stance on AI ethics, require businesses to maintain conventional wisdom, spread good vibes with vigor, and prevent or lessen disagreements or conflicts. Like the DSA, China's recommender law requires more audits and openness for recommendation algorithms. As part of this regulation, China has established an algorithm registry to help learn about algorithms and ensure they operate within reasonable bounds. The security evaluation of registered algorithms is part of the registry. Nevertheless, it is unclear how much helpful information on black box technologies this registry will be able to offer. In the interim, such documentation and comprehension efforts are akin to those of the DSA and other EU laws, such as the EU AI Act.

China recently approved temporary generative AI regulations on May 23, 2023, effective August 15, 2023. The regulations are founded on five central tenets that aim to balance innovation and legal governance. China's essential socialist ideals must be upheld by generative AI, which cannot jeopardize national security or interests, encourage discrimination and other forms of violence, or spread false information (Hine & Floridi, 2024). It is vital to take action to stop discrimination originating from generative AI based on race, religion, country, area, gender, age, employment, and health. Generative artificial intelligence must uphold intellectual property rights and corporate ethics to prevent unethical competition and the disclosure of trade secrets. It is also necessary to take action to increase dependability, accuracy, and transparency. In order to facilitate this, the regulations mandate that generative AI providers perform data processing operations in a manner that maximizes the authenticity, accuracy, objectivity, and diversity of training data while adhering to legal data sources, protecting intellectual property rights, and obtaining consent for the use of personal information.

China's Personal Information Protection Law (PIPL), a government data privacy law aimed at protecting personal information and addressing issues with personal data leakage, has ramifications for automated decision-making technology in addition to these laws that directly target AI. Adopted on August 20, 2021, and coming into effect on November 1, 2021, the PIPL imposes requirements on international firms operating in China and Chinese organizations to safeguard Chinese residents' privacy and personal information (Calzada, 2022). According to the law, any information, whether electronically or otherwise recorded, pertaining to a known or identifiable natural person within the People's Republic of China is considered "personal information" (PI). Similar to the EU's GDPR, PI does not include anonymized data that is non-reversible once anonymized and cannot be used to identify a specific natural person. The following are some of the primary contributions made by the PIPL, together with guidelines about impact assessments and automated decision-making.

More rights are granted to data subjects on how their data is used. They can ask to have their data edited or removed,

have its usage restricted, or have their prior consent revoked. Stricter guidelines for data transmission and sharing, which your company and any joint data controllers from outside parties may need to meet to pass data evaluations. Required security measures must be used when processing and storing the PI, and authorized staff members handling the PI must get training; when the amount of PI is above the threshold established by the Cybersecurity Administration of China (CAC), mandatory data localization is required (Feng, 2019).

The following regulations apply to companies and people who process personal data in China or outside the country, provided the following requirements are met. It provides goods or services to natural persons in China, or personal information is processed. Furthermore, the analysis and evaluation of the behavior of natural persons in China or other situations specified by laws and administrative rules is granted. The processing of personal information by natural persons for domestic or personal purposes is exempt from the law. This covers situations requiring immediate action to safeguard people's lives, health, or property. Aside from these exceptions, personal information handlers who violate the PIPL may be fined up to 50 million RMB, confiscate their money (up to 5% of their yearly revenue), or shut down their firm (Cui & Qi, 2021).

The PIPL is important in regulating AI since it controls data, which is essential to AI. The PIPL operates in China, as recent instances demonstrate how the GDPR applies to AI in the EU. This is seen in China's deepfake regulation, which stipulates that organizations using deepfakes must abide by the country's current PIPL rules. China's Ministry of Science and Technology also released a New Generation Artificial Intelligence Code of Ethics on September 21, 2021, in addition to these rules. The National New Generation Artificial Intelligence Governance Professional Committee released the Ethics Code, which was formed by the Chinese Ministry of Science and Technology to investigate policy recommendations for AI governance. It offers guidance for natural and legal persons and other pertinent institutions and covers the entire life cycle of AI. The following are the primary contributions made by the Specification's general provisions. The first one is the enhancement of human well-being. This implies that AI systems ought to adhere to shared ideals, respect human rights and the core interests of society, foster harmony, enhance livelihoods, and adopt a sustainable strategy for the growth of the economy, society, and environment (Calzada, 2022).

The second is the promotion of justice and fairness. In order to advance equality of opportunity and justice, AI systems should be inclusive, effectively safeguard the rights and interests of those who engage with them, and distribute the advantages of AI throughout society. Respecting vulnerable populations and making accommodations where needed are important. The third is security and privacy protection. AI systems should respect user privacy and make sure that consent is sought before processing personal data. Data handling should be done safely, and personal privacy should be legally safeguarded. As seen above, the verticals of safety, privacy, and fairness are at the center of the Specification's general provisions. Management standards are urged to concentrate on the proper governance and use of authority in order to minimize AI hazards. The Specification also includes supply specifications that emphasize observing market regulations and making sure emergency plans are in place, as well as R&D specifications on data storage and use that center on security measures and equity.

Additionally, organizational management is encouraged to expand upon the Ethics Code and create policies that align with the requirements of the systems they employ by the organization and implementation rules. The federal government is not the only entity focusing on AI legislation; provincial and local governments are also involved. In contrast to national measures that are more restrictive, regional rules in China have offered a better balance between support for innovation and regulation. Regional laws seem to endorse industry and government best practices for advancing AI development. The province and local AI law in Shanghai and the Shenzhen Special Economic Zone are examined in this section (Dixon, 2023).

The provincial-level Shanghai Regulations, passed in September 2022 and enacted on October 1 of the same year, are intended to foster the growth of the AI industry. Regarding the creative advancement of AI, the rule is seen as industry promotion law. But the law also establishes a graded management system in light of AI's potential future effects. It implements sandbox supervision, which gives businesses a dedicated area to test and investigate new technologies. The Shanghai AI Regulation is unique because it allows for certain leeway for minor violations. This demonstrates a more significant commitment to promoting innovation and aims to continue encouraging the development of AI without burdening businesses or developers with the dread of strict regulation. This is accomplished by including a disclaimer that states that no administrative penalties will be applied for small infractions and that relevant municipal offices will compile a list of infraction behaviors. The rule also creates an Ethics Council to raise ethical awareness and act as a check and balance to the innovation-center strategy (Cheng & Zeng, 2023).

Like the Shanghai Regulations, the Shenzhen AI Regulation was passed in September 2022 and became operative on November 1, 2022, to advance the AI sector. By providing more funding for these initiatives, the rule seeks to incentivize Chinese governmental organizations, more especially those in the Shenzhen Special Economic Zone, to be at the forefront of AI adoption and development. The policy takes a risk-management approach to AI to support this expansion. It does this by permitting Shenzhen-based AI services and products deemed "low-risk" to continue their trials and testing without local regulations as long as international criteria are met. The regulation's Article 72

highlights the value of AI ethics and promotes risk assessments to find unfavorable consequences in systems and goods. The risk classification system will be developed and administered by the Shenzhen government. This is a significant development even though it's a local rule because Shenzhen is home to many AI and tech-related companies. Between 2021 and 2025, USD 108 billion is expected to be invested in this industry.

According to one perspective, China has observed how rules are increasingly being used to establish international norms and standards. In fact, China has been involved in some of the world's earliest enforcement of AI regulation, wanting to set that precedence for itself. However, there is disagreement about whether China's approach to AI regulation is a ploy for political advantage or a sincere attempt to limit the negative effects of AI system research and implementation. However, interpreting China's intentions in the AI regulatory arena in such a binary manner would be incorrect. China's efforts are undoubtedly driven by a desire to establish international norms. However, they also incorporate a multifaceted strategy aimed at regulating the negative effects of AI and comprehending "high-risk" algorithms rather than merely cataloging them. For instance, China is concentrating on the technical ramifications of digital services. In contrast, other regions of the world have prioritized bias and transparency, which is comparable to the goals of the DSA. Making a head start in this regard by trying to delve into the intricacy of black box technology and recommender systems through its algorithmic registry.

It is becoming increasingly apparent that enterprises must be able to keep up with the changing regulatory landscape surrounding them. Given that China is ahead of the curve, it will be intriguing to observe who sets the gold standard for AI in the East, how others may be able to learn from China's example, and how East-West relations on AI continue to converge. Even if the businesses operate outside of China, the country's worldwide influence suggests that the proposed laws might be adopted in other countries and significantly impact the ECOWAS region.

3. Methodology

Text analysis is essential in several social scientific fields, including political science, psychology, sociology, and communication studies. The significance and potential of text analysis have increased dramatically in recent years because most human communication is now recorded and processed as digital data due to digitalization. At the same time, text analysis is still a difficult task.

Even though machine learning and natural language processing, two computer techniques for evaluating textual data, have advanced rapidly in recent years, they are still challenging to use and frequently need substantial amounts of manually coded training data and an in-depth understanding of computational techniques. Even then, the approaches frequently only obtain a limited degree of accuracy since they have trouble with irony and sarcasm, drawing conclusions that call for background knowledge about the world, and important interpretative tasks like placing oneself in the author's shoes. Humans have been regarded as the unmatched gold standard for text analysis. Humans, however, are not without significant restrictions. Manual text reading is time-consuming and expensive, restricting research to small sample sizes, especially for interpretive tasks requiring more in-depth analysis. Because of this, bias, a lack of rigor and repeatability, and poor data quality have all been attributed to manual text analysis (Chang, et al., 2024).

However, the advent of Large-Language Models (LLM) like ChatGPT may change this and the way text analysis is done in the social sciences. Pre-trained on a significant portion of all material on the Internet and in all books ever published, ChatGPT is built on a massive neural network with billions of parameters. These LLMs have proven capable of several unexpected emergent tasks, including programming and translation. Studies have shown that LLMs can perform almost any task we give them regarding text processing (Wang, Qian, Zhou, Chen, & Tan, 2023).

These models can even perform jobs that previous computational methods have failed, such as irony, sarcasm, or subjective and contextual interpretation, because they are general rather than task-specific. According to recent research, LLMs work effectively for many tasks, such as text annotation assignments, ideological scaling, mimicking samples for survey research, and much more. Many academics feel that LLMs constitute a paradigm shift in text analysis in the social sciences because they are simple to use, quick, inexpensive, and relevant to various text analysis tasks. They also disrupt the traditional distinction between the quantitative and qualitative domains by enabling computational analysis of novel challenges (Homoki & Ződi, 2024).

Advanced artificial intelligence (AI) systems called large language models are made to understand and produce human language. These models use enormous volumes of textual data to understand patterns, semantics, and syntax. They do this by utilizing deep learning techniques based on artificial neural networks, essentially abstract mathematical models of brains.

ChatGPT is the most well-known LLM at the moment. An AI chatbot called ChatGPT was created by OpenAI and released in November of 2022. ChatGPT mimics a dialogue with the user. It is built on OpenAI's LLMs GPT-3.5 and GPT-4 and belongs to the Generative Pre-trained Transformer (GPT) family of language models. After being trained on an incredibly large corpus of text, the GPT models were refined to provide replies similar to those of humans by having human trainers serve as both the user and the assistant to the AI solution. Although the smaller transformer-based language models functioned similarly to an advanced autocomplete, the larger models started to exhibit unexpected emergent characteristics and even acquired capabilities for which they had not been

specifically trained. For example, ChatGPT generates fresh sentences and information instead of repeating previously spoken words. In addition, the chatbot may create prose or poetry on any subject in a specific manner, translate between multiple languages, and even generate programming code. One of the most significant emerging capacities for social scientists is the models' ability to interpret almost any textual statement. Almost any query concerning a particular text can be posed to the model by researchers, such as determining themes or topics, if the text contains false information, what emotions are conveyed in the text, or the author's potential objectives. There are yet more tasks that the models are finding excellent at. In interpretive textual analysis, early research has demonstrated that the models can perform better than human experts, demonstrating higher accuracy, reduced bias, and more dependability across languages and regional settings (Mökander, Schuett, Kirk, & Floridi, 2023). The article utilizes a comparative textual analysis approach to analyze AI on the energy regulatory environment in the ECOWAS and how Chinese AI regulations may impact the development of a solid regulatory framework for the region.

4. ECOWAS Energy Regulations

The regional authority for cross-border electrical interconnections in West Africa is the ECOWAS Regional Electrical Regulatory Authority (ERERA). The adoption of an Energy Protocol, which aims to establish the proper institutional and legal framework for the growth of West Africa's electricity industry, is a manifestation of the desire of ECOWAS member states to realize electricity interconnections through the cooperative implementation and sharing of the region's energy resources. In January 2008, the Member States of ECOWAS established the ECOWAS Regional Electricity Regulatory Authority (ERERA) by Supplementary Act A/SA.2/1/08 as a specialized organization of ECOWAS within the framework of the Energy Protocol and the West African Power Pool (WAPP) Program. The overall goal of ERERA is to control cross-border electricity exchanges amongst ECOWAS member states, supervise the establishment of the prerequisites for rationalization and dependability, and assist in creating an economic and regulatory framework conducive to the growth of the regional market (Akinyemi, Efobi, Osabuohien, & Alege, 2019).

According to Article 7 of the Energy Protocol, ERERA's overall mission is to regulate cross-border power pooling among ECOWAS Member States and supervise the implementation of necessary conditions to ensure rationalization and reliability. Additionally, it supports establishing a regulatory and economic environment conducive to the growth of the regional market and supervises compliance with the principle of freedom of electricity transit. Furthermore, it supervises the establishment of a clear, transparent, and predictable tariff-setting methodology for regional power pooling, is in charge of the technical regulation of regional power pooling and the monitoring of regional market operations, and aids the ECOWAS Commission in defining the strategic direction of the regional market. Furthermore, it shall create efficient channels for resolving disputes amongst participants in the regional power market, oversee its appropriate implementation, and facilitate effective communication amongst the many players in the sector. Finally, the organization develops partnership relations with national regulatory bodies in the Member States and offers them technical advice and help upon request.

In relation to its missions, specific roles include the responsibility of ERERA to manage and regulate the regional electricity market and provide guidance to the ECOWAS commission on all matters concerning the regional market's structure and policies. Another critical focus is overseeing the development of the regulations governing the operation of the regional market and the grant of access to the regional power transmission network, as well as overseeing the implementation and observance of technical guidelines and standards relevant to the regional electricity market. This implies that operators who fail to comply with applicable regulations may face sanctions, and therefore, it makes sure that community directives regarding the regional market's organization are followed (Gatete & Dikko, 2024).

Additionally, there are several requests from national regulatory bodies for permissions or licenses to engage in the regional market that it is required to accept. Another crucial area is overseeing the implementation of the concepts of accounting separation and transparency by power firms in coordination with national regulators. Hence, ERERA is responsible for ensuring that these regulations, guidelines, and principles do not allow for any form of discrimination, cross-industry, or market manipulation, which is an important cornerstone and responsibility in addition to conducting regular operator benchmarking and financial and technical viability assessments (Adigun, 2024).

ERERA plans to develop the regional electricity market by aiding in the efficient development and management of energy resources, demand-side management, economic activity competitiveness, and control over future technological decisions. Furthermore, the organization examines and provides feedback on the Master Plan that WAPP has presented for the creation of regional infrastructure and approves the operators' selection criteria for building the regional power infrastructure so as to prevent anti-competitive practices; consult on any requests for permission to build new lines to the regional transmission network, as specified in the master plan. Finally, it has to make sure the regional network growth strategy is followed and offer solutions if any deviations could have an impact on the local market.

When determining the rates for ancillary services and transmission, ERERA will approve tariff proposals from operators, establish regulations on accounting standards for

tariff structure and cost for transmission and related services, release the relevant tariff rates, and supervise their implementation. Finally, ERERA is responsible for updating the tariff and accounting guidelines to reflect the cost of ancillary services and transmission through open stakeholder consultation. Another crucial aspect is that when resolving disputes, ERERA settles disagreements about how this Regulation or any other Act pertaining to the regional market should be applied or interpreted and creates and disseminates guidelines and processes for resolving conflicts.

Auditing is another crucial task, and in cooperation with national regulators, WAPP, transmission network managers, market operators, and other sub-regional and regional institutions, establish a system for gathering and managing data on power pools, market participants' performance, and other relevant topics. Furthermore, it distributes pertinent information on market operations to the ECOWAS Commission, national regulators, and WAPP while adhering to confidentiality guidelines. Additionally, an annual activity report is submitted to the ECOWAS Commission President. The Regulatory Council is ERERA's management and decision-making body. The Chairperson is one of the three members that make up the Regulatory Council. The members of the Regulatory Council are chosen for a five-year fixed term that is not renewable.

After the second Chairman's term ended in July 2022, a new Chairman took over. His name is Mr. Kocou Laurent Rodrigue TOSSOU, and he works as an engineer. Laurent Tossou has joined the ranks of the two other Regulatory Council members, appointed in May 2017: Mr. Aly Mar NDIAYE, an engineer, and Dr. Haliru DIKKO, an economist. A group of experts in charge of regulatory concerns and a department in charge of administration, finance, and human resources support the Regulatory Council. This organizational structure, created for ERERA's initial three years of operation, is gradually strengthened in accordance with how the activities and the regional market change over time. In order to aid the Regulatory Council in making decisions, consultation institutions may be established as regulatory tools under the ERERA Regulations. Another crucial aspect is the working groups; in order to facilitate the effective gathering of data on the West African power industry, two working groups were established in May 2015: one for data collection and the other for program planning, which aimed to encourage dialogue on the ERERA work programs.

There are several guidelines for Organizing West African Regional Electricity Markets. The primary goal of the Directive, which was adopted in June 2013 by the ECOWAS Council of Ministers, is to establish the general guidelines that would govern the Regional Electricity Market inside the boundaries of the ECOWAS Energy Protocol. Additionally, the Regional Electricity Market Rules (RMR) represent an important component. In accordance with the guidelines and protocols outlined in the "Operation Manual for WAPP Interconnected Power System," these regulations control the trading of all electricity that travels through the Interconnected Transmission System of the West African Power Pool (WAPP) between participating nations. Finally, the WAPP Operation Manual guarantees, through technical guidelines, that all of the WAPP's interconnected power systems operate the network of interconnected Western African countries effectively and efficiently and that they share equally in the responsibilities and rewards that come with interconnection (Wesseh Jr & Lin, 2016).

Finally, the Transmission Tariff Methodology for WAPP is another critical component. The Regional System and Market Operator (SMO) will use the Transmission Tariff Methodology for the WAPP to create a transparent, understandable, and consistent mechanism for determining transmission pricing. In the context of cross-border power exchange transactions in the regional energy market, it lays down the procedures to be followed as well as the guidelines for transmission pricing.

The West African Power Pool (WAPP) was formed by a group of power firms with the goal of creating a regional electricity market within the ECOWAS area. Creating a Power Sector Regional Regulatory Body (RRB) was a principle taken to ensure harmonization of practices within the regional market and to encourage cross-border power exchanges between Member States. Without assessing current regional regulation models in the energy sector generally and the power sector specifically, its design would not have been possible. The analysis of regional regulation practices across the globe reveals two distinct categories of organizations: those established at the governmental or intergovernmental levels, possessing genuine authority over the regulated areas with respect to decision-making, oversight, and control, and those originating from associations of national regulators, typically limited to consultative authority (Ogwezzy, 2017).

In order to ascertain how different stakeholders interact and their effect on the power sector's functioning, it is necessary to analyze the institutional structure of the area in question before establishing a regulatory body at the regional level. In order to do this, it is necessary to look at the background and surroundings of each regulatory model, highlighting the roles and responsibilities of the regulator and, if needed, examining how it interacts with other regional organizations whose operations affect cross-border power exchanges as well as national regulators. The analysis makes the identification of models that will serve as models for the development of regulations for the establishment and functioning of the Regional Regulatory Body in the ECOWAS power sector possible.

5. Legal Analysis of AI's impact on the ECOWAS

The nature of AI R&D poses additional challenges to the effective regulation of AI. AI R&D is similar to other technologies of the Information Age in that it is diffuse, opaque, discrete, and discreet. That is to say, AI

development frequently takes place in private or isolated environments, making oversight and regulation challenging. The attribution of responsibility is complicated by the fact that AI systems are constructed from various components, most of which are obtained from separate sources. Moreover, centralized control is challenging due to the broad nature of AI development and the fact that it can be conducted by a variety of actors, including small teams or lone individuals. Lastly, effective monitoring is hampered by the fact that the inner workings of AI systems are frequently opaque, either as a result of the technology's complexity or developers' deliberate secrecy (Ahmad, et al., 2021).

There is a great deal of hope that legal frameworks might reduce the associated public risks of artificial intelligence (AI) without inhibiting innovation, even in spite of the technology's complexity and possible hazards. A comprehensive strategy that strikes a balance between legislation and technical advancement is needed to address the legal voids surrounding AI. The first issue is how inadequate the current legal system is to address AI. The legal system must change to accommodate AI's special needs. This involves the challenging but not unique task of developing legal terminology for artificial intelligence. The legal system is known for its history of clarifying vague concepts and making necessary adjustments. Likewise, courts have long accommodated technological advancements, and they are not unfamiliar with the concepts of foreseeability and causality in deciding culpability.

An additional problem to the one above is the management of AI systems to avert harm after development. However, This does not negate the need to regulate AI development before implementation. Current legal systems can address the discrete and opaque nature of AI. For example, a lot of technologies combine parts from several sources, and courts have long handled culpability in these situations. Legal measures, such as incentives or regulation, might require transparency in AI systems, requiring businesses to reveal the inner workings of their systems. AI is not the only sophisticated system. Even though components of other contemporary technologies come from different sources, the legal system has evolved to deal with these complications. For instance, the car industry has guidelines for allocating responsibility in cases where many components cause a failure. The opacity of AI can also be decreased by enacting legislation mandating the release of AI specifications and code, as well as by offering tax breaks and tort rules that support open systems. It's also important to remember that big, obvious companies developing AI give regulations a tactical edge. Even if AI has the potential to spread widely, large companies with substantial financial and human resources are expected to make significant advancements. Businesses like Google, IBM, Facebook, Microsoft, and Facebook have already made significant investments in AI initiatives, indicating that businesses and governments will drive most of AI development. The concentration facilitates regulators and judges' oversight and management of the public hazards associated with AI. Globally, the application of artificial intelligence (AI) in the energy industry is fast developing, and various nations and areas are now putting rules and laws in place to deal with its effects. Globally, policymakers are realizing more and more how crucial it is to regulate AI to guarantee that it is applied morally and responsibly. Nations, including Brazil, Israel, Italy, Japan, and the United Arab Emirates, are proactively molding their AI policies to mitigate any possible adverse outcomes.

Europe recently took a big step forward by enacting extensive AI laws. These rules are intended to address a number of topics, including high-risk systems, public spaces' use of AI, and openness in AI systems. Model review, risk mitigation, and incident reporting will all be more stringent for highly impactful models that represent systemic hazards (Tallberg, Lundgren, & Geith, 2024).

China has published a draft set of generative AI regulations and is looking for public input on the draft regulations. China, in contrast to most other nations, has legislation requiring generative AI to adhere to "Socialist Core Values." According to the draft laws, training data sources are restricted because developers may be held accountable if their data violates third parties' intellectual property. Additionally, developers may be held accountable for the results produced by their AI. Legislation requires AI services to generate only "true and accurate" material. China is ahead of other countries that are only now beginning to create new laws because these proposed regulations are an extension of current laws pertaining to deepfakes, recommendation algorithms, and data security. Israel's Ministry of Innovation, Science, and Technology released a draft policy on artificial intelligence regulation in 2022. The draft policy aims to give businesses, organizations, and governmental entities involved in artificial intelligence a moral and practical direction. The policy underlines the value of responsible innovation and stresses that privacy, human dignity, public interests, fundamental rights, and the rule of law must all be respected in the development and application of AI. While artificial intelligence (AI) is transforming several industries, including healthcare and banking, there are also serious hazards for the general population. It is increasingly important to make sure AI systems are safe and consistent with human values as they get more intelligent and independent. It is possible to develop a thorough regulatory structure in order to handle these difficulties. By creating an organization tasked with verifying the security of AI systems, this approach can control the dangers associated with AI while encouraging innovation (Sheehan, 2023).

This legislative framework suggests creating a dedicated organization to attest to the security of AI systems. This approach presents a nuanced liability mechanism, in contrast to typical regulatory organizations that might outright ban harmful products. This system separates AI that is certified from uncertified. AI system designers, producers, and vendors who obtain agency certification will be subject to

limited tort responsibility. Companies are encouraged to make sure their AI systems adhere to safety regulations by this restricted responsibility. Businesses that provide uncertified AI for use in commerce risk severe joint and several liability. This incentivizes them to pursue certification since it implies they will be held entirely responsible for any damage done by their AI systems.

This framework makes use of many institutions' advantages. With their democratic legitimacy, legislators will establish the general objectives and aims of AI legislation. The scientific evaluation of AI safety will be handled by an impartial organization that employs experts, keeping these choices separate from electoral politics. Courts will use their experience managing specific cases to resolve disputes and assign blame for problems associated with AI (Stuurman & Lachaud, 2022).

A crucial component in guaranteeing responsibility and equity in the artificial intelligence (AI) regulatory framework that is being suggested is the court's participation. Courts are given the authority to decide specific tort claims resulting from harm caused by AI systems under this paradigm. In order to establish culpability and administer justice, courts will traverse difficult legal terrain by drawing on their institutional strength and fact-finding competence. In addition, courts will be essential in dividing up the responsibilities of the different parties engaged in the creation, deployment, and use of AI systems. Courts will apply strict liability rules in situations where uncertified AI is involved, holding all parties involved in the development and implementation of the AI system liable. By ensuring that everyone shares the proper burden for harm caused by AI, this responsibility-sharing promotes an accountable culture within the AI sector. With the fast-changing and dynamic nature of technology, disputes are unavoidable, and the legal system is prepared to handle these issues. Specifically, disagreements could emerge regarding AI systems' certification status or the point at which changes made the system uncertified. The court's involvement becomes even more crucial in this situation since it has to sort through intricate legalese and technical issues to render equitable and fair rulings.

Pre-trial proceedings will be held to ascertain whether the AI system complies with certified versions, to set the liability threshold, and to draw a boundary between defendants who are subject to strict liability and those who are subject to limited liability. By guaranteeing that justice is done and legal norms are respected, the court essentially acts as a pillar of the regulatory framework for artificial intelligence.

6. Conclusion

AI's introduction into the energy sector offers hitherto unseen opportunities as well as difficult regulatory obstacles. AI revolutionizes oil drilling and improves smart grids but raises concerns about liability and accountability. Because the current legal system finds it difficult to manage AI's autonomy and clandestine development, regulating AI in the energy sector demands striking a careful balance between supporting innovation and managing dangers. This calls for a comprehensive regulatory approach. Working together to integrate legal, technological, and ethical considerations is crucial as we head toward an AI-driven future. By adopting this strategy, we can mitigate risks and guarantee a just and sustainable energy future while utilizing AI's disruptive potential in the energy sector.

AI may play a significant role in enhancing renewable energy production, supporting localization, and establishing microgrids. This requires understanding the many stakeholders engaged in developing the power sector. This includes investors, financial institutions, local citizens, and entrepreneurs who may encourage the development of new business models and power solutions. This has been indicated by the ECOWAS regional strategy and action plans as a crucial component. Regional capacity-building workshops have aimed to enhance member states' comprehension of green power production and technologies, industrial challenges, and opportunities for key stakeholders in the sub-regions energy sector. AI may enhance faster adoption and more excellent power stability.

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RESP

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Araştırma Makalesi ● Review Article

Bölgesel Kalkınmada Yerel Ürün ve Kadın Kooperatiflerinin Önemi:TR71 Bölgesi *

The Importance of Local Products and Women's Cooperatives in Regional Development: TR71 Region

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ANAHTAR KELİMELER

Sürdürülebilirlik
Kalkınma
Kadın Kooperatifleri

ÖZ

Sosyal ve ekonomik kalkınmanın hedefleri arasında artık sürdürülebilirlikle beraber dengeli kalkınma da bir zorunluluk haline gelmiştir. Yüzyıldan daha uzun süredir Türkiye'de uygulanan kooperatif modeli, istihdam yaratmak, ürün ve hizmet yaratarak atıl konumdaki kaynakların ekonomiye yeniden kazandırılmasını sağlamak gibi ana amaçlara sahiptir. Kadınların istihdama dahil edilmesi, sürdürülebilir gelir elde etmelerinin sağlanması, becerilerinin artırılması, sosyalleşmeleri ve örgütlenmeleri gibi sosyal hedefleri içermekle beraber, çerçevede yerel ürünlerin üretiminin devamı, iç ve dış göçe sebep olacak bölgesel itici faktörlerin azaltılması, bölgeler arası gelişmişlik farkının en aza indirilmesi, kooperatiflerin içinde bulundukları coğrafi bölgenin sürdürülebilir kalkınmasına katkı sağlaması, yerel kaynakların dengeli kullanılması, çevrenin korunması gibi gayeleri de kapsamaktadır. Bu çalışma TR 71 bölgesinde yerel ürün ve gıdaların kadın kooperatifleri vasıtasıyla bölgenin ekonomik kalkınmasına ve sürdürülebilir üretimine etkilerinin belirlenmesini amaçlamaktadır.

KEYWORDS

Sustainability
Development
Women's Cooperatives

ABSTRACT

Balanced development, along with sustainability, has become a necessity in the pursuit of social and economic development. The cooperative model, which has been practiced in Turkey for more than a century, has the main objectives of creating employment, creating products and services, and reintroducing idle resources into the economy. Women's cooperatives have social objectives such as including women in employment, providing them with sustainable income, increasing their skills, socializing and organizing them. Within this framework, the following objectives were qualitatively investigated: the continuation of the production of local products, the reduction of regional push factors that cause internal and external migration, the minimization of the development gap between regions, the contribution of cooperatives to the sustainable development of the geographical region in which they are located, the balanced use of local resources, and the protection of the environment. This study aims to determine the effects of local products and foods in TR 71 region on the economic development and sustainable production of the region through women's cooperatives. In this sense, it is thought that the region will contribute to the literature on the economic and social development potential of the region based on the local.

1. Giriş

İktisadi kalkınma günümüzde sadece, ekonomik büyüme, sanayileşme ve kentleşme olarak değil aynı zamanda ekonomik sürdürülebilirlik, sosyal adalet, yerel ekonomik kalkınma şeklinde de anılmaktadır. Dünya genelindeki kalkınma çalışmalarının odağında kırsal kalkınmanın yer almasına rağmen, kırsal bölgelerdeki az gelişmişlik ve buna bağlı olarak yoksulluk varlığını devam ettirmektedir (Ashley ve Maxwell, 2001; Odi, 2002). Bununla birlikte yoksul nüfusun büyük çoğunluğu kırsal bölgelerde hayat

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sürmektedirler (Anderson, 2003; IFAD, 2011). Benzer durum Türkiye için de geçerlidir. Sosyal ve ekonomik göstergelerin birçoğunda kırsal bölge nüfusunun, kent nüfusundan daha yoksul olduğu ortaya konulmuştur. Çağımız şartlarına göre kırsal bölge ve kent arasında yaşam şartları ve refah makası giderek açılmaktadır. Çünkü kırsal bölgelerdeki, temel refah şartları olan sağlık, eğitim, ulaşım ve konut sorunu gibi problemlere kalıcı ve yeteri çözümlerin henüz tam olarak sağlanamaması en önemli nedenler arasında sayılabilir (Bıçkı, 2011).

Kır ve kent arasındaki refah farkının en aza indirilmesi amacıyla, söz konusu problemi yaşayan ülkelerin tümünde, kırsal kalkınma politikaları ile kırsal alanda yaşayan nüfus, diğer bir ifade ile köylü nüfusun gelir ve yaşam koşullarının iyileştirilmesi kalkınma amaçlarının gerçekleştirilmesinde ilk sıralarda yer almaktadır (Gülpak, 1997). Bu sebeple kırsal kalkınma; doğal kaynak kullanımının sürdürülebilir bir şekilde kullanılmasından yola çıkarak, hem kırsal nüfusun gelir seviyesinin yükseltilmesi hem de yaşam standartlarının iyileştirilmesi kırsal alan ile gelişmiş bölgeler arasındaki gelişmişlik farkının en aza indirilmesi amaçlanıp, aynı zamanda bölgedeki çevre ve kültür değerlerinin korunması ve geliştirilmesi göz önünde tutularak, yerel bölgelerde farklılık içeren, ekonomik, sosyal ve kültürel ihtiyaç, potansiyel ve dinamikleri de içeren bir bakış açısı ile geniş sektör ağlı bir yaklaşımla planlanan faaliyetlerin tamamı olarak tanımlanmaktadır (DPT, 2006).

Tanımlanan kırsal kalkınma amaç ve yönelimleri dikkate alındığında bu noktada kırsal bölgelerde yerel ürünler oldukça önemli hale gelmektedir. Zira yerel ürünler, bölgenin doğal ve kültürel mirasını yansıtan önemli unsurlardır ve yerel ekonomilerin canlanmasına katkı sağlayarak bölgenin sosyal ve ekonomik potansiyelini yükseltmektedirler. Aynı zamanda, bu ürünlerin üretimi ve pazarlanması, yerel tarım ve el sanatlarının korunmasını desteklemekte ve çevresel sürdürülebilirliğe de katkı sunmaktadırlar. Kırsal alanlarda yerel ürünlerin büyük çoğunluğunun kadın emeği ile üretildiği dikkate alındığında kadın kooperatiflerinin yaygınlığı ve aktifliği dikkate değer hale gelmektedir.

Kadın kooperatifleri, kadın eliyle kurulmuş ve onlar tarafından yürütülen kooperatifler olarak yalın biçimde tanımlanmakla birlikte uluslararası literatürde tam olarak kabul görmüş bir tanımı bulunmamaktadır (KEİG, 2015: 15). Türkiye'de kadın kooperatiflerinin kuruluşu çeyrek yüzyıla dayanmakla birlikte son yirmi yıla bakıldığında sayılarının artışında bir ivme olduğu görülmektedir. Sivil toplum kuruluşlarının çalışmaları, bakanlıkların politikaları, yerel yönetim faaliyetleri ve çeşitli kamu kuruluşları ile uluslararası kuruluşların destekleriyle son yıllarda kadın kooperatifleri sayısında önceki yıllara nazaran yüksek bir artış görülmektedir. (Bilgin ve Tanıyıcı, 2008). Günümüzde kadın kooperatiflerinin sayısının artmasında, bahsi geçen kurum ve kuruluşların kooperatiflere üretim yeri, meslek edindirme eğitimi, sivil toplum kuruluşları ile kadınların motive edilmesi gibi faktörlerin etkisinden bahsedilebilir. Diğer taraftan yapılan desteklerin saiki ise, kadın kooperatiflerinin, yoksullukla mücadelede ve kırsal kalkınmada, kadınların istihdama dahil edilmesi, ekonomik ve sosyal güçlenmelerinin sağlanması için önemli araçlardan birisi olarak görülmesi olarak düşünülebilir. Dolayısıyla kadın kooperatifleri, kadınların ekonomik ve sosyal hayata katılımını artırarak, toplumsal cinsiyet eşitliği ve kalkınma hedeflerine katkıda bulunmaktadırlar. Kadınların kooperatifler aracılığıyla elde ettikleri gelir, ailelerinin ve toplumun genel refahını artırırken, yerel ekonominin çeşitlenmesine ve güçlenmesine de yardımcı olabilmektedir.

Dünya genelinde de durum Türkiye'deki benzer amaç ve politikaları barındırmaktadır; pek çok kurum ve kuruluşun, yoksullukla mücadele, ekonomik kalkınmanın sağlanması ve refah seviyesinin artırılması ve kadınların güçlenmesi amacı, toplumsal yapıda yer etmiş olan cinsiyete dayalı güç eşitsizliklerinin azaltılması ile sağlanabilecektir. Cinsiyete dayalı toplumsal yapıdaki güç dengesizliğinin bu yolla aşılması, kadınların sosyal ekonomik açıdan dezavantajlı olduğu ülkelerde, kadın haklarının yerleşmesine de önemli katkılar sağlayacaktır (Demetriades 2009).

Türkiye'de TR71 bölgesinde kadın kooperatifleri ile ilgili yapılan çalışmalar ile, mevcut durumun araştırıldığı çalışmalar, faaliyet halindeki kooperatifler ve kadınların kooperatifleri aracılığıyla ekonomik ve sosyal yaşama dahil olabilmesine destek veren çalışmalar, kadınların güç kazanması ve kadınların istihdama katılma potansiyellerinin artırılması çabasını içermektedir. Diğer taraftan kooperatifleşme sahasına bakıldığında, kadın kooperatifleri genel itibariyle 'kadınlara ait iş' şeklinde nitelendirilen faaliyet alanlarında yer aldığı görülmekte ve çoğunlukla kooperatif üyeliği ve kaynaklara erişimde bazı sıkıntılar ortaya çıkabilmektedir. Dolayısıyla kadınların kooperatifleşmesi kırsal kalkınma politikalarının gerçekleştirme araçlarından birisi olarak kabul edilen kadınların güçlenmesi, cinsiyet dengesizliğinin yarattığı dezavantajın ortadan kaldırılması, kadın istihdamının artırılması amaçlarının gerçekleştirilmesini tartışmalı bir konuma taşımaktadır. Bu bağlamda özellikle kırsal alanda kadın kooperatifleşmesi ve yerel ürünlerin ekonomik sürdürülebilirlik potansiyellerinin araştırılması önem arz etmektedir. Çalışmanın motivasyonunu söz konusu önemlilik oluşturmaktadır. Dolayısıyla çalışmanın amacını, TR71 Bölgesi'nde yerel ürünlerin ve kadın kooperatiflerinin bölgesel kalkınma üzerindeki önemini belirlemek ve vurgulamaktır. Bu sebeple çalışma, yerel ürünlerin ve kadın kooperatiflerinin TR71 Bölgesi'nin ekonomik, sosyal ve kültürel dokusuna olan katkısını ortaya çıkarmak için bir pencere açmayı hedeflemektedir.

2. Kavramsal Çerçeve

Günümüzde ekonomik kalkınmanın gerçekleştirilmesinin bir ayağı da bölgesel gelişmişlik farkının azaltılarak kırsal kalkınmanın sağlanmasıdır. Kırsal kalkınma için yörenin ya da bölgenin var olan sosyal, kültürel ve coğrafi varlıklarının

optimum şekilde değere konu olması ve bütün kaynakların kullanımında sürdürülebilirliğin dikkate alınması önem arz etmektedir. Bu anlamda bir yörede coğrafi şartların elverdiği ölçüde üretimi gerçekleştirilen ve o yöreyle özdeşleşmiş ürünler kırsal kalkınma için en etkili şekilde kullanıldığında, yörenin potansiyelinin değerlendirilmesine önemli derecede katkı sağlaması mümkündür. Böylesi bir sürecin temelinde, gelişmiş ülkelerde uygulandığı gibi kırsal kalkınmanın yerel olanaklara göre gerçekleştirilmesi ve bölgenin özelliklerinin dikkate alındığı stratejiler geliştirilerek standart yaklaşımların dışında daha farklı yaklaşımlarla kalkınmanın sağlandığı görülmektedir (Başıbüyük, 2004). Yerel ürünlerin ve bölgesel kültürel potansiyellerin değerlendirilmesi, coğrafi işaret ile niteliğinin artırılması ve dünya genelinde o yöreyle kodlandırılması kırsal kalkınmanın gerçekleştirilmesi için önem arz etmektedir. Diğer taraftan kooperatifleşme ve özellikle kadın kooperatiflerinin yerel ve bölgesel ürün bazında sayılarının ve faaliyet alanlarının artırılması bir taraftan potansiyel kadın emeğinin etkin kullanımı ve kadının güçlenmesinin sağlanması ile bölgenin sosyal ve ekonomik kalkınmasının sağlaması açısından geniş ve katmanlı bir katkı yaratması kırsal kalkınma çalışmaları açısından büyük önem taşımaktadır.

Yerel Ürün: Birçok ürün dünyada 'coğrafi' adı ile bilinmekte ve bu ürünler yer aldıkları bölgenin kendisine özgü doğal şartları ya da insan faktörünün bilgisi, becerisi, deneyimi ve geleneklerinden oluşan bir nevi tipik ürünler yöresel ürün olarak nitelendirilmektedirler (Tekelioğlu ve Demirer, 2008: 89). Yöresel ürünlerin ortaya çıkmasında çok farklı değişkenler etkendir. Söz konusu etkenler bağımlı ve de bağımsız değişkenler olarak nitelendirilmektedir. Farklı tarihi geçmiş, bölgesel ve ulusal kültür, gelenek, yaşam tarzı, çalışma şartlarının değişkenliği gibi sosyal şartlar, merak, ilgi ve yaratıcılık, emek gibi beşeri şartlar bağımlı değişkenleri oluştururken, bölgenin iklimi, toprak yapısı, ve yükseltisi bağımsız değişkenleri oluşturmaktadır (Coşkun, 2001: 3-5). Bağımlı değişkenler sosyal değişkenler de dahil olmak üzere insan faktörüne bağlı iken bağımsız değişkenler büyük oranda insan faktörünün dışında var olan verilerdir. Tüm bu verileri kullanarak şekillendiren, fayda yaratan etken yine beşeri faktördür. Bu sebeple bahsi geçen verilerle ortaya konan ürün o coğrafya ile tanınır ve işaretlenir.

Coğrafi İşaret: Belirlenen bir toprak üzerinde, belirli bir bölge ya da alanda mevcut olan ürünleri ve kalitesini göstermekle beraber o bölgenin ticari çıkarlarını da temsil etmektedirler. Bununla beraber coğrafi işaretler, ürünle ilgili net ve ürünün menşei ile ilgili güvenilir bilgi vermesi bakımından tüketicilere yardımcı olmaktadır. Çünkü coğrafi işaret, bir ürünün belirli bir yöreye veya bölgeye ait olduğunu, ün ve özelliklerini o bölge veya yöreden aldığını diğer ifade ile ürünün bütün niteliklerinin o coğrafyanın menşeinden oluştuğunu ifade etmesi bir nevi ürünün kimlik kartı niteliğini taşımaktadır (TPE, 2004: 49; Gökovalı, 2007; Bérard ve Marchenay, 2008)

Coğrafi işaretler, temelde ayırt edici işaretlerdir. Bu sebeple entelektüel özellikli sermaye olarak değerlendirilerek ekonomide önemli bir ağırlıkta yer alırlar. Ekonomisi sanayiden ziyade tarıma dayalı olan gelişmekte olan ülkeler için coğrafi işaretler ayrıcalıklı bir anlam taşımaktadır. Dolayısıyla bu ülkelerin kırsal kalkınmasında, yerel ürünlerin coğrafi işaretlerle kalitesinin ve menşeinin belgelenmesi ürün ticareti ve uluslararası camiada kalitesinin duyurulması açısından fayda yaratmaktadır. Çünkü gelişmekte olan ülkelerde sanayileşme henüz tamamlanamadığı için, geleneksel üretim teknikleri ve tarımsal üretim ekonominin ana yapısını oluşturması açısından bu yöntemle üretilen ürünlerin ekonomiye katkısı önem arz etmektedir.

Kooperatifçilik: Kooperatifçilik anlayışı, dayanışma ve ortak hareket etme, diğer bir deyişle imece usulü bir araya gelerek bir amacı gerçekleştirme felsefesine dayanmaktadır. Bir ortak girişim olarak ilk defa 28 tekstil işçisi hareketi olarak başlayan kooperatifçilik, günümüzde yarım milyara yakın insanın dahil olduğu bir güç hareketine dönüşmüştür (Koç, 2001; Gibson, 2005). Dolayısıyla günümüzde oldukça yaygınlaşan, multidisipliner yaklaşımla kullanımı artan ve içeriği zenginleşen kooperatifçiliğin sınırlarının belirlenmesi ve tam bir tanımının yapılması zorlaşmaktadır. Zaman içerisinde gerçekleşen değişim ve gelişme ile kooperatifçilik anlayışı da değişime uğramıştır. Bu süreç kooperatiflerin odak noktasını belirli sosyal ve mesleki grubun ve bu oluşumların çıkarlardan soyutlayarak bir bütün şeklinde toplumun geneline yayılmasına sebep olmuştur (Mülayim, 2006; Ada, 2002).

Kooperatifçiliğin, belirli bir amacı gerçekleştirmek için, kültürel, ekonomik ve sosyal niteliklere sahip, üyeliğe giriş, görev, yetki ve sorumlulukların belirlenmiş, işleyişinin demokratik yolla yürütüldüğü, geçmişten beri oluşan prensiplerinin çeşitli yaklaşımlar ve günün şartları ile güncellendiği, hukuk sitemlerinde kendine yer bulan, kamu kurum ve sivil toplum kuruluşları ile iş birliğine girişilebilen, seçilen faaliyet alanı içerisinde belirlenen hedef için üyelerin güç birliği ettiği oluşum şeklinde bir tanımının yapılması da mümkündür.

3. Bölgesel Kalkınmanın Bir Aktörü Olarak Kadın Kooperatifleri

Dünyada ilk defa 1844 yılında İngiltere'nin Rochdale kasabasında, kişilerin sosyal ve ekonomik açıdan güç birliği ederek dayanışmanın sağlanması amacıyla uygulanan kooperatifçilik hareketi sanayileşmenin yoğun şekilde yaygınlaşmaya başladığı bir döneme denk gelmiştir. Türkiye'de ilk kooperatifçilik hareketleri benzer bir tarihte oluşmuştur; resmi olarak ilk uygulamanın 1863 yılında faaliyete geçen ve Mithat Paşa tarafından kurulan, bugünkü Ziraat Bankası ve Tarım Kredi Kooperatiflerinin temelini oluşturan Memleket Sandıkları ile yapıldığı görülmektedir (Mülayim, 2006; Koç, 2001; Hazar, 1990). Günümüzdeki sosyal güvenlik sisteminin de temelindeki oluşum olarak sayılan Memleket Sandıkları'na, sosyal güvenliğin de temel

işlevlerinden olan nesiller arası ve katılımcılar arası dayanışma niteliğine binaen atıfta bulunulabilir.

Anadolu'da 13. ve 19. Yüzyıllar boyunda faaliyette bulunan Ahi birliklerini kooperatif benzeri yapılanmaların ilk örnekleri olarak gösterilebilir. Yapısal olarak köklü bir geçmişe sahip olan Ahi Birlikleri, barındırdığı, ahlaki, ticari ve ekonomik, sosyal ve politik değerleri ile yapılandırdığı üyelik şematiği bir çeşit kooperatif benzeri örgütlenme olarak nitelendirilebilir (Mülayim, 2006; Koç, 2001; Hazar, 1990). Böylelikle Türkiye'de, Dünya'daki ilk uygulamasından kısa süre sonra uygulanabilmesi, kooperatifçiliğin oluşumunun uzun bir geçmiş birikiminin üzerine inşaa edildiğini söylemek mümkündür.

Ortak özelliklerine bakıldığında kooperatifler, benzer ekonomik sıkıntıları gidermek için çabalayan, ekonomik sıkıntıların zararlarını en aza indirebilmek için, üretim, tüketim ve kredi benzeri temel iktisadi gereksinimlerini karşılayabilmek için kurulan modern kurum şeklinde de tanımlanabilir. Bu tanımlama ile kooperatifler genellikle iktisadi niteliği ile ön plana çıksa da aynı zamanda toplumsal ve de kültürel amaçlara da sahiptir. Kooperatifleşme hareketleri özellikle toplumun genelinde tanımda bahsi geçen amaçları taşımakla birlikte, özellikle kırsal alanda yaşayan nüfusa, bireyler arası dayanışma, güven, adalet, hoşgörü, saygı, iletişim, açıklık, özgürlük, katılımcılık, eleştirebilme kabiliyeti, dürüstlük ve sorumluluk bilinci katması gibi sosyal ve kültürel kazanımlar da eklemektedir (Miser, 1999; Ayhan, 1993; Kuş, 2015).

Diğer taraftan bakıldığında, dünya nüfusunun yarısından fazlasının, az gelişmiş ülkelerin kırsal bölgelerinde yaşadığı görülmektedir. Bu durum kırsal kalkınmayı önemli ve öncelikli bir husus haline getirmektedir. Kırsal kalkınmanın tanımı ise, Birleşmiş Milletler tarafından ifade edilen "toplum kalkınması" tanımına binaen yapılmaktadır. Söz konusu tanıma göre, "küçük nüfus gruplarının, içinde bulundukları mevcut ekonomik, toplumsal ve kültürel şartların iyileştirilmesi gayesi ile girişilen gayretlerin devletlerin bu konuyu amaç edinerek uyguladıkları faaliyetlerle birleştirilmesiyle, bu bölgesel nüfusun toplumun bütünüyle kaynaştırılarak, ulusal kalkınma çabalarına tam manada katılımlarının sağlanması ile bölgesel farklılıkların azaltılması süreci kırsal kalkınma olarak ifade edilmektedir (Geray, 2014: 10). Diğer bir ifade ile, kırsal bölgelerin bütün kaynakları dahil olmak üzere, kırsal nüfusun sürdürülebilirliğinin oluşturulması, mevcut kaynakların optimum düzeyde ve çevreye duyarlı olarak kullanılması, sivil toplum örgütleri ve yerel idarelerin katılımlarının artırılması ve kırsal bölgelerde yaşayanların hayat şartlarının iyileştirilmesi kırsal kalkınmanın temel amaçları arasında yer almaktadır (İnal, Çekiç vd., 2009; Gümüşoğlu, 2012). Kırsal kalkınma tanım ve amacından yola çıkarak, kırsal alandaki her bireye ulaşabilmek, çok yönlü katılımın sağlanması, sürdürülebilirliğin sağlanması, aşamalı olarak ekonomik ve sosyal sorunların giderilmesi, halk, STK ve kamu iş birliğinin artırılması, faaliyetlerin etkinliğinin yükseltilmesi şeklinde kırsal kalkınmanın prensiplerini sıralamak mümkündür.

Toplum kalkınması ile kooperatifçilik kavramlarının birbirlerini tamamlayan ve birbirlerinden beslenen iki kavram olduğunu ifade etmek olasıdır. Çünkü küçük toplulukların özellikle kırsal alandaki nüfusun, ekonomik, toplumsal ve kültürel yönden durumlarının iyileştirilmesi ve bu alanlarda refah seviyesinin yükseltilmesi için kooperatif hareketinden faydalanılması gerekmektedir. Çünkü kooperatifçiliğin temelinde, kırsal nüfusun yaşadığı bölgenin kaynakları kullanılarak, kendi kendine yardım, sorumluluk alma, demokrasi bilinci, eşitlikçilik, tarafsız olma ve en önemlilerinden birisi olan dayanışma ruhu gibi değerlere; gönüllü ve de serbest katılım, ortakların demokratik yönetimi ve ekonomik katkısı, özerkliği ve bağımsızlığı, eğitme, öğretme, bilgilendirme ve kooperatifler arası işbirliği oluşturma, toplumsal sorumluluk gibi temel ilkelere (Rehber, 2011) haiz kooperatifçilik hareketi toplumun kalkınması için elzem olan halkın gayretlerine kaynak oluşturmaktadır. Bu açıdan bakıldığında kırsal kalkınma, imeceyle hareket etmenin oluşturduğu faydalarını, kooperatifçilik yoluyla gerçekleştirilen projelerle topluma sunmakta ve kırsal kalkınmanın ön şartlarından birisini de kooperatifçilik oluşturmaktadır.

Kırsal kalkınma yaklaşımlarından birisi olan "içsel kalkınma yaklaşımı" büyük oranda yerel kaynaklarla ve yerel üreticilerce üretilen üretim modeline dayanması sebebiyle oldukça önemlidir. İçsel kalkınma modelinde, esasen yerel aktörlerin kapasitelerinin artırılmasıdır ve bu gelişme ekonomik kalkınmanın önemli bir unsuru olarak kabul edilmektedir. Böylelikle kırsal kesimde yaşayan nüfusun problem çözme becerilerinin artırılması yoluyla merkezi yönetime olan ihtiyaç beklentisi ve bağımlılığının azaltılması sağlanmış olacaktır. Bu bağlamda sadece kapasite geliştirilmesinin yanında sosyal, kültürel ve çevre ve yerel sermayenin gibi yerinde kaynakların harekete geçirilmesi üzerinde durulmaktadır. Çünkü içsel kalkınma yaklaşımına göre yereldeki tüm bu yerel sermayeler kırsal kalkınma için vazgeçilemez unsurlardır (Theeuwen vd., 2021). Yerel kalkınmanın sağlanmasında içsel kalkınma modelinin uygulanabilirliği yerel ve ulusal aktörlerin iş birliği ile uygulanacak politika faaliyetlerine bağlıdır. Kalkınma politikaların gerçekleştirebilmesi kırsal aydınlanma ile desteklenebilir. Bunlar arasında, mahalli idarelerin yönetim kapasitelerinin artırılması, yerel girişimcilerin desteklenmesi, girişimcilere ve yerel aktörlere eğitim verilmesi, özellikle kooperatifleşme sürecindeki kadınların bu süreçle ilgili eğitim desteği almaları gibi politikalar alanda ön plana çıkmakta ve böylece yerel değerlere hem saygı gösterilmiş hem de üretime katkı sunulmuş olmaktadır. Türkiye'de kırsalda üretimi ve istihdamı artırmak, kırsal alanda yaşayanları sosyal ekonomik bakımdan güçlendirmek için tarımsal kalkınma kooperatifleri kurulmuştur. Bu kooperatiflerin kuruluş dinamikleri farklı olsa da aynı amacı taşıyan birlik özelliğini taşımaktadırlar. Tarımsal Kalkınma Kooperatifi, TARİŞ, PANKOBİRLİK, Süt Kooperatifleri, Çay Kooperatiflerini,

sivil toplum kuruluşlarınca da desteklenen küçük boyutlardaki yerel ürün ve kadın emeği üretimi yapılan ve sayıları gün geçtikçe artan kooperatifleri kırsal kalkınma faaliyetleri içerisinde, içsel kalkınma yaklaşımının örnekleri olarak vermek mümkündür.

Dünya'da yoksulluğa bir çözüm olarak görülen ve istihdamı artırması sebebiyle kooperatiflerin bir ekonomik kalkınma aracı olarak önemi giderek artmaktadır. Kooperatifleşme hareketleri dahilinde kadın kooperatifleri hususu ise devletler, sivil toplum örgütleri ve de uluslararası kuruluşların artık daha da yakından incelediği bir olgu haline dönüşmüştür. Özellikle yoksulluk ve işsizlik, sosyal eşitsizlik gibi olumsuzluklardan en çok etkilenen grup olan kadınların, bu sorunu kadın kooperatifleri çözümüyle aşması yönünde yoğun çalışmalar ve bu konuda olumlu beklentiler söz konusudur (KEDV ve CCA, 2015).Bu amaçla kadın girişimciliğinin öneminin altı çizilerek hem ulusal hem de uluslararası seviyede hazırlanan ve uygulanan projelerle kadınların kooperatif kurabilmeleri ve ya kooperatiflere aktif üye olmaları konusunda teşvik ve destekler oluşturulmaktadır. Zira, büyük oranda kırsal bölgelerde ve kısmen kentlerde kadın kooperatifleri ve kadın kooperatifleşmesi kalkınmanın en önemli çözüm ayaklarından birisi olduğu kabulüyle popüler olmakta ve toplumsal ve ekonomik projelerde öne çıkmaktadır. Kooperatiflerin teşvik edilmesi ve geliştirilmesi komitesi (COPAC) 'nin dünya genelinde 2015 yılında yaptığı bir araştırmaya göre 1990'lı yıllardan itibaren kadınların kooperatiflere aktif katılım oranın %75 arttığı ortaya konulmuştur (KEİG, 2015). Bu oranın günümüzde de giderek artmasında kalkınma politikalarının zamanla değişime uğraması, ekonomik sistem ve uygulamaların dönemsel olarak farklılaşması, kadının sosyal ve ekonomik hayattaki yerinin pozitif anlamda sorgulanmaya başlanması, yerel kaynak, yerel ürün ve yerel kültürün değerlenmesi ve kırsal nüfusu yerinde ihya etme gibi değişen dönüşen ve birbirini etkileyen, sosyal, ekonomik ve kültürel bakış açısının da değişime önemli katsının olduğunu düşünmek mümkündür.

Son yüzyıllık sürece bakıldığında kırsal kalkınma politika veya yaklaşımlarının 19. Yüzyılın ikinci yarısında ortaya çıktığı görülmektedir. Zamanla kırsal kalkınma yaklaşımları dönemin sosyal ve ekonomik koşullarından etkilenmiş; 1960'lı yılların modernleşmesinden, 1970'li yılların hükümet müdahalelerinden, 1980'li yılların rekabetçi piyasasından, 1990'lı yıllarda katılım ile nitelendirilerek değişime uğramıştır (Ellis vd., 2001). Kadınların kalkınmaya dahil edilmesi 1980 yılı sonra denk gelmiş, kooperatifler insani kalkınmada bir araç olarak görülmüş, aynı dönem yoksulluğa yönelik politikaların ağırlık kazanmıştır. 1990'lara gelindiğinde "toplumsal cinsiyet ve kalkınma" yaklaşımları öne çıkmış, bireysel mikro krediler ile kooperatiflere verilen mikro kredilerin insani kalkınma araçlarından birisi kabul edilmiştir. 1960'lı yılların ortalarında küçük çiftlik tarımcılığının büyüme ve kalkınmanın en önemli gücü olarak kabul edildiği kırsal kalkınmadaki ilk paradigma kayması yaşanmıştır. Paradigmada ikinci önemli değişim, "tabadan tavana", "süreç" yaklaşımları olarak nitelendirilen dış teknoloji ve ulusal düzeydeki politikalardaki değişimle olmuştur. Bu paradigma değişimi, aslında bir katılımı içermektedir; kırsal bölgede yaşayan halkın değişim için, yoksulluklarının ve sorunlarının çözümüne katkıda bulunabilecekleri ve pozitif bir değişim için kendi özelliklerini kendilerinin kontrol etme yetkisi veren bir süreci işaret etmektedir. Böylelikle yoksulların kendi sorunlarının çözümüne kendilerinin de katkıda bulunabilecekleri katılımcı paradigma kabul görerek, müdahaleci devlet anlayışı ve her çözümü devletten bekleme düşüncesinin zayıflamasıyla kooperatifler ve STK'ların kırsal kalkınma araçları olarak daha etkin konuma gelmiştir. Aynı zamanda bu süreçte kadınların erkeklerden daha farklı tecrübeler edindikleri üzerinde durularak kırsal kalkınmada toplumsal cinsiyet anlayışı güçlenmiştir (Çetin, 2009; KEİG,2015; Petridou ve Glaveli, 2008).

Türkiye'de kadın kooperatiflerinin örgütlenmesi 1990'ların sonuna doğru deprem bölgesi olan Kocaeli, İzmit ve İstanbul'da öncelikli olarak başlamıştır. Ardından Doğu ve Güneydoğu Anadolu bölgeleri ile devam ederek Türkiye geneline kadın kooperatifi örgütlenmesi yayılmıştır. Günümüzde, farklı faaliyet alanlarına sahip kadın kooperatifleri Türkiye'nin bütün bölgelerinde faaliyet göstermektedir (Cazgır, 2022: 48; Özdemir ve Yılmaz, 2008).

2012 yılında Gümrük veTicaret Bakanlığı "Kadın Kooperatiflerinin Tanıtımı ve Kapasite Geliştirme Projesi"ni başlatmıştır. Bu düzenleme ile kadın girişimcilerin ekonomide daha fazla yer almasının sağlanması, ile özellikle kırsal alanlarda daha yoğun gerçekleştirilen el işi, ev yemekleri ve yöresel ürün gibi ekonomik faaliyetlerde yetiştiricilerin ekonomiye kazandırılması ve bu kadınların ekonomik özgürlüklerini kazanarak maddi bağımlılıklarının azaltılması amaçlanmıştır (KEİG, 2015; Erdoğan 2022).

2014 yılında Kadın Kooperatifleri Birliği kurulmuştur. Bu birlik, yerel düzeyde faaliyet yapan kadın kooperatiflerinin faaliyet alanlarına göre ne tür hizmete ihtiyacı varsa ona göre eğitimler, çalıştaylar, lobicilik vb. faaliyetler düzenlemekte; böylece kadın kooperatiflerinin daha iyi hizmet sağlamalarına katkı yapmaktadır. Kadın kooperatiflerinin olumlu katkıları, sistemin yaygınlaştırılması ve başarıyı yakalaması adına yoğun çalışmaların yapılmasına yol açmaktadır. Günümüz itibariyle kadın kooperatiflerinin sayısı toplam 1040'a ulaşmıştır (Özdemir, 2020, TÜSEV, 2018, KEDV, 2023).

4. Kadın Kooperatifleri ve Yerel Ürünlerin Bölgesel Kalkınmaya Etkileri

Kadın ile kalkınma arasındaki ilişkinin nasıl olması gerektiğine dair yapılan çalışmalar günümüzdeki gelişim çizgisine ulaşana kadar 3 aşamadan geçmiştir. Bu konudaki ilk yaklaşım; liberal ve modern bir toplum ekolüne sahip olan ve kadının ev dışındaki üretken faaliyetlerine

odaklanan görüştür. Bu görüş kadın ve erkeklerin ev içi ve ev dışı faaliyetlerinin iş bölümünü tam olarak ele alamaması ve bunun sonucunda kadının fazla iş yükü ile karşı karşıya kalması ile eleştirilmektedir; zayıf noktasının bu eşitsizlik olduğu ifade edilmektedir. Fakat yaklaşım kadının ekonomik alanda varlığını devam ettirmesine verdiği önem ile sonraki yaklaşımları pozitif şekilde etkilemiştir. Bağımlılık Teorisi ve Radikal Feminizm'in kavramlarından ve analizlerinden etkilenmiş olan kadın ve kalkınma yaklaşımı bu dönemde ortaya çıkmıştır. Kadın ve kalkınma yaklaşımı, merkez (gelişmiş) ülkelerle çevre (az gelişmiş) ülkeler arasında var olan iş bölümü ve sömürü ilişkisinden yola çıkarak toplumsal düzlemde cinsiyet ayrımına dayanan iş bölümü ve sömürüye odaklanmıştır. Temel felsefesi, kadınların ev içi ve ev dışında da zaten çeşitli üretici faaliyetlerde bulundukları, fakat söz konusu faaliyetlerin görünürlükleri, sosyal ve ekonomik konum bakımından marjinal hale dönüştüğüdür. Son aşamada, toplumsal cinsiyet ve kadın yaklaşımı yeniden üretim süreçlerinde cinsiyete dayalı eşitsizliklerin dönüştürülmesi için kapsamlı müdahaleler önermektedir (Özdemir vd., 2020; Miser, 1999). Yaklaşımın önemli kavramlarından biri kadınların güçlenmesidir. Bu çerçevede, kadınlar ataerkil sosyo-ekonomik yapıların zayıflatılması ve değiştirilmesinde anahtar rol oynamalıdır. Kalkınma politikalarının da bu hedefe ulaşabilmeleri için kadınlara destek ve kaynak sağlaması gerektiği vurgulanmaktadır.

Son zamanlarda kadın kooperatifleri, dünyada olduğu gibi ülkemizde de, geniş bir sosyo-politik çevrede onaylanan bir kalkınma yaklaşımı olarak daha fazla önem kazanmaya başlamıştır. Özellikle kırsal alanda yaşayan ve istihdama dahil olamayan kadınların, sosyal ve ekonomik hayata katılımlarını artırmak ve örgütlenme gayretlerine destek vermek amacıyla kooperatifler daha sık gündeme gelmektedir. Bu kapsamda, kadın kooperatiflerinin ekonomik ve sosyal kalkınma için etkin bir çözüm yolu olarak görülmesinde bir fikir birliği oluşmuştur (KEİG, 2015: 15; Aksoy ve Günay, 2018).

Kadın kooperatifleri, ekonomik açıdan kullanılmayan kaynakların harekete geçirilmesine ve büyük ölçekli krediye erişimi artırmaya katkıda bulunurken, girişimcilik ve örgütlenme kültürünün gelişmesine destek sağlamaktadır. Ayrıca sosyal anlamda da önemli bir rol oynamaktadırlar. Bu örgütlenmeler, yoksulluğun azaltılmasına ve ülkenin ekonomik ve sosyal açıdan kalkınmasına katkı sağlamaktadır. Aynı zamanda, kadınların toplumsal konumlarını güçlendirerek toplumsal cinsiyet eşitliği ve adaletinin ilerlemesine de yardımcı olmaktadır. Kadın kooperatifleri, kadınların ekonomik faaliyetlerde daha aktif rol almalarını sağlayarak onların güçlenmesine ve kendi hayatları üzerinde daha fazla kontrol sahibi olmalarına destek olmaktadır. Bu şekilde hem bireysel hem de toplumsal düzeyde kadınların güçlenmesine önemli katkılarda bulunmaktadırlar (Aksoy ve Günay, 2018; Avşar, 2017: 24-25).

Her bölgenin fiziki ve beşerî özellikleri göz önünde bulundurularak hazırlanan kalkınma politikaları kadın kooperatiflerini de etkilemektedir. Kırsal alanlarda el işi, ev yemekleri ve yöresel ürünlerin imalatının daha yoğun olduğu görülmekte ve politika yapıcılar bu alanda faaliyet yapan girişimcilerin güçlendirilmesi için politikalar oluşturulmaktadır. Bundan dolayı kadın kooperatiflerinin sayısının her geçen gün arttığı ve farklı alanlarda dinamik bir yapı sergilediği görülmektedir.

Kırsaldaki kadınların iş hayatına katılımları genellikle daha genç yaşta gerçekleşmekte ücretsiz aile işçisi olarak tarımda faaliyet göstermektedir. Ekonomiye yaptıkları katkıya rağmen kendilerine ait bir ücrete sahip olmayan bu kadınlar, emeklilik haklarından, sağlık hizmetlerinden, eğitim ve sosyal güvenlik haklarından da yararlanamamaktadır. Bundan dolayı kırsal bölgelerde ücretsiz aile işçisi olarak faaliyette bulunan kadınların emek piyasasına katkısının ekonomiye kayıtlı olarak değerlendirilmesi gerekmektedir. Kadınların iş hayatında ücretsiz çalışan kesim olarak görülmesi yerel ekonomik kalkınmada gerçek etkisinin tespit edilmesini engellemektedir. Bu noktada kadınların emeklerini kayıt altına alacak ve onları girişimci olarak piyasada destekleyecek bir yapılanmaya ihtiyaç duyulmaktadır. Bu nedenle bireylerin tek başına yapamayacakları işleri iş birliği ile en iyi biçimde ve maliyette yapmayı sağlayacak kooperatif anlayışının ehemmiyeti artmaktadır. Kooperatifler, üretime dahil edilmeyen kaynakların üretime koşulmasına, tarımsal üretimin ve küçük boyutlu üretimlerin sanayiye uyumlanmasına, girişimcilik ve örgütlenme kültürünün gelişmesine katkıda bulunurken sosyal açıdan kırsal kalkınmanın sağlanmasına, kırsal kesimden göçün önlenmesine, yoksulluğun azaltılmasına vb. imkân tanımaktadır (Tekin, 2019: 45; Davaslıgil, 2011). Kooperatifler, özellikle kadın yoksulluğunun azaltılmasında, kadın girişimci sayısının artırılmasında, kadının işgücüne katılımının pekiştirmesinde, toplumsal cinsiyet eşitsizliğinin ortadan kaldırılmasında, kısaca kadının ekonomik ve sosyal hayatta yerinin güçlendirilmesinde etkili araçlardan birisi olarak kabul görmektedir (Aksoy ve Günay, 2018).

Kooperatiflerin sağladığı yararlar, yoksulluğun azaltılması, istihdamın artırılması, sosyal içermenin sağlanması ve sürdürülebilir kalkınma gibi alanlarda, kadınların güçlenmesi ve toplumsal cinsiyet eşitliği açısından önemli sonuçlar doğurmaktadır. Bu çerçevede, kadın yoksulluğunun azaltılması, istihdamının artırılması, sosyal ve ekonomik olarak dezavantajlı durumda olan kadınların topluma kazandırılması gibi hedefler öne çıkmakta ve kadın odaklı alternatif kalkınma modellerinin geliştirilmesi gerekliliği vurgulanmaktadır (KEİG,2015)

Kooperatifçilik, toplumsal köklere ve demokratik ilkelerine dayanan, değişen koşullara hızla uyum sağlayabilen ve katılımcı, işbirlikçi ilişki ağlarına sahip olmasıyla dikkat çeken bir faaliyettir. Bu özellikleriyle toplumsal kalkınma için etkili bir araç olarak değerlendirilebilir. Kooperatifler, yerel düzeyde ihtiyaç duyulan hizmetlerin sağlanmasında

önemli rol oynamakta, istihdam oluşturmakta ve toplum içindeki bireylerin sosyal bağlarını güçlendirmeye yardımcı olabilmektedirler (KEDV, 2023; Gibson, 2005).

Kooperatifler, toplumsal sosyal sorumluluk ilkesi çerçevesinde, bulundukları coğrafi bölgenin sürdürülebilir kalkınmasına katkıda bulunmaktadır. Bu bağlamda, kooperatifler yerel kaynakların dengeli kullanımını teşvik eder, çevrenin korunmasına önem verir, ortaklar ve üyeler arasında bilgi paylaşımını sağlar ve teknik bilgi ve becerilerin geliştirilmesine destek olur. Dolayısıyla, özellikle az gelişmiş bölgelerde, özellikle kırsal alanlarda kurulan kooperatifler, bölgesel eşitsizliklerin azaltılmasında hızlı ve etkili bir rol oynarlar (Çetin, 2009).

5. TR 71 Bölgesi Kadın Kooperatiflerinin Genel Durumu

Türkiye'de kooperatif modelinin geçmişi yüzyıldan daha uzun sürece dayanmaktadır. İstihdam imkanlarını iyi hale getirmek, ürün ve hizmet temin etmek ve ekonomiye katkı sağlamak için kooperatifçilik uygulamaları devam etmektedir. Kadınlara yönelik kooperatif faaliyetlerinin ise çeyrek asırlık bir geçmişe sahip olduğunu görmekteyiz. Zamanla özellikle kır kent arasındaki refah farkını azaltmak için, toplumda var olan cinsiyet ayrımının, kadınların emek sarfettikleri halde arka planda kalmasının önüne geçmek, kadınların sadece ürün ortaya koymanın ötesinde kaynakları ve ticareti kontrol etmelerinin sağlanması, toplumda emeklerinin karşılığını ekonomik sosyal ve psikolojik bakımdan alabilmeleri adına kadın kooperatifçiliğinin yaygınlaşması için programlar ve çalışmalar geliştirilip uygulanmaktadır. TR71 bölgesi, yöresel ürünlerinin fazlalığı, dikkati çekerken diğer taraftan da kadın emeğinin güçlenmesi için kooperatifleşme yolunda hızla ilerlemektedir. Bu çalışmaların olumlu sonuçları da elde edilmeye başlanmıştır. Fakat Türkiye genelinde olduğu gibi bu bölgeye yönelik yapılan araştırmalar halen kadın kooperatiflerinin, ekonomik, yönetimsel ve de toplum da var olabilme güçlükleri ile karşı karşıya olduğu görülmektedir. TR71 bölgesi kadın kooperatiflerinin mevcut durumlarının tespiti için, genel bir görünümüne bakmak gerekmektedir.

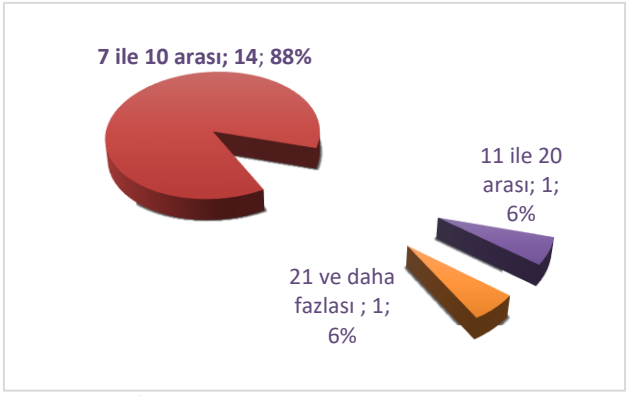
Tablo 1. TR71 Bölgesinde Bulunan Kadın Kooperatiflerinin İllere Göre Dağılımı

	Ticaret Bakanlığının Görev Alanına Giren Kadın Kooperatifi Sayısı	Tarım ve Orman Bakanlığının Görev Alanına Giren Kadın Kooperatif Sayısı
TR71 Bölgesi	31	12
Aksaray	9	9
Kırıkkale	7	0
Kırşehir	5	1
Nevşehir	7	1
Niğde	3	1

Kaynak: AHİKA, Ahiler Kalkınma Ajansı, TR71 Bölgesi Kadın Kooperatifleri Araştırma Raporu, www.ahika.gov.tr.

TR71 Bölgesindeki kadın kooperatiflerinin iller ve bağlı oldukları bakanlıklara göre dağılımı tabloda verilmiştir. Buna göre, bölgede Ticaret Bakanlığına bağlı olarak faaliyet gösteren 31 kadın kooperatifi bulunmaktadır. Bu kooperatiflerin 30'u kadınlar tarafından kurulmuş ve işletilmekte olan kadın girişimci üretim ve işletme kooperatifidir. Diğer bir kooperatif ise kadın emeğinin yoğun olarak kullanıldığı bir üretim ve pazarlama kooperatifidir. Tarım ve Orman Bakanlığına bağlı olarak ise 12 tarımsal kalkınma kooperatifi bulunmaktadır.

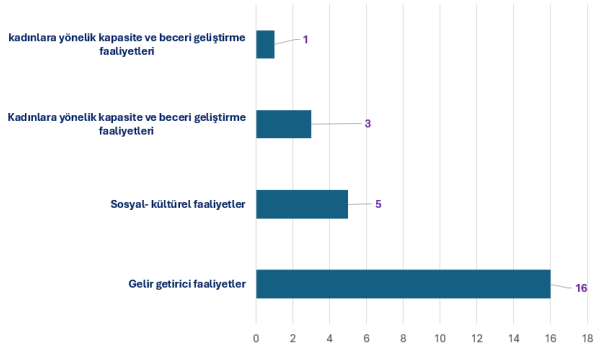
Grafik 1. Kadın Kooperatiflerinin Ortak Sayısına Göre Dağılımı



Kaynak: AHİKA, Ahiler Kalkınma Ajansı, TR71 Bölgesi Kadın Kooperatifleri Araştırma Raporu, www.ahika.gov.tr.

Kadın kooperatiflerinin ortak sayısına göre dağılımı grafik 1 ile gösterilmiştir. Buna göre, 16 kadın kooperatifinden 14'ünün 7 ile 10 arasında ortak sayısına sahip olduğu tespit edilmiştir. Bazı kadın kooperatifleri ise kuruluş aşamasında, 7 ortağı bir araya getirmekte bile zorlandıklarını ifade etmişlerdir.

Grafik 2. Kadın Kooperatiflerinin Faaliyet Alanları



Kaynak: AHİKA, Ahiler Kalkınma Ajansı, TR71 Bölgesi Kadın Kooperatifleri Araştırma Raporu, www.ahika.gov.tr.

Grafik 2'de gösterildiği gibi, kadın kooperatiflerinin faaliyet alanlarının çoğunluğu gelir getirici faaliyetlerden oluşmakta, bunun yanı sıra sosyal, kültürel ve kapasite geliştirmeye yönelik faaliyetler de bulunmaktadır.

Tablo 2'de ise kadın kooperatiflerinin gelir getirici ürün ve hizmetleri listelenmektedir. En fazla üretilen ürünler sırasıyla gıda ürünleri, hediyelik eşya ve tarım ürünleri

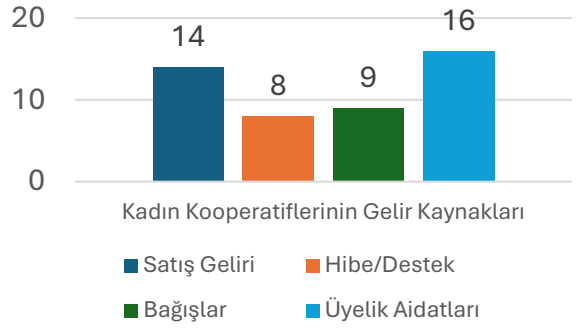
olarak belirtilmiştir. Hizmetler arasında ise lokanta/gıda satışı ve el işi hediyelik eşya satış dükkânı öne çıkmaktadır. Araştırma kapsamındaki kooperatifler genellikle satışlarını kendi bünyelerinde gerçekleştirmekte olup, bazıları ise e-ticaret, dijital pazarlama gibi alanlarda faaliyet göstermekte ve bu yönde altyapı geliştirme çalışmaları yapmaktadır.

Tablo 2. Kadın Kooperatiflerinin Gelir Getirici Ürün ve Hizmetleri

Ürünler		**Frekans**
Ürünler	Gıda ve Tarım Ürünleri	16
	El İşleri	5
	Dokuma	1
	Tekstil	1
Hizmetler	Hediyelik Eşya	7
	Lokanta/Gıda Satış	12
	El işi/Hediyelik Eşya Satış Dükkanı	6

Kaynak: AHİKA, Ahiler Kalkınma Ajansı, TR71 Bölgesi Kadın Kooperatifleri Araştırma Raporu, www.ahika.gov.tr.

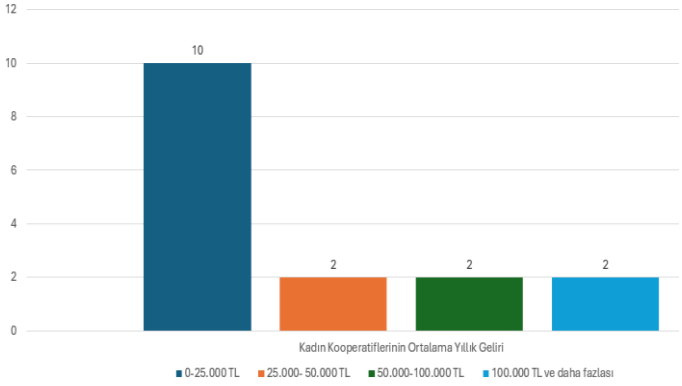
Grafik 3. Kadın Kooperatiflerinin Gelir Kaynakları



Kaynak: AHİKA, Ahiler Kalkınma Ajansı, TR71 Bölgesi Kadın Kooperatifleri Araştırma Raporu, www.ahika.gov.tr.

Bölgedeki kadın kooperatiflerinin gelir kaynakları sırasıyla üyelik aidatları, satış gelirleri, bireylerden ve kurumlardan alınan bağışlar ile hibe/desteklerden oluşmaktadır. Kadın kooperatiflerinin ortalama yıllık geliri Grafik 3'te gösterilmektedir. Bazı kooperatifler henüz bir yıllık faaliyet dönemini tamamlayamamış olduğundan verilen rakamlar tahmini değerlerdir.

Grafik 4. Kadın Kooperatiflerinin Ortalama Yıllık Geliri



Kaynak: AHİKA, Ahiler Kalkınma Ajansı, TR71 Bölgesi Kadın Kooperatifleri Araştırma Raporu,2022, www.ahika.gov.tr.

Araştırma kapsamında ele alınan konulardan biri, kadın kooperatiflerinin başlangıç sermayesini nasıl oluşturduklarıdır. Grafik 4'te görüldüğü gibi, kadın kooperatiflerinin ilk kuruluş yatırımını ortaklık payları, hibe/destekler, bireylerden ve kurumlardan alınan bağışlar şeklinde gerçekleştirdikleri tespit edilmiştir. Katılımcıların beyanlarına göre, kadın kooperatifleri ana sözleşmeleri gereği belirli bir süre ortaklarına kar payı dağıtmamakta ve elde ettikleri karı tekrar kooperatife yatırmaktadır.

TR71 Düzey 2 Bölgesi, Ahiler Kalkınma Ajansı tarafından oluşturulan 2014-2023 Bölge Planı ile yerel kalkınma kapasitesini güçlendirmiştir. Ajans, bölgedeki gelişime katkı sağlayacak ve olumsuz değişimleri önlemekte önemli bir rol oynayacaktır.

6. Sonuç

TR71 Bölgesi; Aksaray, Niğde, Kırşehir, Kırıkkale ve Nevşehir'den oluşan bölge, Türkiye'nin ekonomik ve sosyal açıdan gelişmekte olan bölgelerinden biri olarak bölgesel kalkınma açısından önemi oldukça büyüktür. Yerel ürünler ve kadın kooperatifleri ise bu bölgenin kalkınmasında önemli bir rol oynayabilir. Yerel ürünlerin ve kadın kooperatiflerinin desteklenmesi, yerel üreticilerin ve kooperatiflerin daha fazla gelir elde etmelerini sağlayarak, "yerel ekonominin canlanmasına" bölgenin genel ekonomik büyümesine katkıda bulunabilir. Kadın kooperatiflerinin desteklenmesi, özellikle kadınların istihdam edilme olanaklarını artırabilir. Bu, bölgedeki işsizlik oranlarını düşürmeye ve gelir dağılımını daha adil bir şekilde yeniden düzenlemeye yardımcı olabilir. Yerel ürünler genellikle bölgenin kültürel mirasının bir parçasıdır. Bu ürünlerin kadın kooperatifleri vasıtasıyla üretimine ve pazarlanmasına destek vermek, geleneksel el sanatlarını ve yöresel tarımı korumaya yardımcı olabilir. Böylece, bölgenin kültürel kimliğini koruma çabalarına katkıda bulunulabilir. Yerel ürünler genellikle daha sürdürülebilir tarım ve üretim yöntemleriyle elde edilir. Bu da çevresel sürdürülebilirliği destekleyerek, bölgenin doğal kaynaklarının korunmasına yardımcı olabilir. Yerel ürünler ve el sanatları, bölgesel turizmi canlandırmak için önemli birer unsurdur. Turistler genellikle yerel ürünleri ve el sanatlarını satın alarak bölgeye katkıda bulunurlar. Bu da bölgenin turizm gelirlerini artırabilir.

TR71 Bölgesinde kadınların işgücüne katılım oranları Türkiye ortalamasının oldukça altındadır. Bu durumun sosyo ekonomik yapıya yansımaları da olumsuz niteliktedir. Zira kadınların işgücü piyasasına katılımları, refah ve kalkınmışlık ve de sosyo- ekonomik hayat göstergelerinden birisi olarak önem taşımaktadır. Dolayısıyla kadınların işgücü piyasasına katılım sorunlarının çözülmesi bölgenin kalkınmışlığı açısından oldukça elzem olduğu görülmektedir (AHİKA,2022a: 8) .

Kadın kooperatifleri, kadınların toplumsal ve ekonomik

hayata katılımlarını artırabilir. Kadınların iş dünyasında daha fazla yer alması, toplumsal cinsiyet eşitliğine ve toplumun genel refahına katkıda bulunabilir.

Bu nedenlerle, TR71 Bölgesi'nde yerel ürünlerin ve kadın kooperatiflerinin desteklenmesi, bölgenin kalkınması ve sürdürülebilirliği için hayati öneme sahiptir. Bu destek hem ekonomik hem de sosyal açıdan bölgenin güçlenmesine katkıda bulunabilir.

Bölge, Kapadokya'nın zengin doğal ve kültürel mirasıyla tanınmaktadır. Hacı Bektaş-ı Veli, Ahi Evran-ı Veli, Cacabey, Yunus Emre gibi kültürel figürler ve Abdallık kültürü gibi değerler bu zenginliği oluşturmaktadır. Doğa turizmi, termal ve sağlık turizmi, kültür turizmi, balon turları ve inanç turizmi gibi çeşitli turizm faaliyetleri aktif olarak yapılmaktadır. Bu çeşitlilik bölgenin kalkınma potansiyelini artırmaktadır.

Etkili kalkınma araçlarından biri olarak görülen kadın kooperatifleri ekonomik yönden atıl kaynakları harekete geçirmesi, makro kredilere erişim imkânını artırması, girişimcilik ve örgütlenme kültürünün gelişmesine katkıda bulunmasının yanı sıra sosyal yönüyle de ön plana çıkan örgütlenmelerdir. Bu örgütlenme modeli yoksulluğu azaltarak ülkenin ekonomik ve sosyal açıdan bir bütün olarak kalkınmasında önemli bir rol oynamakta kadının toplumsal konumunun güçlendirilmesinde katkıda bulunmaktadır (Stiglitz, 2004).

Kooperatifler kadınlar için ekonomik yaşama dahil olma fırsatı yaratırken, aynı zamanda kooperatifleşme süreci boyunca verilen eğitimlerle hayat boyu öğrenme fırsatı sunulmaktadır. Bu eğitimler sayesinde sosyal ve teknik beceriler olmak üzere yeni beceriler öğrenilebilmektedir. Bu alandaki literatür ve yapılan çalışmaların incelenmesi sonucu, kooperatifleşme süreçlerindeki faaliyetlerin değer kattığı ve bölgedeki kadın kooperatiflerinin eğitim ve kuruluş aşamasında çeşitli kurum ve kuruluşların maddi desteğinden daha fazla faydalanılması gerektiği kanısı hasıl olmuştur.

Bölgede geleneksel el sanatları da önemli bir yer tutmaktadır. Toprak kap yapımı, halıcılık, dericilik, çömlekçilik, çinicilik, sele sepeti, ebru sanatı ve seramikçilik gibi el sanatları, yerel esnaflar ve sanatkârlar sayesinde yaşatılmakta ve ürünler turistik amaçlarla pazarlanabilmektedir.

Bölgenin demografik, sosyo-ekonomik ve sosyo-kültürel gelişmeler açısından zayıf yönleri ve bazı kısıtları bulunmaktadır. Bunlar arasında su kaynaklarının sınırlı olması, tarımda yüksek maliyetler, sınırlı ürün çeşitliliği, yenilikçilik ve ARGE çalışmalarının yetersizliği, üniversite-sanayi iş birliğinin zayıflığı, düşük girişimcilik, turizmde sosyal imkanların yetersizliği, kadınlarda düşük iş gücüne katılım, göç, su kaynaklarının verimsiz kullanımı ve erozyon önemli zorluklar olarak öne çıkmaktadır.

Ahiler Kalkınma Ajansı tarafından oluşturulan 2014-2023 Bölge Planı, TR71 Düzey 2 Bölgesi'nde ekonomi, eğitim ve sağlık alanlarında içsel gelişmişlik farklarını en aza indirgemeyi ve mevcut ekonomik potansiyelleri gerçekleştirmeyi hedeflemektedir.

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RESP

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Araştırma Makalesi ● Review Article

Strategies and Policies in Recycling Food Waste: The Intermediary Role of Municipalities

Gıda Atıklarının Geri Dönüşümünde Stratejiler ve Politikalar: Belediyelerin Aracı Rolü

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ANAHTAR KELİMELER

Gıda Adaleti
Gıda İsrafı
Geri Dönüşüm
Gıda Atık Yönetimi

ÖZ

Sürdürülebilir kalkınmadaki önemi göz önüne alındığında, "sıfır açlık" dünya çapında her zaman hayati bir konu olarak kabul edilir. Hem Milenyum Kalkınma Hedefleri hem de 2030 Sürdürülebilir Kalkınma Hedefleri açlığı azaltmaya ve uzun vadede gıda güvenliğini sağlamaya odaklanmıştır. Politika yapıcılar sürdürülebilir gıda politikaları belirlerken ve alternatif programlar başlatırken, gıda kaybı ve gıda israfı da gıda güvenliği için yeni zorluklara neden olmaktadır. Gıda israfı için çeşitli geri dönüşüm teknikleri olmasına rağmen, gıda israfı gıda kadar değerli bir ürüne dönüştürülemez. Hükümetler gıda israfının geri dönüştürülmesini ve gıda israfının azaltılması için kamuoyunun farkındalığının artırılmasını desteklemektedir. Gıda israfının geri dönüşümü gıda, atık ve kompost süreçlerinden geçer. Kompost, bitki ve hayvan gıdalarının belirli yöntemlerle nemli oksijen ortamında depolanarak organik gübreye dönüştürülmesi sürecidir. Gıda atıklarının geri dönüştürülmesinin sıfır atık yaklaşımları açısından faydaları olduğu düşünülmektedir. Ancak, gıda atıklarını temelde önleyen politikalar oluşturmak daha önemlidir. Bu çalışma, belediyelerin aracı rolü bağlantısı aracılığıyla gıda atıklarını ve gıda kaybını azaltmak için stratejileri ve politikaları keşfetmeyi amaçlamaktadır. Amaçlandığı gibi, bu çalışma dünya çapında gıda kaybı ve gıda atığı ve gıda atığı geri dönüşümü için son ve mevcut göstergeleri inceleyecektir. Buna göre, ikincil veriler kullanılacak ve tabloların yardımıyla gıda atığı yönetiminin önemi incelenecektir.

KEYWORDS

Food Justice
Food Waste
Recycling
Food Waste Management

ABSTRACT

"Zero hunger" is always accepted as a vital issue worldwide when considering its importance in sustainable development. Both of Millenium Development Goals and 2030 Sustainable Development Goals focused on reducing hunger and achieving food security in the long term. While policymakers set sustainable food policies and launch alternative programs, food loss and food waste also cause new challenges for food security. Although there are various recycling techniques for food waste, food waste cannot be transformed into a product as valuable as food. Governments supports for recycling food waste and promoting public awareness for reducing food waste. Recycling of food waste goes through food, waste and compost processes. Compost is the process of turning plant and animal foods into organic fertilizer by storing them in a humid oxygen environment with certain methods. It is thought recycling food waste has benefits in terms of zero waste approaches. However, it is more important to create policies that fundamentally prevent food waste. This study aims to explore strategies and polices for reducing food waste and food loss through the link of the intermediary role of municipalities. As it is purposed, this study will review recent and available indicators for food loss and food waste and food waste recycling worldwide. Accordingly, the secondary data will be used and with the help of tables, the importance of food waste management will be examined.

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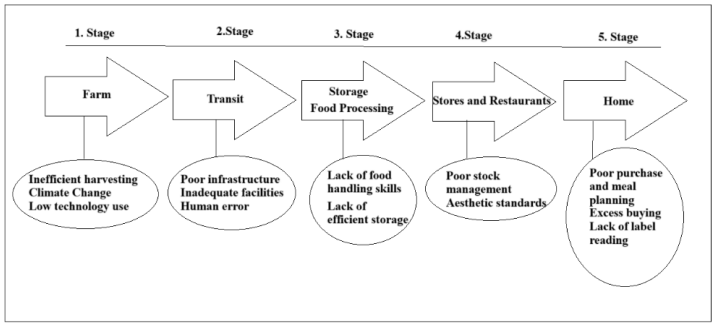
1. Introduction

Food waste and food loss are close concepts but contain some differences. While food waste generally refers to the leftovers of consumed food, food loss sometimes covers different situations such as products left in the field or products that have expired. According to this perspective, some scholars discuss the technical characteristics of food becoming waste and waste recycling and disposal aspects, while others discuss the conditions and policies that cause food waste. Food waste can be grouped as household waste, cafeteria or restaurant waste, and waste from food processing industries (Yasin, et al., 2013). The effect of the country's management systems and policies are seen in food waste disposal methods. Municipalities have a duty in garbage collection and disposal methods as a component of household and other wastes in countries with central and local management systems. While the visible face of food loss is seen as food waste, the fact that food waste that does not reach the table and cannot be recycled is another important problem of the process is evident. The reason why food waste is such a big problem is that hunger and malnutrition problems have not yet been fully solved worldwide. The relationship between food waste and greenhouse gas emissions is also an important indicator in terms of discussing the process for a sustainable future. "The carbon footprint of food produced and not eaten is estimated to be 3.3 Gt CO2 equivalent, without considering greenhouse gas emissions from land use change. Due to food waste, approximately 250 km3 of global surface and groundwater resources are depleted, and food produced but not eaten covers approximately 1.4 billion hectares of land, equivalent to approximately 30% of the world's agricultural land. (Munesue, et al., 2015).

The most problematic processes in terms of food loss can be considered as the stages between the production point and the point of sale. For example, Goodwin (n.d.) stated that while explaining food loss according to the stages between the production and point of sale, it is "farm, transit, storage, shop and home" (Goodwin, n.d.; Serrano, 2024).

Figure 1: Food Loss Journey



Source: based on Serrano (2024) and Goodwin (n.d.)

Although the "Zero Hunger" goal is second on the list of Sustainable Development Goals, the ongoing hunger problems are now being expressed as a hunger scandal. Because statistically, there seems to be enough food to feed people around the world, but approximately one billion people do not have enough food, there are people dying of hunger, and approximately one third of the food produced is thrown away. (Kieran, and Dolan, 2024). This is a serious social inequality and ethical problem. "SDG 2 Zero Hunger represents a unified global call to strategically respond to the immense challenge of global hunger through sustainable food production, distribution and consumption" (Kieran, and Dolan, 2024). According to the United Nations Hunger Report, hunger refers to periods in which a particular community or population experiences serious insecurity in food supply (Uvin, 1994). Hunger, malnutrition and food insecurity are among the most fundamental indicators that policies around the world need to be transformed.

These problems experienced in the food sector and the political dimensions of the process bring the issue of food justice to the agenda. Food justice, as a field of struggle and action, brings a critical approach to mainstream food systems and includes approaches that enable communities to produce their own solutions to food problems, which are among the sources of inequalities in society. Unequal access to healthy food causes settlement areas and geographical locations to be questioned (Heynen, et al., 2012). From this perspective, food justice has transformed the process into an important struggle for rights, along with the search for alternative solutions in the field of access to food.

Aim and Design

The aim of this study is to examine the technical and strategic aspects of food waste recycling together and to present suggestions regarding the intermediary role of municipalities. Generally, food waste combat strategies, which also examine the technical aspects of food waste recycling and food waste prevention policies, are addressed separately in different publications. In this respect, the original value of the study is to examine the relationships between the technical and political infrastructure of the process by considering food waste statistics. In this study, reports containing food waste and indicators related to food waste were examined. This study focuses on the link between food loss, food waste and recycling food waste. Accordingly, this study reviews available and open access data including recent indicators for global food loss and global food waste. It is thought to give a brief policy sheet for scholars and policymakers to launch new food security programs or strategies for reducing food loss and food waste in the long term.

2. Food Waste Statistics: Indicators for Food Waste and Food Loss

In social sciences, statistical data and indicators constitute a criterion for the strength of the scientific basis of academic studies. However, the sources of the data and the political tendencies of the institutions that produce these data are another dimension of the process. The purpose for which the data is examined and processed by which institution, as well

as the purpose for which these data will be used by policy makers, is a separate area of study. When the process is food waste and food waste, it is generally debatable how sound and comprehensive the data is obtained in which countries. In this point, examining indicators can provide a decisive framework for commenting on food waste. "Indicators on food waste come in two categories. Evidence that claims to have outer validity is often found in the grey literature, that is, in multifarious policy reports and documents from advocacy groups and non-governmental organizations. Evidence that claims to have internal validity, other than, tends to focus on narrow applications. While this general balance between external and internal validity is not unique to food waste, no evidence on food waste can claim to have both external and internal validity, which is problematic to say the least when it comes to an emotionally charged topic like food waste" (Bellemare, et al., 2017). Considering this approach, the following information has been compiled from various reports. The tables below, in addition to showing the dimensions of food waste and waste, have addressed indicators with specific approaches. These indicators are which sectors produce more food waste, a data analysis of food waste across continents worldwide, which food products are wasted more worldwide, which processes result in food waste, awareness against food waste in the context of social responsibility through a few sample countries, global food waste indicators for 2024 through selected countries and Top Food Companies' waste generation indicators have been examined. Thus, not only food waste and food waste data were presented, but also the extent to which social awareness was gained to reduce this and what responsible global companies were doing regarding waste generation were taken into consideration.

Table 1: Food Waste by Sectors (2021)

Sectors	Food Waste (million tonnes) -%
Food Service	244 – 27%
Household	569 – 62%
Retail	118 – 11%

Source: adapted from McCarthy, (2021).

The sectors where food loss occurs most are seen as retail, household and food service as seen in Table 1 (McCarthy, 2021). Among these sectors, the largest source of food waste is household-based, with a rate of 62%. In this respect, it can be seen how critical the changes people will make in their daily lives play in solving this problem.

Table 2 shows the percentage distribution of food loss by continent. When this table is examined, it is seen that food loss is less in developed countries and regions, while it reaches the highest levels in the least developed regions. From this perspective, it is seen that the regions with the highest food loss, as known by general indicators, are Africa and the Caribbean, where hunger is also experienced the most. The reasons for food loss include agricultural policies, problems in the supply chain, and climate change. In this respect, Table 3 was created to understand at which stages food loss occurs more so that the process can be examined in detail.

Table 2: Global Food Loss Indicators (2021)

Country	Food loss (%) at highest level	Country	Food loss (%) at lowest level
Western Africa	23.6	Eastern Asia	8.5
Caribbean	22.5	Southern Europe	8.1
Southern Africa	20.4	Western Europe	7.9
Sub-Saharan Africa	20.0	Micronesia	7.3
Small Island Developing States	19.0	Eastern Europe	5.0

Source: adapted from Fleck, (2024c).

Similarly, considering which products are less durable, Table 4 shows the distribution of global food loss by food products.

Table 3: Food loss based for different stages (from production to sale)

Stage	(%) Food Loss
Farm stage	11
After harvest	8
Processing	1
Stores	8
Home and restaurant	10

Source: adapted from Mulhern, (2021).

When Table 3 is examined, it is seen that the highest food loss is in the agricultural stage, but this food loss is also experienced at a high rate in the home and restaurant process. The lowest food loss is in the processing stage, but it is seen that the areas that can be intervened and improved the most are technically processing and stores. In addition, these indicators have given slightly different percentages in other studies. Here are a few findings of important studies on this subject. The McKinsey report states that food suffers from various percentage losses in the stages from the producer to the point of sale. (Mulhern, 2021). According to FAO data, approximately 13% of global food is lost from farm to point of sale. Food loss is a global problem and has a negative impact on food security (Fleck, 2024c).

Table 4: Global Food Loss (2023)

Food	food loss (%)
Fruit and vegetables	45
Fish and seafood	35
Cereals	30
Dairy products	20
Meat and poultry	20

Source: IFCO SYSTEMS, (2023).

When Table 4 is examined, it is seen that the area where the most food loss occurs on a global scale is fruit and

vegetables, with a significant rate of 45%. This also shows that almost half of the fruit and vegetables are lost. The loss of these products, which meet people's vitamin needs and provide a healthy and balanced diet, without being used, is an important problem. In order to solve this, it should be considered to accelerate public policies such as organic food markets, local food initiatives and farm to school (Yıldırım, et al., 2024).

Table 5: Food Waste Awareness (2023)

Country	(%) of adults who search for food waste
China	37
Brazil	34
Germany	32
France	31
US	26
UK	26
Mexico	24

Source: Fleck, (2024b).

Statista (2023) surveyed respondents from several countries to find out how much food waste they have searched for in the last 12 months. According to this survey result seen in Table 5, food waste is most popular in China, while it is least popular in Mexico (Fleck, 2024b). The most effective way to recycle food waste is to consider citizens contributing to the recycling process of food waste in the household process shown in Table 1. The condition for achieving this is for citizens to develop food waste awareness and cooperate in this area. When Table 5 is examined with this approach, it is seen that in China and Brazil, which have quite large populations, the fact that awareness is high among adults in this area is an important advantage, but the fact that this awareness level has not even reached more than half is seen as a problem for a sustainable future and food security.

Table 6: Global Food Wastes Indicators (2024)

Country *	Tonnes (total food waste) *	Food waste (kg) per capita (estimated)*
China	108.667.369	76
India	78.192.338	55
US	24.716.539	73
Brazil	20.289.630	94
Germany	6.502.860	78
UK	5.097.005	76
Russia	4.829.772	33
France	3.942.430	61

Source: Fleck, A. (2024a). *UNEP Food Waste Index Report 2024.

Considering the connections with Table 5, when Table 6 is examined, it can be seen as an advantage that the amount of food waste in China is high, and that citizens have a high level of awareness in this area. However, each of the tables shows how food losses, waste and waste have reached critical levels.

Food loss or food waste can be thought of as resource loss. Boston Consulting Group (BCG) determined that food waste is worth approximately $230 billion. Other negative effects such as resource waste and carbon emission release also occur because of food waste. Therefore, food waste management strategies are an important topic (Greyb, 2024). According to the study compiled by Greyb (2024), some of the prominent companies in the food waste management sector are summarized in Table 7.

Table 7: Waste Generation in Top Food Companies

Firms	Market Capitalization ($ Million), 2022 September	Total Waste Generated (Thousand Tonnes), 2021
Nestle	298.409	1.568
Mondelez	75.148	275
General Mills	45.471	337
Hershey	45.193	61
Danone	32.166	400

Source: adapted from GlobalData, (2022).

GlobalData (2022) explored the market value and food waste amounts of some leading companies in the food sector in its study (see Table 7). Accordingly, Nestle is a company with a market value of $ 298,409 million for September 2022 and produced 1,568 thousand tons of waste according to 2021 records. Mondelez International Inc (Mondelez) has a market value of $ 75,148 million (2022) and produced 174 thousand tons of food waste (2021). General Mills Inc (General Mills) has a market value of $45.471 million (2022) and produced 1.71 thousand tons of food waste (2021). Hershey has a market value of $45.193 million (2022) and produced 61 thousand tons of waste (2021). Danone SA (Danone) has a market value of $32.166 million (2022) and produced 400 thousand tons of food waste (2021)

3. Techniques of Recycling Food Waste

From a technical perspective, recycling food waste is an important part of saving resources and reducing environmental impact. There are various techniques for recycling food waste. Some of these techniques are discussed below.

Composting is the most well-known food waste recycling technique. It involves the process of transforming various organic food wastes such as vegetables and fruit scraps, eggshells into a fertilizer that will increase the fertility of garden soil. In the composting stages, collect organic wastes such as fruit peels, coffee grounds, fine nut shells, and create a well-ventilated area for compost by creating a pile or bin. Add green materials such as grass and brown materials such as cardboard and dry leaves around it. Keep it moist and turn it regularly to aerate. Among the environmental effects of food waste composting are bad odor problems (Cerda, et al., 2018). Especially considering the bad odor issue, it is thought that households' desire to compost in their homes has decreased, and therefore it would be beneficial for municipalities to develop innovative approaches in

collecting this household waste at the beginning of composting.

Anarerobic digestion is a biological process that breaks down organic matter including food waste without oxygen, producing biogas methane and digestate solid material. “Anaerobic digestion is a promising technology for food waste management, but has not yet been fully applied due to a few technical and social challenges” (Xu, et al., 2018). One of the main technical problems in this area is the easy production of harmful intermediate components.

Upcycling food waste is the practice of transforming surplus food or food scraps into new products that are still edible and often nutritionally valuable. Upcycling food refers to products made from food product components that would otherwise be considered waste or by-products (Bangar, et al., 2024).

Food waste recycling in industrial settings, large scale food production facilities can implement advanced recycling methods, such as converting food waste into biofuel or animal feed these two cases are detailed below:

- Converting food waste into biofuel, food waste turning into biofuel through various technical processes contributes to the fields of renewable energy sources and sustainable waste transformation (Hafid, et al., 2022). “Biofuels are prepared from edible biomass such as food waste. However, this situation creates a debate among civil society members about whether it is food or fuel. In the future, industrial production of biodiesel and bioethanol from food waste can contribute to the solution of waste disposal, energy scarcity and energy security problems” (Karmee, and Lin, 2014).
- Food waste from animal feed which are available for eating can be recycling to animal feed. The most important case in this area is ensuring food is safe and non-toxic for animals. Incorporating food waste into feed for fish, pigs, poultry, rabbits and ruminants is possible with the necessary sterilization and precautions, making it an important component in preventing food waste (Rajeh, et al., 2021).

Food waste to energy system, “anaerobic digesters, generally suitable for organic wastes with high moisture contents, have been commercially successful for food waste to energy applications, with the potential for wider deployment to municipal and commercial waste generators” (Ghose, and Franchetti, 2018).

Smart food waste recycling bin, a technique developed using naturally occurring fermentation microorganisms placed on wooden biochips (bio-catalysis), enables the conversion of food waste into energy (Yeo, et al., 2019). Today, techniques like this example are diversifying.

Donation of excess food, food banks and charitable organizations can accept donations of food near or past its sell by date but still safe to eat. Charity and civil society-based websites are being established to support food donations (Jethwa, et al., 2018). However, food donation is a sensitive issue, most institutions do not accept donated food, and sometimes there are various problems in this area regarding the reputation of donors. The most difficult parts of food donation are the reliability of the timing and the health criteria of the donated product.

The techniques discussed here provide a cross-section of different approaches in this field. However, the techniques applied by companies in the food waste management sector are examined in Table 8.

Table 8: Firms from food waste management sector

Firms	How it works?
Winnow	Winnow (based in London) uses computer vision and AI technology to track food waste in commercial kitchens. The technology used by Winnow involves training the machine in photography and imaging discarded food. It provides some data to help companies reduce food waste in the kitchen and minimize their footprint to save money.
Rendisk	Rendisk is a company that provides technological solutions for dishwashing logistics and food waste management used in professional kitchens. The company's important products include "Solus Eco (reduces food waste and water waste), Transfer Eco (a pump-based food waste system that can process heavy and oily waste such as bones, shells, carbohydrates, coffee, etc.), Flex WasteDispo (reduces waste)" and the company has a very effective "Circular composting system (converts food waste into fertilizer)".
BioteCH4	BioteCH4 (based in the UK) converts food waste into compost and biogas using anaerobic digestion technology.
LeanPath	LeanPath works to reduce food waste by tracking and analyzing food waste data in commercial kitchens.
KITRO	KITRO uses AI-powered SaaS solutions in commercial kitchens and reduces food waste.
Wastelink	Wastelink has a recycling platform for food waste. It recycles food waste into animal feed.
Copia	Copia offers technological solutions for food waste management. It is specifically involved in donating excess food from food donors.
TotalCtrl	TotalCtrl (based in Norway) offers inventory optimization using automated expiration systems.)
Phood Solutions	Phood (based in USA) offers a waste tracking system for kitchens.

Source: adapted from Greyb, (2024).

When Table 8 is examined, it is seen that companies in this field have developed innovative approaches based on artificial intelligence, circular composting systems, biogas production, food waste data management, production of

animal food, and platforms developed through donating excess food from food donors. In this field, web-based applications have the potential to create different job opportunities for young entrepreneurs.

4. The Strategies for Recycling Food Waste

In this section, there is a discuss on the policies of different countries regarding food waste, the countries with the highest food waste and their reasons are given in Table 9.

Table 9: Countries with the most food waste

Country	Why food waste is so high
United States	The USA is among the countries with the most food waste globally. It is estimated that around 30 to 40 percent of the food supply is wasted. Unfortunately, 36 million tons of food is wasted in the USA every year.
United Kingdom	The UK has a serious food waste problem. It is estimated that 9.5 million tonnes (approximately) of food is wasted each year. It is also considered to have a significant food waste problem.
Australia	It is estimated that Australia wastes 7.3 million tons of food (approximately).
Canada	Canada is one of the countries with the highest food waste problem. It is estimated that 35.5 million tons of food is wasted each year.
Germany	Germany is one of the countries with the highest food waste among European countries, with an estimated 11 million tons (approximately) of food wasted per year.

Source: adapted from Waste Managed, (2024).

When Table 9 is examined, the USA, where almost half of the food waste is generated, is also the country where food justice issues are most discussed worldwide due to its large population and its lifestyle that causes food waste. Again, the fact that the countries in the Table are the most developed country in the world reveals that the living habits in these countries should be questioned in terms of sustainable food security.

The countries in Table 10 are the countries that have achieved food waste reduction. How these countries have achieved this is summarized in the table.

As seen in Table 10, to prevent food waste, strategies need to be developed in addition to techniques. For the strategies developed in this respect to be permanent, legal regulations are also necessary, as seen in the Danish example. Again, trainings have important contributions to raising public awareness, as seen in the Japanese example. Based on these approaches, various issues for municipalities' food waste recycling strategies can be examined in items.

Promoting source segregation, generally in developed and many developing countries, systems have been developed by municipalities to collect plastic, paper and glass waste separately. However, considering the odor issue, it is very difficult for people to store food waste in a certain area, so when municipalities create easily accessible or alternatively develop supporting community compost hubs, significant progress can be made in this area. Municipalities can prepare a community compost exchange guide on this issue. This guide contributes to community-based waste management and establishes a link between municipal food organic waste and soil management (Dirks, 2021). With this approach municipalities establish centralized composting facilities where organic waste is processed for agricultural and landscaping purposes.

Table 10: Countries for Food Waste Reduction

Country	Implications for reducing food waste
South Korea	Comprehensive policies have been implemented to reduce food waste at all levels (industry, government, household). For example, technology-focused solutions and public awareness programs have been implemented.
Netherlands	Strategies have been developed to prevent food waste at the production and retail levels. In particular, practices have been promoted to reduce food waste in packaging and distribution processes.
Denmark	Legislation includes regulations to prevent food waste. Consumer education and technology-focused solutions are also policies that are being considered together to reduce food waste. Redistribution and recycling practices are being addressed.
Japan	Food waste is being combated through consumer education and technology-focused practices. Food redistribution and recycling practices are prominent.

Source: adapted from Waste Managed, (2024).

Utilizing anaerobic digestion technology, many municipalities are investing in anaerobic digestion plants, recognizing their potential to reduce greenhouse gas emissions and contribute to the circular economy. Investments in facilities where this technology is produced are closely related to the countries' policies in this area (Massaro, 2015).

Encouraging public awareness and engagement, “examine householders’ attitudes, motivations and behaviors towards recycling, potential food waste segregation and prevention activities” (Rispo, 2015). To achieve this, various events can be organized with citizens and public opinion surveys can be conducted.

Integrating food waste recycling into the circular economy, food waste recycling approaches are also among the contributions of municipalities to the circular economy. “A sustainable food cycle in a circular economy can have five stages: food production, processing, distribution, food consumption, and food waste management” (Ojha, 2020).

Incentivizing participation and public participation increase strategies are among the most important functions of municipalities today. “Waste management represents a core

responsibility of local governments and holds a prominent position on the urban policy agenda due to its critical implications for the environment, public health, and public investments" (Fiorillo, and Merkaj, 2024). In this respect, they can encourage various participatory approaches in this area, such as giving awards to site residents who compost in their gardens, providing encouraging information to citizens about food donations, and providing compost training to school students.

5. Conclusions

Food waste is not only an environmental and health problem, but also a social justice issue. In a world where hunger and malnutrition are not prevented, food waste and food waste have reached enormous proportions. Studies on food waste have a wide place in the literature. In addition, indicators on food waste, economic and statistical studies, socio-political dimensions of food waste, technical and engineering dimensions of the process such as food waste recycling and disposal techniques are becoming the subjects of separate publications. This study has an innovative and interdisciplinary content that combines these dimensions but approaches each of them within a summary framework. First, various indicator tables were prepared from the information obtained on food waste and food waste by examining the current 2023-2024 reports. As stated in the previous sections, beyond providing statistical information on the amount of food waste, a simplified framework of trends in this area is presented with data such as which products food waste increases in and which countries are more conscious about the food waste process. This study is thought to give a brief policy sheet for scholars and policymakers to launch new food security programs or strategies for reducing food loss and food waste in the long term.

When it comes to recycling in the field of food waste, the first thing that comes to mind is composting. When food waste is processed and recycled correctly, an efficient fertilizer is obtained, and when this is done with the cooperation of citizens and the municipality, it creates an environmentally friendly social responsibility opportunity for citizens. In addition, in the study, among the food waste recycling techniques, anaerobic digestion, upcycling food waste, food waste recycling in industrial settings as converting food waste into biofuel and food waste to animal feed, Food waste to energy system, smart food waste recycling bin, donation of excess food topics are briefly mentioned together with compost. When these contents are examined, it is seen that innovative approaches for food waste recycling techniques are increasing and diversifying.

A significant part of the food waste problem that occurs because of food waste is also due to consumer habits and commercial practices. When viewed from this perspective, it is seen that a policy change is needed in this area. Food supply systems should also be reconsidered in a way that will reduce food waste.

Since municipalities are the public administration units primarily responsible for the collection and disposal of food waste, they are also responsible for the recycling of the process. In general, municipalities can carry out activities to raise awareness among citizens about food recycling, produce innovative projects in this field with companies, supporting community compost hubs, and integrating food waste recycling into the circular economy. They can take initiatives in cooperation with governments to make legal arrangements for these activities to become permanent. Municipalities can play a pivotal role in addressing the global food waste crisis and building a more sustainable future.

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