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Integrative Approach of Total Quality Management and Circular Economy for Enhancing the Sustainability of Fisheries Sector in South Sulawesi

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Abstract:
This study investigates the potential integration of Total Quality Management (TQM) and the Circular Economy (CE) within the fisheries sector of South Sulawesi, Indonesia, aiming to strengthen food security and environmental sustainability. Using a mixed-methods approach involving surveys (n=100), interviews, and field observations, the study reveals significant service quality gaps, particularly in reliability (-0.93) and empathy (-0.87). Qualitative analysis shows that TQM implementation is still fragmented, while CE concepts remain underutilized despite their economic potential. The research proposes an integrative model combining quality control, waste valorization, digital monitoring, and human resource development. The findings contribute to both academic and practical advancements in sustainable fisheries management.
Keywords: *Total Quality Management, Circular Economy, Fisheries, SERVQUAL, Sustainability, Indonesia*

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I. Introduction

The importance of integrating quality and sustainability in marine resource management is widely acknowledged (Wijkman & Skanberg, 2016; Tjahjono et al., 2017). Indonesia's marine richness (Setiawan et al., 2021) and its socio-economic reliance on fisheries (Kurniawan & Suryadi, 2021) underline the urgency to address inefficiencies (Yuliana & Anwar, 2022) and post-harvest losses (Kurniawan et al., 2021). While CE offers frameworks to reduce waste and reuse resources (Gunawan & Yuliana, 2021), TQM serves as a quality assurance backbone (Novita & Haris, 2022). Despite these advancements, local studies show implementation gaps (Iskandar & Suryadi, 2022), highlighting the need for a synthesized approach.

The fisheries sector is a fundamental pillar of Indonesia's national economy and food security system. With over 17,000 islands and one of the longest coastlines in the world, Indonesia is naturally endowed with vast marine resources that hold immense potential for development and sustainability. Among the many provinces contributing significantly to fisheries production, South Sulawesi stands out due to its strategic geographic location and rich biodiversity in coastal and marine ecosystems. The region is a key player in supplying fishery products both domestically and internationally. However, the sector faces persistent challenges related to quality control, post-harvest losses, inefficient resource use, and environmental degradation. These issues are further exacerbated by fragmented management practices, limited technological adoption, and underdeveloped policy frameworks.

In recent years, the growing emphasis on sustainability and climate resilience has pushed industries, including fisheries, to reconsider traditional linear economic models in favor of more regenerative and resource-efficient approaches. The concept of the Circular Economy (CE), which promotes waste minimization, reuse, recycling, and resource regeneration, has emerged as a strategic alternative to the conventional take-make-dispose model. CE in the fisheries context includes converting fish processing waste into useful by-products such as organic fertilizers, animal feed, collagen for cosmetics, and bioplastics. These practices not only reduce environmental pressure but also open new economic opportunities for communities reliant on fisheries.

Parallel to the rise of CE, Total Quality Management (TQM) has been recognized as a comprehensive framework to ensure consistent quality across production and service chains (Lamatinulu et al., 2023). TQM emphasizes continuous improvement, customer focus, employee involvement, and data-driven decision-making. When applied to fisheries, TQM offers the potential to improve product safety, compliance with international standards (e.g., HACCP, ISO 22000), and market competitiveness. Yet, TQM remains sporadically implemented

in Indonesia's fisheries industry, often constrained by a lack of infrastructure, knowledge, and institutional support.

The convergence of TQM and CE presents a timely and synergistic solution to address both the qualitative and sustainability challenges in fisheries. While TQM ensures process and product integrity, CE facilitates environmental stewardship and resource optimization. Integrating these two paradigms can result in a more resilient, efficient, and competitive fisheries sector that contributes to broader goals such as the Sustainable Development Goals (SDGs), particularly SDG 12 (Responsible Consumption and Production) and SDG 14 (Life Below Water).

Despite the promising outlook, academic and practical insights into how TQM and CE can be jointly implemented in fisheries, especially in developing countries, remain limited. Existing literature often treats the two approaches separately, with CE studies focusing primarily on waste valorization and TQM research concentrating on quality assurance systems. Few studies have examined their intersection and potential complementarities within the operational and socio-technical contexts of small and medium-sized enterprises (SMEs) in fisheries. This gap is particularly evident in tropical maritime regions like South Sulawesi, where traditional practices coexist with evolving market and environmental demands.

Therefore, this study aims to fill this gap by exploring the integrative application of TQM and CE in the fisheries sector of South Sulawesi. Using a mixed-methods approach, the research identifies key quality challenges, assesses stakeholder perceptions, analyzes service quality gaps through the SERVQUAL model, and develops a conceptual framework that synthesizes TQM and CE principles. This framework is designed not only to guide industrial practice but also to inform policymakers and researchers on effective strategies for sustainable fisheries development.

This introduction lays the foundation for an interdisciplinary inquiry into how managerial quality frameworks and ecological economics can converge to shape the future of one of Indonesia's most vital sectors. By examining real-world practices, challenges, and opportunities, the study contributes to the growing discourse on integrative sustainability models in emerging economies. The findings are expected to have both theoretical significance and practical implications, particularly for coastal regions where economic livelihoods and environmental health are intricately linked.

II. Methodology

This study builds upon theoretical frameworks in TQM (Juran, 2016; Deming, 2020) and the Circular Economy (Geissdoerfer et al., 2017; Kirchherr et al., 2017; Padhil et al., 2022) to explore their combined potential in fisheries sustainability. Prior applications of SERVQUAL in agro-industrial contexts (Parasuraman et al., 1988; Hidayat & Yunus, 2022) inform the quantitative measurement of quality gaps, while the integration of NVivo and field observations follows standard qualitative methodologies (Creswell & Poth, 2018).

This study employs a mixed-methods approach to explore the intersection of Total Quality Management (TQM) and Circular Economy (CE) within the fisheries sector in South Sulawesi. The choice of mixed methods is motivated by the need to capture both numerical data on quality perceptions and nuanced insights from industry practitioners, policymakers, and community stakeholders.

2.1 Research Design

The research follows an exploratory sequential design, where qualitative data provides context and interpretation for quantitative findings. The study is divided into three phases:

Phase 1: Desk research and initial field assessment

Phase 2: Quantitative survey for SERVQUAL analysis

Phase 3: In-depth interviews and participatory field observations

2.2 Data Collection Methods

2.2.1 Survey (Quantitative)

A structured questionnaire based on the SERVQUAL model was administered to 100 respondents from various segments of the fisheries supply chain (capture fisheries, processors, and distributors). The five SERVQUAL dimensions—Tangibles, Reliability, Responsiveness, Assurance, and Empathy—were measured using a Likert scale from 1 (Strongly Disagree) to 5 (Strongly Agree). Respondents were selected using purposive sampling to ensure relevance and expertise.

2.2.2 Interviews (Qualitative)

Semi-structured interviews were conducted with 15 key informants, including:

Government officials from the Fisheries Department

Owners/managers of fish processing units

Fishermen association leaders

Environmental NGOs
Academic experts in marine economics and quality management
The interviews explored perceptions of quality, waste utilization practices, constraints in implementing TQM and CE, and recommendations for improvement.

2.2.3 Field Observations

Direct observations were carried out at six locations in South Sulawesi—three coastal fishing villages and three fish processing hubs. Observations focused on processing practices, hygiene standards, waste handling, and any local innovation related to resource efficiency.

2.3 Data Analysis

2.3.1 Fuzzy SERVQUAL Analysis

To account for linguistic uncertainty in human perceptions, a fuzzy logic approach was adopted for the SERVQUAL analysis. The steps included:
Fuzzification of Likert-scale responses
Determination of weight for each SERVQUAL dimension
Calculation of fuzzy gap scores (Perception – Expectation)
Defuzzification to obtain precise numerical gap indicators

2.3.2 Thematic Analysis of Qualitative Data

Interview transcripts and observation notes were analyzed using NVivo 12 software. Coding followed both deductive and inductive strategies to categorize responses into themes such as:
Barriers to quality management
Knowledge of circular practices
Institutional support and market access

2.4 Ethical Considerations

All participants were informed about the purpose of the study and gave their consent before participating. Data confidentiality and anonymity were assured. The research protocol was approved by the institutional ethics committee of Universitas Muslim Indonesia.

2.5 Limitations

The study is limited by its geographic scope and sample size. While the findings provide valuable insights into South Sulawesi, further validation is needed in other coastal regions of Indonesia.

III. Results and Discussion

3.1 Quantitative Findings: Service Quality Gaps

The SERVQUAL analysis revealed notable gaps across all five dimensions of service quality. Reliability exhibited the highest gap score (-0.93), indicating significant concerns among respondents regarding consistency in supply, timeliness of delivery, and dependability of fish processing services. Empathy followed with a gap of -0.87, suggesting that actors in the supply chain feel a lack of responsiveness and personalized attention from service providers and policy institutions.

Dimensi SERVQUAL	Persepsi	Harapan	Gap
Tangibles	**3.26**	**4.08**	**-0.82**
Reliability	**3.18**	**4.11**	**-0.93**
Responsiveness	**3.33**	**4.05**	**-0.72**
Assurance	**3.41**	**4.15**	**-0.74**
Empathy	**3.22**	**4.09**	**-0.87**

These findings align with Hidayat & Yunus (2022), who found similar service gaps in marine-based supply chains, underscoring the need for rigorous quality control and stakeholder communication.

3.2 Qualitative Insights: Implementation Challenges

Field interviews and observations identified several barriers to implementing TQM and CE. Key findings include:
Lack of knowledge and technical capacity regarding quality standards and waste valorization processes.
Limited access to certifications (e.g., HACCP, ISO 22000) due to cost and administrative complexity.
Infrastructure deficiencies, such as absence of cold chain logistics and integrated waste handling facilities.
Interview participants emphasized the need for inclusive training programs and government incentives. As one fish processor noted: “We want to improve, but there’s no support or equipment to manage waste or track quality.” This mirrors previous conclusions by Iskandar & Suryadi (2022) about institutional barriers in rural fishery economies.

3.3 Integration Potential of TQM and Circular Economy

The convergence of TQM and CE offers synergistic benefits. While TQM addresses consistency, safety, and traceability, CE introduces waste minimization and value addition. Our field data supports the development of an integrative model with four key components:

Standardized quality control (TQM practices).

Waste valorization into secondary products (CE initiatives).

Real-time monitoring via digital dashboards.

Capacity building through certified training.

This model is consistent with the CE framework by Geissdoerfer et al. (2017) and responds to practical challenges noted by Novita & Haris (2022). It proposes not only technical solutions but also institutional reforms to ensure adoption.

3.4 Implications and Comparative Analysis

The findings suggest that integrating TQM and CE can support Sustainable Development Goals (SDGs), especially in developing maritime economies. Compared to single-approach interventions, the dual model enhances both productivity and ecological performance. Similar strategies have shown promise in manufacturing industries (Tjahjono et al., 2017), and this study extends that application into fisheries.

In summary, South Sulawesi's fisheries sector shows readiness for transformation but requires coordinated support across technology, policy, and community engagement.

IV. Conclusion

This research has demonstrated that integrating Total Quality Management (TQM) and the Circular Economy (CE) within the fisheries sector can significantly contribute to enhancing sustainability, quality assurance, and economic resilience. The quantitative results highlight persistent gaps in service delivery, with the greatest discrepancies in reliability and empathy, indicating systemic issues in consistency and stakeholder engagement. Qualitative insights corroborate these findings, revealing infrastructural, institutional, and knowledge-based barriers that hinder the adoption of best practices.

The proposed integrative framework aligns both TQM and CE in a unified strategy that addresses product quality, environmental management, and socio-economic empowerment. Its components—standardized quality control, waste valorization, digital monitoring, and capacity building—offer a pragmatic path forward for sustainable development in the fisheries sector.

To operationalize this model, coordinated efforts are needed across various actors. Policymakers must formulate supportive regulations and provide incentives, while industries need to invest in infrastructure and training. Academia and civil society also have critical roles in research, community outreach, and innovation incubation. Future research should focus on piloting this framework in different regional contexts to validate its scalability and effectiveness.

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