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Management Accounting and Value Chain Innovation in Poultry and Fish Meal Industries: Financial, Digital, and Sustainability Perspectives

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ABSTRACT

Management accounting can support cost efficiency, digital transformation, and sustainability in poultry and fishmeal industries. This study reviews how management accounting practices interact with value chain innovations, including activity-based costing, digital monitoring, blockchain-based traceability, life cycle assessment, and environmental performance evaluation. A structured literature review was conducted using recent studies on poultry production, fishmeal processing, farm efficiency, supply-chain traceability, and sustainable feed systems. The findings indicate that integrating accounting information with digital and environmental data can improve cost control, resource efficiency, traceability, and strategic decision-making. However, implementation depends on data availability, technical capability, investment capacity, and organizational readiness. The study provides an integrated perspective for sustainable agrifood value-chain management.

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1. INTRODUCTION

Poultry production and fishmeal processing are important components of modern agrifood systems because they support the supply of animal protein, feed ingredients, and related agricultural products. However, these industries also face increasing pressure to improve production efficiency, reduce resource consumption, strengthen traceability, control environmental impacts, and maintain economic competitiveness. These conditions require management approaches that integrate financial information with operational, technological, and sustainability indicators.

Management accounting provides information for planning, cost control, performance evaluation, and managerial decision-making. In agricultural production systems, the combination of management accounting practices and information and communication technologies can improve efficiency by supporting better resource allocation and operational monitoring [1]. Management accounting can therefore be considered not only as a financial reporting function but also as a decision-support mechanism for agrifood production.

The poultry industry provides a particularly relevant setting for this approach. Feed, energy, labor, mortality, processing, logistics, and product quality directly affect production costs and profitability. Digital monitoring can support more efficient control of environmental conditions and feeding activities, thereby improving operational efficiency in livestock production [2]. Management accounting can complement such technologies by translating production data into cost, efficiency, and performance information.

Traceability represents another important dimension of poultry value chains. Blockchain-based systems have been investigated as mechanisms for improving transparency and product traceability in poultry supply chains, particularly in relation to halal assurance and food-quality requirements [3]. Similar blockchain applications have also been developed for broiler supply-chain traceability, demonstrating the potential of digital platforms to connect production, distribution, and product information across the value chain [4].

More recent approaches integrate traceability with broader supply-chain management. Halal-hygiene assurance and blockchain-integrated traceability frameworks demonstrate how digital systems can support transparency, product assurance, and coordination in broiler supply chains [5]. These developments are relevant to management accounting because improved traceability can provide more reliable operational information for costing, performance assessment, compliance, and supply-chain decision-making.

Sustainability is equally important in fishmeal production. Fishmeal processing requires energy, raw materials, transportation, and processing infrastructure, creating environmental impacts throughout the production chain. Life cycle assessment of fishmeal plants has demonstrated opportunities for cleaner production through the identification of major environmental burdens and process-improvement opportunities [6]. Energy-related environmental hotspots have also been identified in fishmeal and fish oil production, emphasizing the importance of process optimization and energy efficiency [7].

Recent assessments further demonstrate that the environmental performance of fishmeal and fish oil production is influenced by technological development, energy use, and production practices [8]. Such environmental information can complement conventional management accounting by supporting life-cycle-oriented cost evaluation, resource-efficiency assessment, and sustainability-based investment decisions.

The sustainability challenge also extends to feed formulation and alternative protein resources. Comparative life cycle assessment has shown that alternative protein ingredients can provide opportunities to reduce dependence on conventional fishmeal in aquaculture feeds [9]. In poultry production, precision nutrition and feed innovations can similarly contribute to more sustainable production through improved resource utilization and reduced environmental burdens [10].

Despite these developments, financial management, digital innovation, traceability, and environmental assessment are frequently examined separately. A more integrated perspective is required to explain how management accounting can connect cost information with operational efficiency, digital technologies, supply-chain transparency, environmental performance, and long-term sustainability in poultry and fishmeal industries.

This study aims to examine how management accounting can support value-chain innovation in poultry and fishmeal industries from financial, technological, and sustainability perspectives. Specifically, this study addresses the following questions: (i) How can management accounting support cost control and operational efficiency in poultry and fishmeal industries? (ii) How can digital technologies and traceability systems strengthen management accounting information across agrifood value chains? (iii) How can environmental and life-cycle information be integrated with management accounting to support sustainable decision-making? and (iv) What opportunities and implementation challenges influence the adoption of integrated management accounting systems in poultry and fishmeal industries?

The novelty of this study lies in integrating management accounting, digital value-chain innovation, traceability, and environmental sustainability within a single framework for poultry and fishmeal industries. Rather than considering management accounting only as a tool for recording and controlling costs, this study positions it as a decision-support mechanism linking financial performance with operational data, technological innovation, resource utilization, and sustainability indicators.

2. LITERATURE REVIEW

2.1. Management Accounting and Operational Efficiency

Management accounting supports managerial decision-making by converting operational and financial data into information for planning, cost control, performance evaluation, and resource allocation. In agricultural production, the effectiveness of management accounting can be strengthened when accounting practices are integrated with information and communication technologies. Such integration can improve farm efficiency by supporting more accurate monitoring of production activities and resource utilization [1]. This role is particularly important in poultry production because feed, energy, mortality, labor, processing, and logistics directly influence production costs. Digital monitoring of feeding and environmental conditions can improve operational control and provide production data that can subsequently be incorporated into accounting and performance systems [2]. Management accounting can therefore operate as an interface between physical production data and financial decision-making. **Table 1** summarizes the main operational roles considered in this study.

Table 1. Management accounting functions in poultry and fishmeal value chains.

MANAGEMENT ACCOUNTING FUNCTION	OPERATIONAL INFORMATION	EXPECTED MANAGERIAL CONTRIBUTION
Cost control	Feed, labor, energy, processing, logistics	Identification of major cost drivers
Performance measurement	Production output, mortality, conversion efficiency	Operational evaluation
Resource monitoring	Feed, water, energy, raw materials	Resource-efficiency improvement
Investment evaluation	Technology, equipment, digital systems	Capital-allocation decisions
Sustainability accounting	Energy use, emissions, waste, environmental impacts	Sustainability-oriented decisions
Supply-chain information	Traceability and product movement	Transparency and coordination

2.2. Digital Traceability and Value Chain Innovation

Digital technologies are increasingly important in agrifood value chains because they allow information to be recorded, exchanged, and verified across multiple production and distribution stages. Blockchain-based traceability has been examined in poultry supply chains as a mechanism for improving transparency, halal assurance, and product information [3]. Broiler supply-chain applications also demonstrate that blockchain can connect information from different stages of production and distribution through digital traceability systems [4]. More integrated models combine blockchain with hygiene and halal-assurance mechanisms, indicating that traceability can become part of broader supply-chain management rather than functioning only as a product-tracking tool [5].

These technologies are relevant to management accounting because traceability data can support cost identification, compliance evaluation, supplier monitoring, inventory control, and performance measurement. The interaction between accounting information and digital traceability is summarized in **Table 2**.

Table 2. Digital innovations and their potential contribution to management accounting.

DIGITAL INNOVATION	MAIN FUNCTION	POTENTIAL ACCOUNTING CONTRIBUTION
Digital monitoring	Real-time production observation	More timely cost and performance information
IoT-based systems	Monitoring feed and environmental conditions	Resource-efficiency measurement
Blockchain	Product and transaction traceability	Reliable supply-chain information
Digital dashboards	Integration of production indicators	Faster managerial decision-making
Data analytics	Interpretation of production patterns	Forecasting and performance evaluation
Integrated traceability	Linking suppliers, production, and distribution	Cost and compliance transparency

2.3. Environmental Performance and Fishmeal Production

Environmental sustainability is a major issue in fishmeal and fish oil production because processing requires energy, transportation, raw materials, and other resources. Life cycle

assessment has been used to identify environmental burdens and cleaner-production opportunities in fishmeal plants [6]. Subsequent studies have identified energy-related environmental hotspots in fishmeal and fish oil production, demonstrating that energy consumption and process configuration can substantially influence environmental performance [7]. More recent assessments continue to show that environmental impacts vary according to production technology, energy sources, operational practices, and supply-chain conditions [8]. These findings are relevant to management accounting because environmental information can be incorporated into investment evaluation, resource-efficiency analysis, and sustainability-oriented managerial decisions. Conventional financial indicators can therefore be complemented by environmental indicators related to energy use, material consumption, emissions, and waste.

2.4. Sustainable Feed and Alternative Protein Resources

Feed represents an important connection between poultry, aquaculture, and fishmeal value chains. Fishmeal is traditionally used as a protein ingredient, but concerns regarding resource availability and environmental impacts have encouraged research into alternative feed materials. Comparative life cycle assessment indicates that alternative protein sources such as microalgae can be assessed against conventional fishmeal from environmental and production perspectives [9]. In poultry production, precision nutrition and feed innovations may similarly improve resource utilization and reduce environmental burdens [10]. From a management accounting perspective, alternative feed strategies require simultaneous consideration of procurement cost, feed efficiency, production performance, environmental impacts, and long-term economic viability. Thus, sustainable feed innovation creates a need for integrated accounting approaches that evaluate both financial and environmental performance.

2.5. Integrated Perspective

The literature demonstrates four closely related dimensions: management accounting, operational efficiency, digital traceability, and environmental sustainability. However, these dimensions are frequently examined independently. Agricultural efficiency studies emphasize accounting and ICT [1], poultry studies emphasize digital production and traceability [2-5], while fishmeal studies emphasize environmental performance and life cycle assessment [6-9]. The present study integrates these perspectives by treating management accounting as a decision-support mechanism that can connect financial information with production, digital, traceability, and environmental data. This integrated perspective provides the conceptual basis for analyzing value chain innovations in poultry and fishmeal industries.

3. METHOD

3.1. Research Design

This study used a structured literature review to examine the relationship among management accounting, value chain innovation, digital technology, operational efficiency, and environmental sustainability in poultry and fishmeal industries. The study relied entirely on secondary data and did not involve primary surveys, experiments, or interviews. The analytical approach was qualitative and comparative. Relevant studies were examined to identify recurring concepts, technologies, operational applications, sustainability indicators, and managerial implications.

3.2. Literature Search and Selection

Literature was identified from academic search platforms and publisher databases, including Google Scholar, Scopus, ScienceDirect, and other academic journal databases relevant to agricultural production, accounting, digital technology, and sustainability. The study also considered web-based academic sources for identifying relevant literature. The search focused on combinations of keywords such as: (i) management accounting and agricultural production; (ii) poultry production and operational efficiency; (iii) poultry supply chain and blockchain; (iv) fishmeal production and life cycle assessment; (v) environmental accounting and sustainability; (vi) feed innovation and alternative protein; and (vii) digital technologies in agrifood value chains. Priority was given to peer-reviewed journal articles that directly addressed at least one component of the proposed framework.

3.3. Inclusion and Exclusion Criteria

The literature-selection criteria are summarized in **Table 3**. Older studies were retained when they provided important methodological or sectoral foundations, particularly for life cycle assessment of fishmeal production [6].

Table 3. Literature inclusion and exclusion criteria.

CRITERION	INCLUSION	EXCLUSION
Publication type	Peer-reviewed journal articles	Unverifiable or non-academic sources
Topic	Management accounting, poultry, fishmeal, traceability, sustainability, or feed innovation	Studies unrelated to agrifood value chains
Application	Operational, financial, technological, or environmental analysis	Studies without relevant managerial implications
Language	English or publications with sufficient English bibliographic information	Sources that could not be interpreted reliably
Availability	Verifiable academic publication	References without traceable publication information

3.4. Analytical Classification

The selected literature was classified into four analytical categories: (i) management accounting and operational efficiency; (ii) digital technology and traceability; (iii) environmental performance and life cycle assessment; and (iv) sustainable feed and alternative protein resources. Each study was examined according to its sector, principal method, technological or accounting approach, main performance dimension, and implications for managerial decision-making.

3.5. Comparative Analysis

Comparative analysis was used to examine similarities and differences between poultry and fishmeal industries. Poultry-related studies were evaluated mainly in relation to production efficiency, feeding, digital monitoring, traceability, and supply-chain coordination [2-5]. Fishmeal-related studies were evaluated primarily in relation to energy use, environmental impacts, cleaner production, and life cycle performance [6-9]. The comparison was then used to identify areas in which management accounting could integrate these different forms of information into a common decision-support framework.

3.6. Conceptual Analysis Procedure

The analytical procedure consisted of five stages, as summarized in **Table 4**. The first stage established the literature base. The second classified studies according to poultry, fishmeal, accounting, digital technology, and sustainability themes. The third identified major financial, operational, traceability, resource-efficiency, and environmental indicators. The fourth compared the roles of these indicators across poultry and fishmeal industries. Finally, the fifth stage integrated the findings into a conceptual framework explaining how management accounting can support financial performance, digital value-chain innovation, and sustainable decision-making.

Table 4. Stages of the analytical procedure.

STAGE	ANALYTICAL ACTIVITY	MAIN OUTPUT
1	Identification of relevant literature	Verified literature base
2	Classification by sector and research focus	Poultry and fishmeal categories
3	Identification of financial, digital, operational, and environmental indicators	Value-chain innovation dimensions
4	Comparative analysis of the two industries	Similarities and sector-specific differences
5	Integration of findings	Management accounting and value-chain framework

4. RESULTS AND DISCUSSION

4.1. Management Accounting as a Value Chain Decision-Support System

The analysis indicates that management accounting can function as more than a conventional cost-recording mechanism in poultry and fishmeal industries. Its broader role is to integrate financial, operational, digital, traceability, and environmental information into managerial decision-making. This perspective is consistent with evidence showing that management accounting practices combined with information and communication technologies can improve efficiency in agricultural production [1].

In poultry production, accounting information can be connected with feed cost, labor, mortality, energy use, logistics, processing, and product quality. Digital monitoring systems can strengthen this process by providing timely production information that can later be interpreted through cost and performance indicators [2]. Management accounting therefore becomes part of an integrated information system linking physical production with financial consequences.

Table 5 summarizes the main value-chain functions identified from the reviewed literature. The findings suggest that the value of management accounting increases when it is connected with operational data rather than used only after production has occurred. Financial performance is also an important consideration in poultry enterprises because the formation and distribution of financial results directly reflect business effectiveness and managerial performance [11].

4.2. Digital Technologies and Traceability in Poultry Value Chains

Digital technologies represent an important component of value-chain innovation in poultry production. Blockchain-based traceability systems can improve transparency, product identification, and information exchange across poultry supply chains [3]. Similar systems have been developed specifically for broiler supply chains to connect production and

distribution information through digital applications [4]. More integrated traceability models combine blockchain technology with halal and hygiene assurance. Such systems demonstrate how digital infrastructure can support product integrity, supply-chain coordination, and managerial control [5]. From a management accounting perspective, traceability data can also strengthen costing, compliance monitoring, inventory evaluation, and supplier performance analysis.

Table 5. Main value-chain functions of integrated management accounting.

VALUE-CHAIN FUNCTION	MAIN INFORMATION	MANAGEMENT CONTRIBUTION
Cost control	Feed, labor, energy, processing	Identification of major cost drivers
Production monitoring	Output, mortality, resource use	Operational performance evaluation
Supply-chain traceability	Product movement and transaction data	Transparency and compliance support
Resource efficiency	Feed, water, energy, raw materials	Efficiency improvement
Environmental evaluation	Emissions, waste, energy intensity	Sustainability-oriented decisions
Strategic planning	Financial and operational indicators	Investment and long-term planning

The relationship among digital technologies, operational information, and accounting applications is summarized in **Table 6**. These findings show that digital value-chain innovation should not be separated from management accounting. Instead, digital systems can provide the data infrastructure required for more accurate and responsive managerial analysis.

Table 6. Digital technologies and their contribution to management accounting.

TECHNOLOGY	PRIMARY FUNCTION	POTENTIAL ACCOUNTING CONTRIBUTION
Digital production monitoring	Real-time observation	Timely cost and performance data
IoT-based monitoring	Feed and environmental control	Resource-use evaluation
Blockchain	Traceability and verification	Reliable transaction and product information
Integrated supply-chain systems	Data exchange across actors	Improved coordination and transparency
Data analytics	Pattern recognition and forecasting	Better planning and decision-making

4.3. Environmental Performance in Fishmeal Production

Environmental performance is a major concern in fishmeal and fish oil production because these processes involve energy consumption, raw materials, transport, processing, and waste generation. Life cycle assessment has identified important environmental burdens and cleaner-production opportunities in fishmeal processing [6]. Subsequent analysis has shown that energy-related processes represent significant environmental hotspots in fishmeal and fish oil production [7]. More recent assessments also indicate that environmental impacts can vary according to production technology, energy sources, process efficiency, and operational practices [8]. These findings are important for management accounting because environmental information can be translated into managerial indicators. Energy intensity, material losses, waste generation, and emissions can be incorporated into resource-efficiency analysis, investment appraisal, and sustainability evaluation.

Table 7 summarizes the environmental information that can be integrated into management accounting systems. This integration allows financial and environmental objectives to be evaluated simultaneously rather than independently.

Table 7. Environmental indicators relevant to management accounting in fishmeal production.

ENVIRONMENTAL INDICATOR	OPERATIONAL RELEVANCE	MANAGEMENT ACCOUNTING USE
Energy consumption	Processing efficiency	Energy-cost evaluation
Material utilization	Raw-material efficiency	Yield and loss analysis
Waste generation	Process performance	Waste-related cost assessment
Emissions	Environmental burden	Sustainability performance evaluation
Water use	Resource efficiency	Resource-cost monitoring
Life-cycle impact	Overall environmental performance	Long-term investment assessment

4.4. Sustainable Feed Innovation and Resource Efficiency

Feed represents an important connection between poultry and aquaculture value chains. Alternative protein resources are increasingly evaluated because of concerns regarding the environmental burden and long-term availability of conventional feed ingredients. Comparative life cycle assessment has demonstrated that alternative protein sources such as microalgae can be evaluated against conventional fishmeal in aquaculture feeds [9]. In poultry production, precision nutrition and feed innovations can also contribute to improved resource utilization and lower environmental impacts [10]. Financial performance is equally important because the effectiveness of poultry enterprises depends on how production results are translated into business outcomes and distributed financial returns [11]. Alternative feed ingredients have also been investigated in poultry production, including the development of chicken feedstuff using banana peel, illustrating opportunities for utilizing agricultural by-products in feed formulation [12]. Management accounting should evaluate feed alternatives using multiple dimensions rather than procurement cost alone. Economic cost, feed efficiency, production performance, environmental impact, and supply security should be considered together.

Table 8 presents an integrated decision perspective for feed innovation. This multidimensional approach is particularly relevant for agrifood industries because lower short-term costs do not necessarily correspond to stronger long-term economic or environmental performance.

Table 8. Integrated evaluation of feed and protein innovations.

EVALUATION DIMENSION	EXAMPLE INDICATOR	MANAGERIAL RELEVANCE
Financial	Feed cost per unit output	Cost competitiveness
Operational	Feed conversion efficiency	Production performance
Environmental	Life-cycle impact	Sustainability
Resource	Material and energy demand	Resource efficiency
Supply-chain	Availability and traceability	Supply security
Strategic	Long-term viability	Investment decision

4.5. Integrated Financial, Digital, and Sustainability Framework

The main conceptual result of this study is that management accounting can be positioned as the integrating mechanism connecting financial performance, digital value-chain innovation, operational efficiency, and environmental sustainability.

The proposed framework begins with operational and supply-chain data. These data are generated from production monitoring, digital traceability, resource-use measurement, and environmental assessment. Management accounting then converts these inputs into cost, efficiency, compliance, sustainability, and investment information. The resulting information supports managerial decisions concerning process improvement, technology adoption, feed strategy, resource efficiency, and long-term value-chain development.

This integrated relationship is illustrated in **Figure 1**. The proposed framework is not linear. Digital monitoring, blockchain-based traceability, life cycle assessment, and resource-efficiency indicators continuously provide information to management accounting. In return, accounting analysis supports decisions that influence production, investment, technology adoption, and sustainability performance. The framework therefore represents a continuous decision-support cycle.

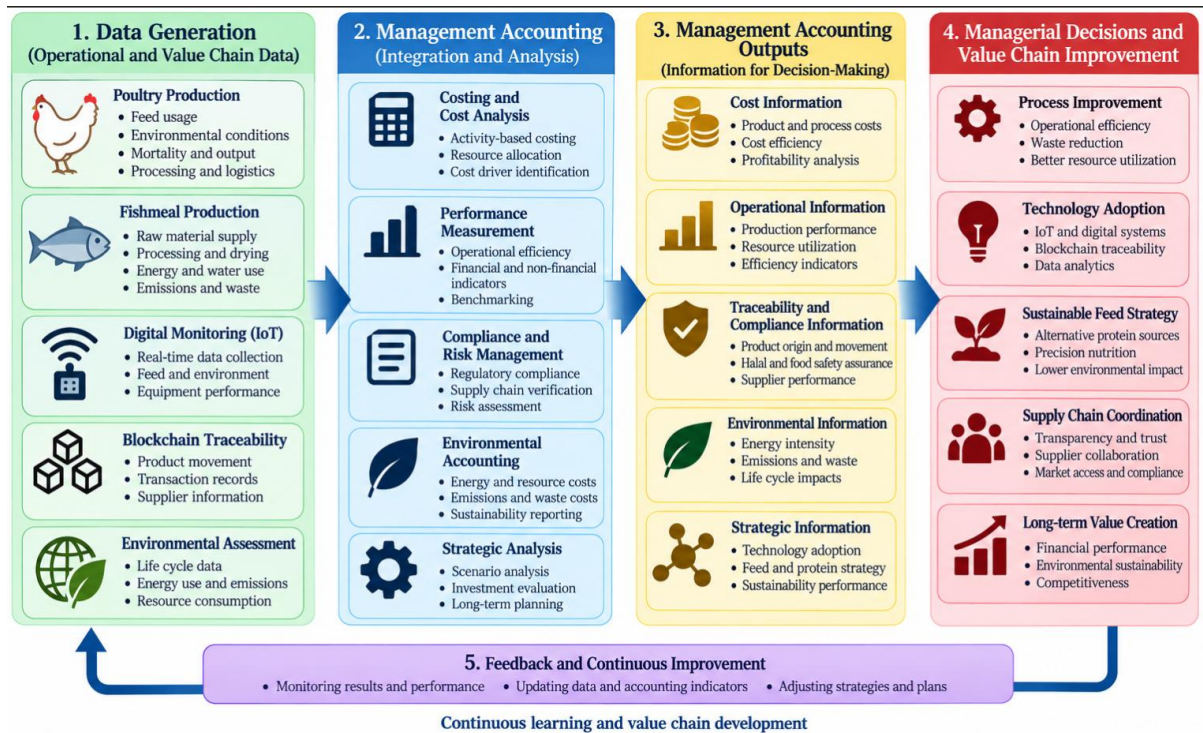


Figure 1. Integrated management accounting framework for financial, digital, operational, and sustainability performance in poultry and fishmeal value chains.

The proposed conceptual relationship is summarized in **Table 9**. The framework highlights that poultry and fishmeal industries have different operational characteristics, but they share a common managerial requirement: reliable integration of financial and non-financial information. In poultry production, the strongest contribution comes from digital monitoring and traceability [2-5], while in fishmeal production, environmental and life-cycle information is particularly important [6-8]. Feed innovation and alternative protein assessment provide

an additional sustainability dimension [9, 10, 12]. Management accounting provides the mechanism for bringing these information streams into a common decision-support structure.

Table 9. Integrated management accounting and value-chain framework.

STAGE	MAIN PROCESS	MAIN OUTPUT
1	Data generation	Production, cost, traceability, environmental data
2	Information integration	Combined financial and non-financial information
3	Management accounting analysis	Cost, efficiency, risk, and sustainability indicators
4	Managerial decision-making	Technology, feed, process, and investment decisions
5	Value-chain improvement	Greater efficiency, transparency, and sustainability
6	Feedback and monitoring	Continuous performance improvement

5. CONCLUSION

Management accounting can support value-chain innovation in poultry and fishmeal industries by integrating financial, operational, digital, traceability, and environmental information. Digital monitoring and blockchain can strengthen transparency and production control, while life cycle assessment and resource indicators improve sustainability evaluation. Feed and protein innovations also require combined financial and environmental assessment. The proposed framework positions management accounting as a decision-support mechanism connecting data generation, performance analysis, managerial decisions, and continuous improvement. Future studies should test the framework using firm-level financial, operational, digital, and environmental data from poultry and fishmeal enterprises.

6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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