Research Article

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International Accounting Standard for Biological Assets in the Poultry Sector of Tungurahua Ecuador: A Descriptive and Natural Language Processing Study

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Abstract

International Accounting Standard (IAS) 41 for Biological Assets establishes guidelines for accounting for live assets and agricultural products, which in this case was taken into account for an analysis in the poultry industry. This standard seeks to standardize accounting processes with the measurement of biological assets at fair value; in the poultry industry, proper accounting is a problem, due to the biological and economic nature of birds, in addition to the measurement of their growth and the valuation of assets at various stages of their development. IAS 41 enables poultry firms to properly recognize the revenues and expenses associated with these assets, improves financial transparency, and facilitates business decisions based on truthful and accurate data. This descriptive study analyzed the application of IAS 41 in the poultry sector in Ecuador and evaluated the economic and fiscal situation of the companies. Natural language processing (NLP) techniques were used to analyze interviews and textual documents in order to extract information that contributes to improve accounting practices, compliance with international regulations, identify patterns and generate topics related to the implementation of IAS 41. It was found that this standard represents an important framework for accounting for biological assets and that it influences the management of poultry operations by helping companies to optimize production and solve operational efficiency problems; this in turn facilitates trust among entrepreneurs, clients, investors and regulators.

Keywords: *IAS 41; Biological Assets; Poultry; Finance; Accounting*

1. Introduction

The International Accounting Standard (IAS) for Biological Assets establishes a set of guidelines crucial for the proper accounting of living assets and agricultural products in various industries (Marrufo & Cano, 2021; Tene, 2020). In the poultry sector, the application of this regulation is particularly necessary because it covers the rearing, handling and recovery of poultry at different stages of their life cycle (Figueroa, 2007; Rodríguez & Sánchez, 2021). IAS 41 seeks to standardise and appropriately structure accounting processes in order to have a more accurate and transparent representation of biological resources and their changes over time.

The poultry sector has challenges with regard to accounting for biological assets, due to the biological and economic nature of poultry (De Ramírez, 2012). The challenges in the sector range from the measurement of biological changes, the valuation of assets at different stages of growth, to the variability of associated costs (Klychova et al., 2014; Menglikulov et al., 2024). The implementation of IAS 41 allows poultry companies to specify their income and expenses related to these assets (Arimany et al., 2013); this leads to strategic decisions based on concrete and comparable data.

According to Marrufo y Cano (2021) & Tene (2020), the application of IAS 41 in poultry provides a framework for accounting for biological assets and influences the overall management of the industry's operations. Transparent, accurate and clear accounting for biological assets helps companies to better utilise and manage their resources, optimise their production chain and achieve operational efficiency (Ruiz et al., 2020). It also facilitates trust between firm owners, investors, regulators, customers and other stakeholders by providing a consistent view of the poultry company's financial situation.

This descriptive study focuses on poultry companies and the implementation of IAS 4, in order to assess their economic and fiscal situation from a financial point of view in Ecuador, using advanced natural language processing (NLP) techniques. Interviews were analysed using algorithmic applications seeking co-occurrence and topic generation, as the use of NLP allows the processing of large volumes of textual data (Beltrán & Mojica, 2020); this enabled the extraction of information to improve accounting practices and ensure compliance with international standards.

The use of natural language processing in this research offers a new perspective on accounting, because it allows for a detailed analysis of texts resulting from specific interviews in an important productive sector in Ecuador. This methodology can identify inconsistencies and suggest opportunities in accounting practices and is a valuable tool for accounting professionals seeking to improve their understanding of international accounting standards on biological assets.

2. Literature Review

2.1 Evolution of Accounting Standards for Biological Assets

The evolution of accounting standards for biological assets was a complex process in the history of accounting, as it marked the need to adequately reflect the value and transformations of these assets in the financial statements of firms. This development was driven by advances in accounting theory, by business practice and by the need for international harmonisation of biological assets (Barona & Norma, 2020). At the beginning of the 21st century, the International Accounting Standards Committee (IASC) introduced International Accounting Standard 41 (IAS 41) - Agriculture, published in 2001, which recommended the use of fair value for measurement instead of historical cost; the adoption of fair value was intended to provide a more accurate and relevant representation of the economic value of biological assets, taking into account their biological transformations and the market in which they operate (Ning, 2004).

However, the implementation of IAS 41 also faced challenges in many economies, especially in developing and post-Soviet countries, because of problems related to the measurement of biological

assets at fair value due to the lack of active markets and price volatility. Kaliuha y Shenderivska (2017) explained that IAS 41 is a useful framework as it allows for the application of fair value in countries with economies in transition, even though this application is affected by the lack of reliable market data and the complexity of the social and economic conditions in which these nations live.

The debate on the use of fair value or the use of historical cost was a central issue in the evolution of these standards, Guo y Yang (2013) discussed the pros and cons of both methods, highlighting that, while historical cost is reliable but may not be relevant, fair value is relevant but may not be reliable due to the variability of market prices. A hybrid measurement model therefore emerged as a viable solution for agricultural enterprises in China, where historical cost could be used initially and fair value when market prices are reliable (Rapp et al., 2024).

He adoption of fair value proved to be useful in improving the predictability of cash flows, research by Argilés-Bosch et al. (2017) found that measuring biological assets at fair value improves the ability of accounting data to predict future cash flows. However, they also noted that this methodology may introduce volatility in the indicators due to fluctuations in the values of biological assets.

In the Latin American context, Marrufo Garcia y Cano Morales (2021) highlighted that International Accounting Standards, although useful, may not be fully adapted to the particularities of the agricultural sector in this region. They pointed out that the implementation of IAS 41 in small and medium-sized agricultural enterprises presents accounting drawbacks focused on costs and associated with measuring fair value.

The evolution of accounting standards for biological assets also involved an increased focus on disclosure; Nian-dong (2007) argued the importance that should be given to accounting confirmation, measurement and disclosure, with the objective of establishing a system that truly reflects the value of biological assets and provides accurate and reliable information for potential users.

2.2 International Comparison of Accounting Practices in the Poultry Sector

In Ukraine, for example, accounting and analytical support for economic risk management in poultry companies improved significantly; by virtue of the integration of accounting and analytical information flows, which enabled poultry companies to identify their current status and forecast future development, taking into account all risks assessed by the accounting system. This tool influenced economic security and facilitated decision-making within the firm to minimise internal and external risks (Luchyk, 2021).

In the UK, poultry sector accounting had problems related to diseases such as coccidiosis, a parasitic disease affecting chickens, and Williams (1999) developed a segmented model to estimate the monetary losses due to coccidiosis and the costs of its control. Such a model allows separate quantification of loss elements for any given broiler-producing entity, providing a valuable tool for agricultural economists and the global poultry industry; the implementation of such a model facilitates a comparison of the costs of performance and chemical control, which creates a strong financial management in the sector.

From a quality point of view Kök (2009) conducted a survey with leading poultry meat producers in Turkey, revealing a high adoption of ISO 22000 among large companies. These companies not only adopt stricter schemes, but also take better advantage of governmental support services, allowing them to manage a wider range of contaminant risks and improve their competitiveness in the global market (Kök, 2009). On the other hand, from the point of view of the economic value added, Alawode Olufemi et al. (2020) found that efficient cash management, accounts receivable, accounts payable and inventory management have a significant positive effect on the economic value added of the poultry industry in Ogun State, Nigeria.

In terms of international accounting harmonisation, the implementation of International Financial Reporting Standards (IFRS) and specifically IAS 41 - Agriculture, has presented both

benefits and challenges. Elad (2004) discussed its implications, although IAS 41 provides a sound conceptual framework, its implementation can be complicated in French-speaking countries due to conceptual differences in national accounting systems. This discrepancy highlights the need for adjustments and revisions to achieve effective harmonisation of accounting practices internationally.

2.3 Financial Impact of IAS on Poultry Companies

Branswijck et al. (2011) found that the capitalisation of operating leases under IAS 17 significantly affected debt-to-equity ratios, return on assets and current liquidity ratio in listed companies. These changes are indicative of how the adoption of IAS can alter the financial perception of a firm, and how it affects its evaluation by investors and analysts.

For its part, Souza & Shikida (2021) observed that changes in accounting for biological assets and producing plants resulted in retrospective accounting adjustments that substantially affected current liquidity and asset turnover. These changes reflect how the transition to IAS may require significant adjustments in the financial management of agricultural enterprises.

Jones et al. (2019) conducted a systematic review on the financial impact of production diseases in poultry systems, highlighting that accurate measurement of these costs is essential for making informed decisions on prevention and treatment. The implementation of IAS improves the quantification and management of these risks, creating a sound basis for positive interventions.

2.4 Technology and Information Management in Biological Asset Accounting

The adoption of information technologies in biological asset accounting facilitated the management of complex data and the implementation of international accounting standards; for example, the implementation of digital accounting systems in companies improved the ability to record and track biological transformations of assets, providing more accurate data, used in a timely manner for decision-making (Koval, 2019). One of the main developments in this field is the use of web-based information systems and big data technologies to manage and analyse large volumes of biological data.

Khushvakhtzoda y Nazarov (2021) developed an information module for biological asset accounting based on web services architecture, achieving better integration and analysis of data in a digital format. This approach improves the accuracy of accounting records, while facilitating the evaluation of biotransformation results and providing a solid basis for strategic decision-making. Fair value measurement of biological assets is another area that has benefited from technological advances; the use of discounted cash flow models and other quantitative methods allows companies to more accurately assess the value of their biological assets, even in the absence of active markets.

Cavalheiro et al. (2017) applied a fair value-based pathway to evaluate soybean crops in Brazil, using internal data and structured interviews to obtain an accurate valuation, this method demonstrated that, in addition to economic and accounting knowledge, agronomic knowledge is required to properly evaluate biological assets in quantitative and qualitative terms. From the point of view of comparability of financial statements, Chernova y Gazizyanova (2023) proposed the inclusion of a specific section for biological assets in the notes to the financial statements, recommending the disclosure of cash flows in transactions with biological assets.

In terms of challenges, the adoption of technology and information management in accounting for biological assets is not without its problems, the high variability of market values and the complexity of biotransformation can introduce volatility in financial statements. This mention is given in full in Shu (2019) study on biological assets such as live pigs and this market effect on financial indicators, demonstrating unpredictability.

2.5 Regulatory and Compliance Challenges in the Poultry Sector

In many countries, environmental regulations revolutionised by imposing strict controls on emissions and waste management. In the United States, for example, concerns about air and water quality in relation to nitrogen and phosphorus emissions led to the implementation of nutritional strategies to reduce nutrient excretion in poultry operations (Powers & Angel, 2008). In Canada, a study assessed how the personality traits, experience and education of employees influenced their compliance with biosecurity measures on poultry farms, highlighting the importance of training and selection of appropriate personnel to improve compliance (Racicot et al., 2012).

In developing countries, such as Bangladesh, regulatory challenges include a lack of inclusive policies and clear technical principles, as well as deficiencies in management capacity and laboratory infrastructure for adequate testing. The study revealed that shortage of capital, inadequate biosecurity management and lack of adequate information systems lead to barriers in poultry regulatory compliance (Rahman et al., 2015). Animal welfare regulation is another critical challenge Siegford et al. (2008) note that increasing consumer demands for more ethical production practices have led to the implementation of regulations that seek to improve poultry welfare. However, these regulations often present inconsistencies and conflicts with environmental sustainability goals. Welfare practices, such as pasture rearing, can increase methane emissions and nutrient leaching into soil and water, requiring a careful balance between ethics and environmental sustainability.

In addition, managing compliance with food regulations is crucial to ensure the safety and quality of poultry products. In Malaysia, the regulation of halal compliance in poultry slaughtering and processing has required a coordinated effort between regulators and companies to ensure compliance and maintain halal integrity in the food supply chain (Hashim et al., 2018).

Environmental regulations in Ecuador require poultry farms to implement waste management measures to minimise pollution. For example, a study of the 'Dos Hermanos' factory farm showed that, although many of the recommendations of the environmental management plan were met, there were still areas requiring improvement, such as the disposal of dead birds and the management of suspended solids in effluents (Guananga Díaz et al., 2019). Antimicrobial resistance is a growing concern, especially in the context of intensive poultry production. A study by Vinueza-Burgos et al. (2019) revealed a high prevalence of antibiotic resistance in Escherichia coli isolated from poultry farms in Ecuador, which underlines the need for strict regulation and continuous monitoring to control the use of antimicrobials in animal production.

From the point of view of access to inputs, this also represents a challenge for the poultry industry in Ecuador. Self-sufficiency in the production of maize and soya, which are key components of poultry feed, is limited, forcing companies to rely on imports. A study in the province of Tungurahua highlighted that 100% of the maize and soya used in poultry production comes from other provinces and international imports, which increases costs and the vulnerability of the sector to fluctuations in international prices (Pomboza-Tamaquiza et al., 2018).

3. Methodology

3.1 Descriptive and Financial Analysis

Statistical methods and an economic evaluation were combined to obtain an unbiased understanding of the state and performance of the companies in the poultry sector, the descriptive analysis focused on describing and organising data, using statistics that summarise the companies' financial and operational information; measures of central tendency and/or distribution over a given period were calculated. This descriptive analysis was combined with the financial analysis to obtain a clear picture of the current operations of the companies and the economic position of the company. This combination provides a solid basis of data and analysis to foresee future situations and adjust policies according to organisational requirements.

3.2 Qualitative Evaluation with Latent Dirichlet Allocation (LDA)

Natural Language Processing (NLP) is a branch of artificial intelligence that analyses and studies large volumes of textual data automatically. NLP was used to process interviews and documents related to biological asset accounting in the poultry sector. As part of this approach, we applied the Latent Dirichlet Allocation (LDA) technique, which is a specific method within PLN used to identify hidden topics in large sets of texts. LDA allows us to group words that often appear together and generate topics that help to detect thematic patterns, providing a deeper insight into accounting and regulatory practices in the analyzed sector.

The research was aided by a qualitative assessment with Latent Dirichlet Allocation (LDA), an advanced method for discovering hidden themes in large collections, useful in document analysis, content clustering and topic modelling. LDA is a probabilistic generative model that allows sets of observations to be explained through unobserved clusters to converge on similar data.

For each document, a topic distribution is chosen from a Dirichlet distribution. The Dirichlet distribution is parameterised by a vector , which is a hyperparameter of the model that must be defined beforehand. A low value of suggests that a document contains a mixture of few topics, while a higher value indicates a more uniform mixture of more topics. For each word in a document, a topic is selected according to the distribution of topics in the document. A word is chosen according to the distribution of words associated with that topic, which is defined by another parameter, β.

The LDA model can be described with the following distributions:

$\theta_d \sim$ **Dirichlet** (α), where θ_d is the distribution of topics for the document d.

$z_{d,n} \sim$ **Multinomial** (θ_d), where $z_{d,n}$ is the subject assigned to the n −ésima last word in the document d.

$w_{d,n} \sim$ **Multinomial** $(\beta_{z_{d,n}})$, where $w_{d,n}$ is the word observed in n the document item d, y β is the parameter defining the distribution of words for a given topic.

Inference in LDA generally involves the use of methods such as Gibbs sampling or expectation-maximisation (EM) algorithms to estimate unknown distributions θ and β from the observed data. The objective is to maximise the likelihood of the observed data under the model by fitting these parameters.

3.3 Qualitative Assessment Modelling with Networks in Co-occurrence Matrices

Co-occurrence matrix graphs are a powerful way to represent and analyse relationships between elements in diverse data sets. They are especially useful in network analysis, natural language processing, and other areas where interactions between elements are key. A co-occurrence matrix is a square matrix that counts how many times each pair of elements (e.g. words and actors) occur together within a specific context. These matrices are widely used in statistics to analyse co-occurrence relationships and patterns.

For each instance of the defined context, it increments the counter of the matrix $M[i][j]$ where i y j are the indices of the co-occurring elements. The matrix is defined as: $M = [m_{ij}]$ where m_{ij} represents the number of times the element co-occurs with the element within the set context.

4. Variables and Study Subjects

Table 1. Variables

Variables of Descriptive Analysis Poultry Enterprises	Descriptive and Financial Analysis Variables
CIIU A0146.01	Assets
Provinces	Heritage
Regions	Sales revenue
Place in the Ranking	Profit before tax (UAI)

Variables of Descriptive Analysis Poultry Enterprises	Descriptive and Financial Analysis Variables
	Net profit
	Income tax (IR) payable

The information comes from the Superintendencia de Compañías Valores y Seguros (SUPERCIAS), Portal de Información, Sector Societario, finally, ranking of companies; in the box are databases of companies legally registered in Ecuador. Likewise, as a method of segmentation, the provinces are used as the axis of observation.

5. Results and Discussion

5.1 Descriptive Analysis of Poultry Enterprises

First of all, we look at the region where the most dominant companies in the poultry sector are located:

Table 2. Region vs. Position

Region	Average	Median	Minimum	Maximum
Coast	43788.38	30743	210	118634
Galápagos	53091	53091	53091	53091
East	60482.5	60482.5	2298	118667
Sierra	40282.26	16572.5	217	119399

With reference to table 2, we can see that the coast and the highlands have the largest companies in this sector, with a minimum difference of 7 positions between them. Consequently, the eastern region and finally the island region or the so-called Galapagos.

Table 3. Provincia vs. Posición

Province	Average	Median	Minimum	Maximum
Azuay	40742	10763	1327	119355
Bolívar	114471	114471	114471	114471
Carchi	119147	119147	119147	119147
Cañar	9200	9200	9200	9200
Chimborazo	62276	62276	62276	62276
Cotopaxi	61588	62238	9061	119399
El Oro	36965.88	26732	4705	107794
Galápagos	53091	53091	53091	53091
Guayas	48973.98	39142.5	210	118634
Imbabura	13924	13924	5151	22697
Loja	23095	13713	9861	45711
Los Ríos	15089	12416	9499	23352
Manabí	36978.22	23718	9573	114429
Napo	2298	2298	2298	2298
Orellana	118667	118667	118667	118667
Pichincha	34740.48	9054	217	115789
Santa Elena	27963	27963	27963	27963
Santo Domingo	56310.62	40072	3221	119209
Tungurahua	23517.92	7587	588	85242

Provinces such as Azuay, Cotopaxi, Guayas, Loja, Manabí, Pichincha, Santo Domingo and

Tungurahua have a wider range between minimum and maximum assets, indicating a greater heterogeneity in the size of poultry enterprises. This is indicative of the presence of both large and small enterprises in these areas. In provinces where the average is significantly higher than the median (e.g. El Oro, Guayas, Manabí), this suggests an asymmetric distribution of assets, with some firms having significantly more assets than most, raising the average. Provinces with close average and median (e.g. Bolivar, Carchi, Cañar) suggest a more even distribution of assets across firms.

Analysing the focal province of study, i.e. Tungurahua shows significant variability in assets among poultry enterprises, with values ranging from 588 to 85,242. This wide range suggests that both very small and significantly larger enterprises coexist in Tungurahua. The average number of assets in Tungurahua is 23,517, while the median is considerably lower, at 7,587. This indicates an asymmetric distribution of assets, where a few firms with large amounts of assets raise the average, while most firms have considerably lower assets.

The considerable difference between the average and the media, as well as the wide range, could indicate an industry with well-established market leaders and a number of smaller firms that may be struggling to grow or remain competitive.

5.2 *Descriptive Analysis by Financial Aspects*

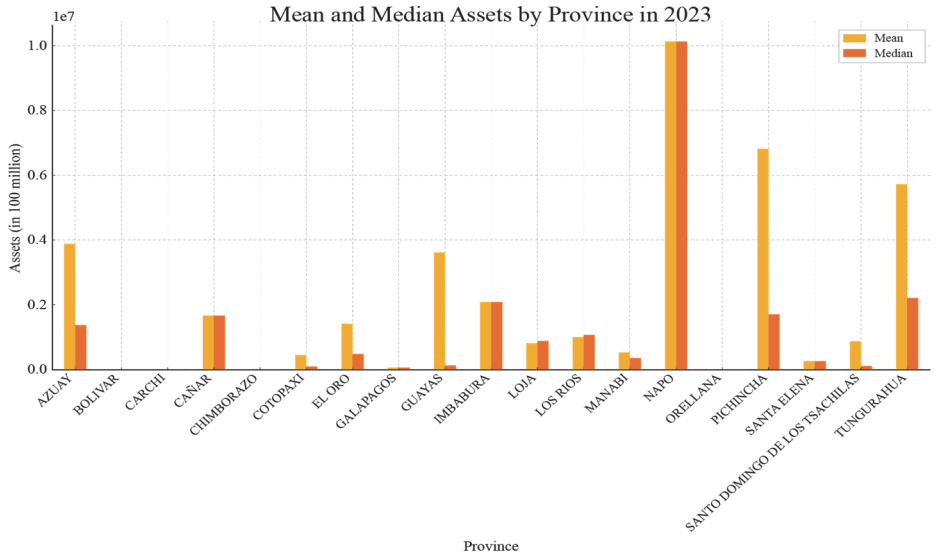

Figure 1. Descriptive analysis of assets by province in 2023

Key accounting accounts and their implications for financial management development are analysed: Physical assets, in this case machinery and equipment, are essential to the production capacity of poultry enterprises, so taking them into account in this analysis is of vital importance. That said, it was identified that investments in machinery and non-residential buildings increased the profitability of the enterprises, ensured a steady flow of production and reduced costs in the long run (Bazyvoliak et al., 2022). Working in capital management is also vital to the financial health of these businesses. Efficient management of current assets, such as inventories and accounts receivable, improves liquidity and profitability, allowing companies to operate without disruption and maintain a stable financial balance (Ali, 2013).

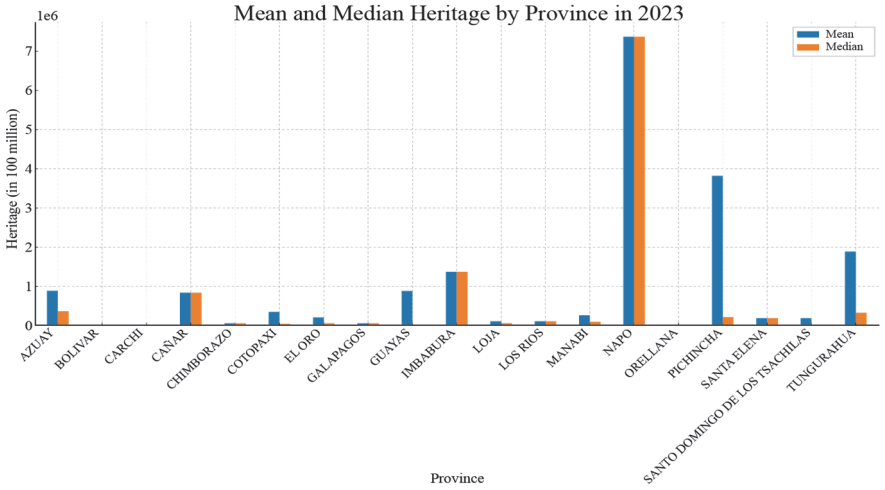

Figure 2. Heritage descriptions by province

On the other hand, biological assets, which include the birds themselves, are considered critical not only for their intrinsic value, but also for their role in reproduction and continuous production of meat and eggs, contributing significantly to food security and the rural economy (RybakovaO, 2015). Proper asset management, supported by real-time accounting systems, allows companies to monitor their value, avoid significant depreciation and plan investments efficiently. This is crucial to maintain competitiveness and profitability in a constantly changing market (Supriati et al., 2017).

Tangible assets, which include assets such as land, buildings and machinery, are crucial to operations. These assets not only provide the infrastructure necessary for production, but also increase the net worth of the enterprise, facilitating access to finance and improving its economic solvency (Bhatta et al., 2008). Intangible assets, which may include trademarks, patents and exploitation rights, also play a vital role. These intangible assets not only distinguish the company in a competitive market, but can also generate additional revenue through licensing and franchising, thereby expanding growth opportunities (Supriati et al., 2017).

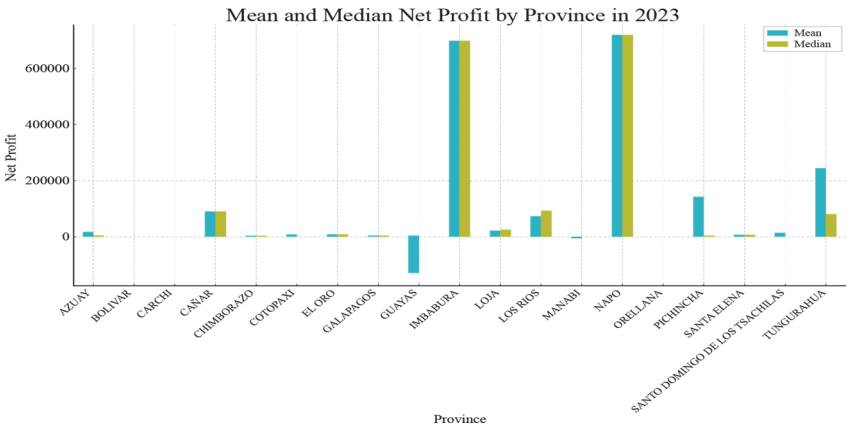

Figure 3. Utility descriptions by province

In addition, efficient asset management enables poultry companies to improve their resilience to market fluctuations. Proper asset management, through investment and maintenance policies, ensures that assets maintain their value and functionality, thus reducing the risk of financial losses and optimising available resources (Rivera Godoy, 2021). Equity also influences a company's ability to make strategic investments. Companies with strong equity can diversify their operations, invest in new technologies and expand their production capacity, resulting in a competitive advantage in the poultry sector, characterised by its dynamism and constantly growing demand (Mottet & Tempio, 2017).

Profits are vital for reinvestment in the business. Poultry companies that generate sufficient profits can invest in technological improvements and expansion of their facilities, which improves their competitiveness in the market. These investments not only optimise production, but also reduce long-term operating costs, strengthening the company's financial position (Luchyk, 2021).

In addition, profits allow poultry companies to effectively manage the risks associated with market volatility. With a solid profit base, companies can build financial reserves that act as a cushion against fluctuations in input prices, variations in market demand or unexpected events such as disease outbreaks. These reserves are essential to maintain operational stability during difficult periods (Miller & Sherrick, 1994).

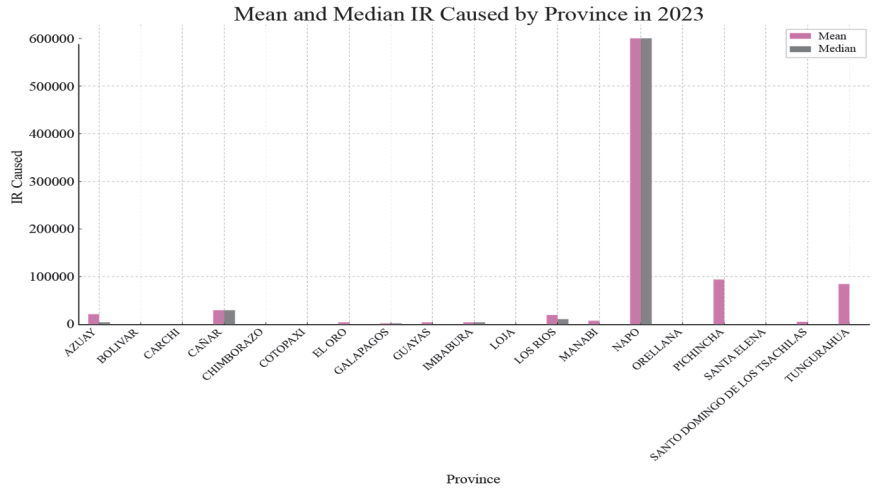

Figure 4. Income Tax Descriptions by Province

On the other hand, profits are a key factor in attracting external investment. Potential investors look for companies with a solid profit history, as this indicates efficient management and growth prospects. The ability to consistently generate profits improves the perception of the company in the market and facilitates access to finance, which is essential for expansion and diversification plans (Doss et al., 2017). Finally, profits also have a positive impact on staff morale and motivation. Companies that manage to maintain high profitability can offer incentives and bonuses to their employees, which improves productivity and reduces staff turnover. A motivated team is a valuable asset that contributes directly to the continued success of the company (Keister et al., 2021).

Income and property taxes can have a significant impact on the profitability of poultry enterprises. A study on the economics of poultry production in the United States revealed that property taxes and employee compensation are important components of the operating costs of these enterprises (Baker & Passmore, 2010). High tax burdens can reduce profit margins, thus limiting the ability to reinvest in technology and expand production.

In addition, taxes can also influence the tax evasion behaviour of entrepreneurs. In Blitar, Indonesia, it was found that poultry business owners often engage in tax avoidance to reduce their tax payments through strategic tax planning. Despite being aware of their tax obligations, many entrepreneurs choose to reduce their tax payments due to the perception that the tax burden is too high (Sepriana, 2021).

The impact of fiscal policies on investment is also relevant. An analysis of the Common Agricultural Policy (CAP) in the European Union showed that subsidies and specific tax policies can significantly influence production costs and the international competitiveness of poultry companies. The elimination of these policies could turn the EU into a net importer rather than an exporter, underlining the importance of fiscal policies in the market structure (Alston, 1986).

Tax incentives can also play a vital role in the development of the poultry sector. In Ukraine, tax exemptions and targeted incentives have provided a significant boost to the development of the poultry sector, allowing for an increase in production and profitability of enterprises. However, it has been pointed out that these policies can create unequal competitive advantages between different types of agricultural enterprises, promoting the concentration of capital in certain areas at the expense of others (Tulus, 2018).

Finally, environmental tax policies also affect poultry companies. In China, the implementation of environmental taxes has increased the operating costs of poultry farms, forcing many to adapt to new regulations and invest in cleaner technologies. Such taxes aim to reduce the environmental impact of poultry production, but can also represent a significant financial challenge for poultry companies (Wu, 2018).

5.3 *Assessment and Interviews with Latent Dirichlet Allocation Modelling*

Following the algorithmic formulation using LDA, a word cloud is generated:

Figure 5. Word cloud theme 1

Context: Focuses on account management and asset recognition in business, with an emphasis on compliance and generalities that assist in business management.

Figure 6. Word cloud theme 2

Context: It deals with the application of standards (IAS 41) and the verification of compliance in companies, highlighting the assessment and review process.

Figure 7. Word cloud theme 3

Context: Focuses on the application of IFRS and other standards (LORTI), looking at how small, medium and large companies comply with these regulations, and the importance of paying taxes according to the rules.

5.4 Co-occurrence Matrix Graph Modelling

Following the co-occurrence formulation elaborated with Python, a conjunctive graph diagram is modelled as a first observation:

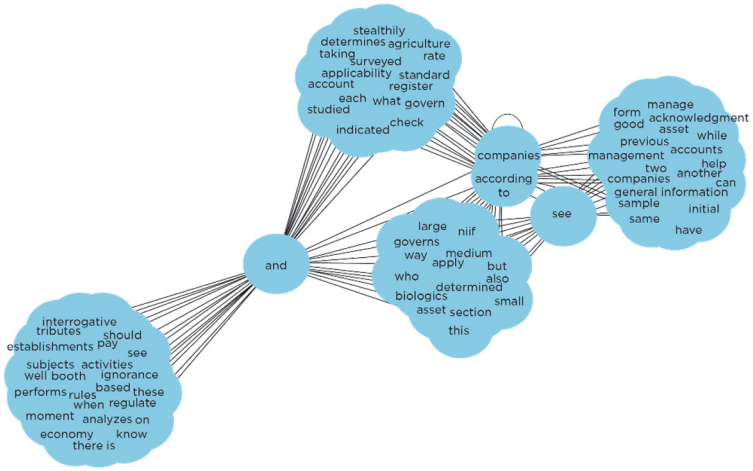

Figure 8. Word Co-occurrence Graph

The first graph represents a word co-occurrence graph based on the full text. In this graph, each node symbolises a specific word, and the edges (lines) connecting the nodes indicate the frequency with which these words appear together in the same sentences. The word 'and' acts as a central node, connecting a large number of words, revealing its high frequency and its role as a connector of ideas

in the text.

The graph shows several word clusters, which are groups of closely connected nodes. One of these clusters, located at the top left, includes words related to the study and determination of standards, such as 'determining', 'applicability', 'stealthily' and 'surveyed'. This suggests that the text devotes a considerable section to discussing the assessment and application of specific standards. Another significant cluster, located in the middle, is composed of words such as 'compliant', 'companies', 'observes' and 'management', indicating a thematic focus on how companies adhere to standards and how these observations are managed. A third cluster, at the bottom left, groups words related to economic activities and regulations, such as 'activities', 'standards', 'establishment' and 'economic'. This cluster reflects discussions about economic activities and the regulations that govern them.

Discerning that there is excessive clustering promotes an aggregate filter, giving the following result:

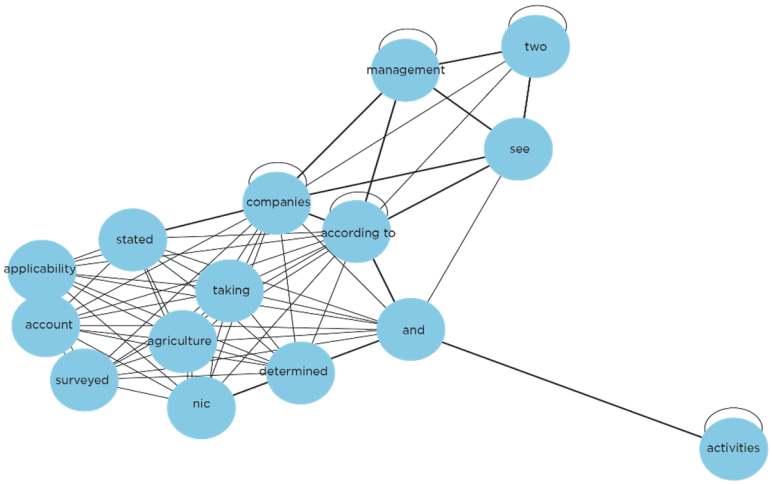

Figure 9. Co-Occurrence Graph of Filtered Words

The second graph shows a filtered word co-occurrence graph, where only the most relevant words in the text have been selected. This approach simplifies the visualisation by highlighting the most important relationships between keywords. As in the first graph, the word 'and' is presented as a central node with many connections, highlighting its high frequency and connective function in the text.

This graph, although simpler, still reveals key word clusters. A central cluster on the left includes words such as 'applicability', 'indicated', 'respondents' and 'nic', highlighting the importance of the application and assessment of standards in the text. Another significant cluster, in the centre right, groups words such as 'companies', 'compliant', 'observes', 'management' and 'two', indicating a focus on business management and compliance. A third interesting node is 'activities', which is isolated, suggesting its relevance, but with fewer direct connections in this simplified visualization.

6. Discussion and Conclusions

The implementation of International Accounting Standard 41 became a topic of wide debate in the accounting literature, specifically on its applicability in highly technical sectors such as poultry. According to Barona y Norma (2020), IAS 41 establishes a robust framework for accounting for

biological assets by allowing a more accurate representation of changes over time in the value of these assets, and Ning (2004) supports this view, the use of fair value provides a deeper and truer picture of the financial state of agricultural enterprises. But a problem arises in the peripheral economies, as highlighted by Kaliuha & Shenderivska (2017), In these countries, fair value is difficult to apply because active markets are scarce, and price volatility is high.

The investigation found supported by the observations of Ning (2004) n the Ecuadorian poultry sector, that IAS 41 facilitates financial transparency and organisational decision-making. But, just as they predict Kaliuha & Shenderivska (2017) There were challenges in measuring and implementing fair value for these assets. This is due to the complexity of valuing birds in their different life stages, as well as the variability of production and maintenance costs.

Guo & Yang (2013) discussed fair value and historical cost, while the former better reflects the current economic value of assets, its volatility may compromise the reliability of financial statements, which is not the case for historical cost. This is reflected in the results of this study, where the adoption of fair value improved the relevance of financial information, but increased the volatility of financial indicators, and also corroborated the observations of Argilés-Bosch et al. (2017who recall the pros and cons of this accounting standard.

The application of natural language processing (NLP) technologies in this research provided a new perspective on accounting in the poultry sector, identifying inconsistencies and opportunities to make accounting practices in Ecuador more robust and consistent. This innovative approach complements traditional financial analysis techniques and is a reflection of the growing combination of digital technologies in accounting, a topic little explored in previous studies such as Branswijck et al. (2011) and Souza & Shikida (2021), which focused more on the normative aspects and less on technological implementation.

As in the case study by Rivera & Peña (2014), which highlights the importance of the valuation methodology for biological assets in Panama and Chile, in Ecuador it is also noted that the correct measurement and valuation of poultry assets is crucial to comply with the standard. However, Ecuador faces additional challenges, such as variability in accounting practices among companies and lack of adequate infrastructure, which hinders a standardized implementation of IAS 41, in contrast to the more advanced cases observed in Chile Furthermore, the study by Miranda et al. (2017) on compliance with IAS 41 in the Philippines highlights the diversity in accounting practices according to the size and organisations of livestock farms, something that is also reflected in the Ecuadorian context, where poultry companies present different levels of compliance with the standard depending on their size and organisational capacity.

The results on the implementation of IAS 41 in Ecuador show a need to really adjust the accounting standard in the local poultry sector and to seek its adaptation. This is subject to the findings of Marrufo Garcia & Cano (2021), who argued that international accounting standards, while beneficial, may need to be adapted to accurately reflect operations in specific sectors within local contexts.

7. Limitations

The use of natural language processing (NLP) has several limitations that need to be considered when interpreting the results. One of the main challenges is the presence of biases in text interpretation, as NLP algorithms can be influenced by the context in which they are trained, which could lead to erroneous or inaccurate interpretations. To mitigate this problem, more robust training models were employed, ensuring that the input data was diverse and representative of different perspectives and contexts within the poultry sector.

8. Declaration of Conflicts of Interest

The authors have declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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