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Aquaculture Insurance in Zambia: An Institutional Analysis of Risks, Challenges and Opportunities

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ABSTRACT

Aquaculture insurance is a viable tool for addressing risks associated with the aquaculture sector. This study investigates the institutional risks, barriers and opportunities related to aquaculture insurance in Zambia, guided by Institutional Theory, Market Failure Theory and Risk and Uncertainty Theory. Data were collected from 51 purposively selected insurance companies and banks using a semi-structured questionnaire designed to capture institutional, market and risk-related variables. The findings indicate that the aquaculture insurance market is still underdeveloped, with only 16% of surveyed institutions currently offering aquaculture insurance products. Among the eight institutions offering aquaculture insurance, pond location was the most frequently considered criterion (87.5%), while production cost, number and size of ponds, species and culture system were each considered by 62.5% of providers. Major challenges include difficulty in assessing aquaculture risks (84.3%), while notable opportunities lie in collaboration with other companies (100%), increased government support (88.2%) and improved extension services on aquaculture insurance (88.2%). There was no statistically significant association between years in operation and provision of aquaculture insurance (Fisher's exact test, $p = 0.2678$), while institutions offering aquaculture insurance were significantly more familiar with the aquaculture industry than those not offering such products (Mann–Whitney U test, $W = 7.5$, $p = 0.007$). The study concludes that aquaculture insurance provision in Zambia is currently low but viable. From an institutional perspective, the findings highlight how regulatory structures, market inefficiencies and risk uncertainty shape insurance provision in the sector. We recommend developing aquaculture-tailored insurance products and improving risk assessment mechanisms through enhanced technical capacity building and stakeholder collaboration to foster a resilient and inclusive aquaculture insurance market. Further research is needed to examine the determinants and profitability of aquaculture insurance among fish farmers.

1 | Introduction

Globally, aquaculture is an important practice for ensuring food security, supporting economic development and reducing pressure on wild fisheries (Naylor et al. 2021; Shabba et al. 2026). In Zambia, aquaculture has experienced significant growth, with an annual expansion rate of 10% over the past two decades, positioning it as a key contributor to food security, employment and economic diversification (FAO 2024a; Maulu et al. 2019; Maulu, Hasimuna, Mphande, et al. 2021; Ragasa et al. 2022; Hasimuna et al. 2025a; Hasimuna et al. 2023). This growth has been facilitated by financial support and investment that have mostly targeted small-scale fish farmers through various programmes and institutions such as the Zambia Aquaculture Development Enterprise Project (ZAEDP), the African Development Bank (AfDB) and the Citizen Economic Empowerment Commission (CEEC) (Musuka et al. 2023; Mphande and Chama 2015; Zhang et al. 2023; Hasimuna, Mphande, Maulu, et al. 2025b). In addition, the adoption of cage fish farming systems has also contributed to the increase in aquaculture production (Hasimuna et al. 2019; Zhang et al. 2023).

However, despite the progress in the industry, aquaculture remains a high-risk venture due to numerous challenges such as disease outbreaks, climate change, predation, high operational costs and theft (Cole et al. 2009; Hasimuna et al. 2023; Maulu et al. 2024). These risks can lead to stock losses, damage to facilities and equipment and additional liabilities, resulting in significant financial setbacks (Luna et al. 2023). Consequently, in the absence of financial safeguards including insurance, savings, credit facilities, emergency funds, guarantee schemes and public support programmes, aquaculture businesses are often compelled to either close down or reduce their operations when such calamities occur, ultimately hindering the sector's economic growth. Hence, to sustain the industry and ensure its continued growth, it is necessary to identify mechanisms that can secure the financial resilience of aquaculture enterprises (Mensah et al. 2024; Siankwilimba et al. 2024). While risk management tools such as insurance exist, biosecurity measures remain essential for preventing disease outbreaks (Hasimuna et al. 2020), extension services (Maulu, Hasimuna, Mutale, et al. 2021), improved husbandry practices, surveillance systems, diversification and early warning systems, their adoption in the aquaculture sector remains limited, particularly in developing countries like Zambia (Mensah et al. 2021; Van Anrooy et al. 2022; Mphande et al. 2026).

Aquaculture insurance is a specialized form of financial coverage designed to protect aquaculture farmers and businesses from financial losses arising from risks inherent in farming aquatic organisms such as fish, shellfish, shrimp and aquatic plants (Legísima and Scott 2021; Van Anrooy et al. 2022; Watson et al. 2023). It typically covers losses from events such as disease outbreaks, water quality issues, natural disasters, equipment failure or theft, all of which can severely disrupt operations (Mphande et al. 2026; Mensah et al. 2024; Roberts 2007; Van Anrooy et al. 2006, 2022). Aquaculture insurance policies may include coverage for stock mortality, infrastructure damage or business interruption (Mensah et al. 2024; Roberts 2007). By mitigating financial risks, aquaculture insurance safeguards farmers against losses and supports the sustainability and growth of this vital industry, enabling farmers to recover from unforeseen setbacks (Roberts 2007; Watson et al. 2018; Patil et al. 2025). Effective aquaculture insurance systems depend on several interrelated institutional pillars that collectively reduce uncertainty and improve the insurability of aquaculture enterprises. These include reliable production and loss data for actuarial risk assessment; robust aquatic animal health and biosecurity systems capable of preventing, detecting and responding to disease outbreaks; supportive legal and regulatory frameworks governing both aquaculture and insurance markets; climate and environmental monitoring systems that provide timely information on weather-related risks; and adequate technical capacity among insurers to assess aquaculture-specific risks and design appropriate insurance products (Mphande et al. 2026; Van Anrooy et al. 2006). Equally important are farmer awareness, financial literacy and accurate farm record-keeping, which improve both underwriting and claims verification (Masina et al. 2026). Public–private partnerships involving government agencies, research institutions, financial institutions, insurance companies and producer organizations further strengthen these pillars by facilitating data sharing, risk reduction and policy support. Together, these institutional components enhance insurers' confidence, improve premium pricing and claims management and increase the long-term sustainability of aquaculture insurance schemes, particularly in emerging aquaculture sectors such as Zambia.

Countries that have successfully implemented aquaculture insurance, including China, India, Vietnam and Japan, have generally done so by strengthening many of these institutional pillars through government support, premium subsidies, public–private partnerships, improved aquatic animal health systems and enhanced risk management mechanisms (Yu and Yu 2021; Van Treeck et al. 2020; Van Anrooy et al. 2022; Patil et al. 2025; Xu et al. 2025; Global Aquaculture Insurance Consortium, 2025). Successful aquaculture insurance systems require coordinated participation among multiple stakeholders rather than insurance companies alone. Governments establish enabling policies and may provide premium subsidies or catastrophe support; regulatory agencies oversee both insurance and aquaculture sectors; financial institutions often require insurance as collateral protection when extending credit; farmers contribute production records and adopt risk-reducing management practices; while research institutions and extension services strengthen disease surveillance, biosecurity and technical capacity. Consequently, the development of aquaculture insurance depends on the effectiveness of the broader institutional environment within which insurers operate (Mphande et al. 2026). Weaknesses in any of these stakeholder groups can undermine the viability of aquaculture insurance markets, particularly in developing countries. According to the most recent global study on aquaculture insurance conducted in 2020, the number of aquaculture insurance policies in force was estimated to be about 40,000 (Van Anrooy et al. 2022; Mphande et al. 2026; Mensah et al. 2024).

In Africa, aquaculture insurance remains underdeveloped (Mphande et al. 2026, with only a few countries such as South Africa (Van Anrooy et al. 2022), Egypt (Abdel-Hady et al. 2026), Nigeria (Sule et al. 2019; Dukiya 2023) and Ghana (Mensah et al. 2024) reported to have implemented such schemes, mostly on a limited scale (Nguyen and Jolly 2019). Despite the importance of

these multiple stakeholders, insurance service providers occupy a particularly critical position because they determine whether aquaculture risks can be underwritten, how premiums are calculated, the conditions for coverage and the overall feasibility of insurance products. Without a clear understanding of insurers' perceptions of aquaculture risks and institutional readiness, it is difficult to establish viable insurance schemes regardless of farmer demand or government support. Consequently, this study deliberately focuses on insurance service providers as an important entry point for understanding the barriers and opportunities to aquaculture insurance development in Zambia.

Although Zambia has experienced rapid growth in aquaculture production (Hasimuna, Mphande, Maulu, et al. 2025b; Mphande et al. 2023), the extent to which these institutional pillars are established remains insufficiently understood. Limited information is available on insurers' perceptions of aquaculture risks, the availability of production and loss data, the adequacy of biosecurity and regulatory systems, and the institutional readiness required to support the development of aquaculture insurance products. Furthermore, while studies have documented farmers' limited awareness of aquaculture insurance (Maulu et al. 2024), the perspectives of insurance companies and financial institutions remain largely unexplored. This study therefore examines these issues from the perspective of insurance service providers to identify existing challenges and opportunities for establishing a viable aquaculture insurance market in Zambia. The study was informed by three complementary theoretical perspectives. 1. Institutional Theory which suggests that the effectiveness of insurance markets depends on the strength of formal institutions such as regulatory frameworks, governance systems and organizational collaboration (North 1993). 2. Market Failure Theory which explains why insurance markets may fail to emerge when information asymmetry, high transaction costs, adverse selection or moral hazard prevent efficient market operation (Akerlof 1970). 3. Risk and Uncertainty Theory that distinguishes between measurable risks that can be insured and uncertain events that are difficult to quantify, thereby influencing insurers' willingness to underwrite aquaculture enterprises (Knight 1921). Together, these theories guided the formulation of the study by examining institutional readiness, market constraints, insurers' perceptions of aquaculture risks, and the conditions required for developing viable aquaculture insurance products in Zambia. To address the identified knowledge gaps, this study is grounded in Institutional Theory, Market Failure Theory and Risk and Uncertainty Theory, which collectively provide an analytical lens for understanding how institutional structures, market inefficiencies and risk dynamics shape aquaculture insurance provision (Knight 1921; Akerlof 1970; North 1993). Although this study focuses on insurance service providers, its findings are intended to complement existing research on farmers and provide evidence that can inform policymakers, regulators and financial institutions involved in developing aquaculture insurance in Zambia. Therefore, this study aimed to: (a) assess whether insurance companies and banks perceive aquaculture insurance as a viable product; (b) identify the key factors, types of risks covered and premium rates considered in the provision of aquaculture insurance; and (c) examine the challenges and opportunities associated with offering aquaculture insurance in Zambia.

2 | Materials and Methods

2.1 | Study Site

This study was conducted in Zambia, focusing on two key districts: Lusaka and Kitwe, located in Lusaka Province and Copperbelt Province, respectively (Figure 1). Lusaka, the capital city, serves as the country's primary commercial and administrative centre, hosting a high concentration of financial institutions and insurance companies. Kitwe, situated in the industrialized Copperbelt region, is Zambia's second-largest city and another major commercial hub with a substantial presence of insurance providers. These districts were purposely selected due to their significant roles in Zambia's economic landscape and their high density of insurance firms, making them ideal locations for investigating the institutional dynamics, risks, challenges and opportunities related to aquaculture insurance in Zambia. These locations were therefore expected to capture the perspectives of the majority of insurance companies operating in Zambia's formal insurance sector.

2.2 | Ethical Approval

This study was approved by Kapasa Makasa University (KMU) Research and Ethics Board (REB) and conducted in strict compliance with their guidelines. The REB recommended obtaining verbal consent instead of written consent to facilitate direct interaction between the researcher and participants while minimizing potential discomfort. Accordingly, all respondents interviewed face-to-face provided informed verbal consent, which was recorded by the interviewer by ticking the consent box on the physical questionnaires. For participants responding via Google Forms, consent was implied by their continuation in completing the questionnaire. All respondents were informed of their right to opt out without any consequences.

2.3 | Theoretical Framework and Analytical Lens

This study was guided by an analytical framework integrating Institutional Theory (North 1993), Market Failure Theory (Akerlof 1970) and Risk and Uncertainty Theory (Knight 1921). Institutional Theory was used to conceptualize how regulatory environments, organizational structures, and policy frameworks influence the development and provision of aquaculture insurance. Market Failure Theory provided a lens for understanding inefficiencies in the insurance market, particularly issues related to information asymmetry, high transaction costs and low demand for insurance products in emerging aquaculture systems. Risk and Uncertainty Theory was applied to guide the identification of production and environmental risks, as well as the challenges associated with risk assessment and pricing in aquaculture insurance. The theoretical framework was operationalized through the design of the questionnaire and interview guide. Institutional Theory informed questions relating to regulatory frameworks, organizational readiness, institutional support and collaboration among stakeholders. Market Failure Theory guided questions examining information asymmetry, affordability, premium pricing, demand for aquaculture insurance and barriers to market development. Risk and Uncertainty Theory

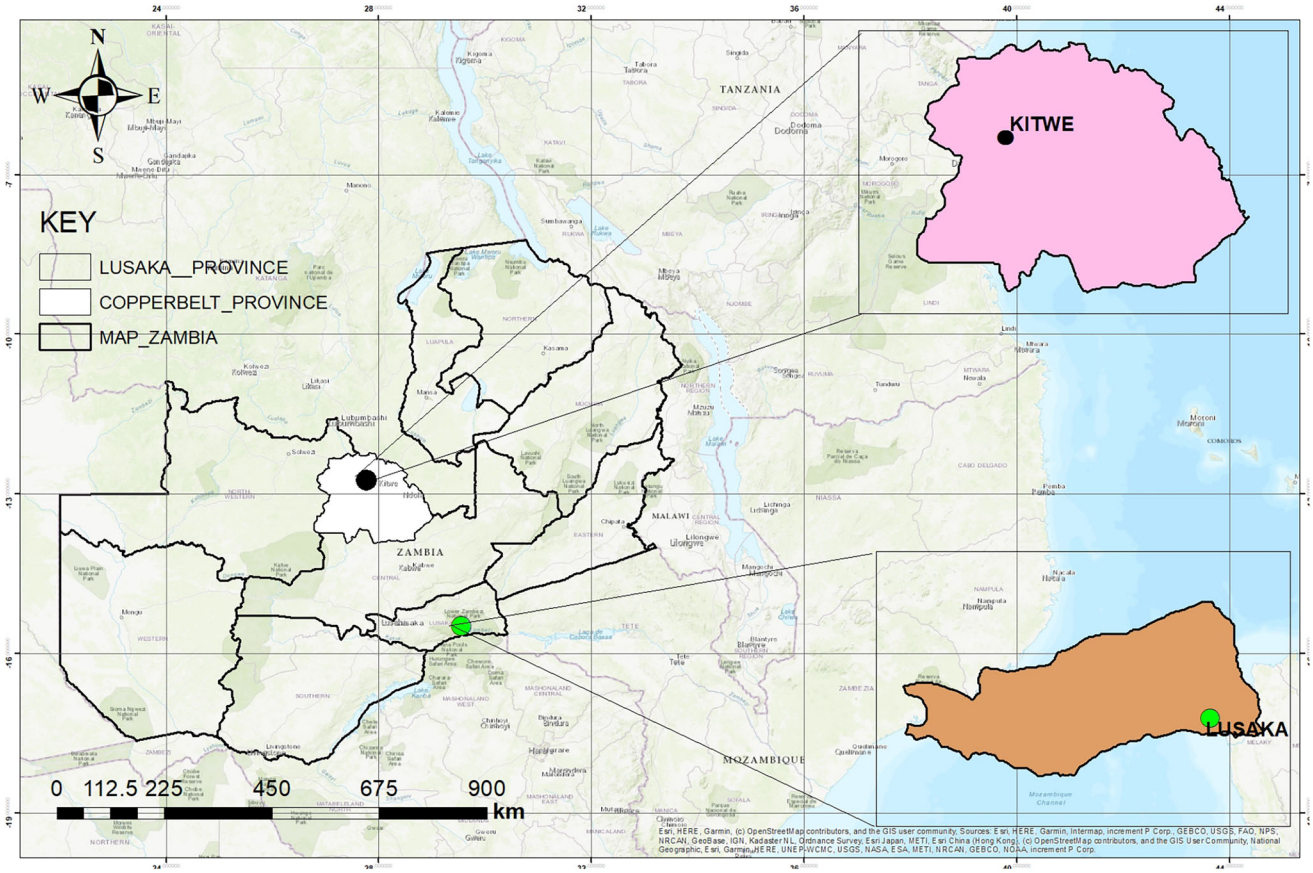

FIGURE 1 | Location of Lusaka in Lusaka Province and Kitwe in Copperbelt Province, Zambia, where questionnaire data on aquaculture insurance were collected from June to September 2024.

informed questions on insurers' perceptions of aquaculture risks, risk assessment criteria, insurable perils and pricing considerations. During data analysis, these theoretical perspectives were used to interpret the institutional, market and risk-related factors influencing the feasibility of aquaculture insurance provision in Zambia.

2.4 | Study Design and Data Collection

The study employed a mixed-method approach combining qualitative and quantitative research designs. A purposive sampling strategy was adopted because aquaculture insurance is a highly specialized field, and only a limited number of insurance companies in Zambia possess the expertise, mandate or decision-making responsibilities relevant to agricultural and aquaculture insurance. Purposive sampling is widely recommended in qualitative and mixed-methods research where participants are deliberately selected based on their knowledge and ability to provide rich, relevant information rather than statistical representativeness (Patton 2015; Creswell and Creswell 2018). This approach ensured that respondents possessed sufficient technical and managerial experience to provide informed perspectives on aquaculture insurance. Consistent with the study objectives, the research deliberately focused on insurance service providers because they are the principal actors responsible for underwriting risks, designing insurance products, determining premium structures and assessing the feasibility of introducing new insurance products. Although aquaculture insurance development involves multiple stakeholders, including farmers, regulators, financial institutions and government agencies, understanding insurers' perspectives represents a necessary first step in identifying the supply-side constraints affecting the establishment of aquaculture insurance in Zambia.

Primary data were collected from 51 insurance companies using a semi-structured questionnaire (see Supporting Information), which collected data on respondents' demographic information, key factors, risks covered, premium rates, challenges in offering aquaculture insurance and opportunities in the aquaculture insurance sector.

Data were collected through face-to-face and online interviews between June and September 2024, following a pre-testing phase (Muhala et al. 2021; Mphande et al. 2023; Siankwilimba et al. 2023). The questionnaire was administered to senior managers and other officers occupying decision-making positions because they are directly involved in product development, underwriting, risk assessment and strategic decisions regarding the introduction of new insurance products. Their positions enabled them to provide informed views on the institutional and operational feasibility of aquaculture insurance in Zambia. Selected key informant

TABLE 1 | Demographic characteristics of respondents and institutional characteristics of surveyed companies in Lusaka and Kitwe districts, Zambia, June–September 2024 ($n = 51$). Values are presented as frequency (n) and percentage (%).

Category	Variable	Percentage (%)
Gender	Male	41
	Female	59
Position	Branch Manager	47
	Sales Manager	53
Qualification	Degree	71
	Masters	29
Type of company	Public	2
	Private	98
Institution	Insurance company	88.2
	Banks	11.8
Aquaculture insurance provision	Yes	16
	No	84

interviews were conducted with managers from these insurance companies to gain deeper insights into their perceptions of aquaculture insurance in the study area. All interviews were conducted in English without translation, as all respondents were conversant with the language.

2.5 | Data Analysis

Survey data from insurance companies and banks in Lusaka and Kitwe districts were coded and entered into Microsoft Excel 2016 for data cleaning and standardization before analysis. The data were analysed using descriptive statistics, including frequencies and percentages, in IBM Statistical Package for the Social Sciences (SPSS) Statistics (v29). This analysis was used to summarize respondent demographics, perceived viability of aquaculture insurance, key decision factors, types of risks covered, premium rates, challenges and opportunities in the aquaculture insurance sector. Inferential statistical analyses were conducted to assess associations and differences among selected variables related to aquaculture insurance provision. Fisher's exact test was used to examine the association between the number of years a company had been operating and whether companies offered aquaculture insurance, as it is appropriate for categorical variables with small sample sizes. A Mann–Whitney U test was performed to compare familiarity with the aquaculture industry between companies that offered aquaculture insurance and those that did not. Statistical significance was determined at a 5% significance level ($p < 0.05$). For proportions presented in figures, 95% confidence intervals (CIs) were calculated using the score-test method without continuity correction. The corresponding proportions were presented as percentages, with the numerator and denominator reported where relevant. Results were presented using tables and figures to illustrate key trends and patterns.

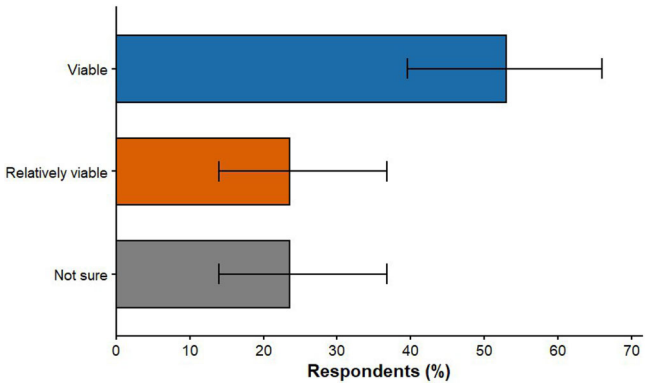

FIGURE 2 | Perceived viability of aquaculture insurance among respondents from insurance companies and banks in Lusaka and Kitwe districts, Zambia, June–September 2024 ($n = 51$). Bars represent the percentage of respondents selecting each response category: viable, 27/51 (52.9%); relatively viable, 12/51 (23.5%); and not sure, 12/51 (23.5%). Error bars represent 95% confidence intervals for the proportions, calculated using the score-test method without continuity correction.

3 | Results

3.1 | Demographic Information of the Companies and Respondents

The demographic characteristics of respondents and participating institutions are presented in Table 1. Female respondents comprised 59% of the sample, while 41% were male. Respondents were primarily Sales Managers (53%) or Branch Managers (47%), and most participants were employed by private companies (98%), with 2% from public institutions. Most participating institutions were insurance companies (88.2%), while banks accounted for 11.8% of the sample. At the time of the study, 16% of institutions reported offering aquaculture insurance, while 84% did not.

3.2 | Factors Associated With Aquaculture Insurance Provision

Of the 51 institutions surveyed, 16% reported offering aquaculture insurance, while 84% did not. Among institutions operating for more than 10 years, 71% (36/51) reported offering aquaculture insurance, compared with 29 % (15/51) among those operating for less than 5 years. However, there was no statistically significant association between years in operation and aquaculture insurance provision (Fisher's exact test, $p = 0.2678$).

In contrast, familiarity with the aquaculture industry differed significantly between institutions that offered aquaculture insurance and those that did not (Mann–Whitney U test, $W = 7.5$, $p = 0.007$). Institutions offering aquaculture insurance had higher familiarity scores (median = 6) than those not offering such products (median = 3).

3.3 | Perceived Viability of Aquaculture Insurance

The viability of aquaculture insurance is shown in Figure 2. Of the 51 respondents, 27 (52.9%) perceived aquaculture insurance

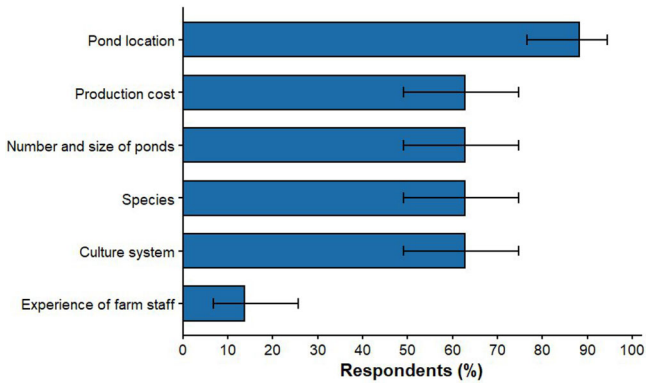

FIGURE 3 | Criteria considered by insurance providers before offering aquaculture insurance coverage in Lusaka and Kitwe districts, Zambia, June–September 2024 ($n = 8$). Bars represent the percentage of insurance providers offering aquaculture insurance that identified each criterion as important when considering aquaculture insurance coverage: pond location, 7/8 (87.5%); production cost, 5/8 (62.5%); number and size of ponds, 5/8 (62.5%); species, 5/8 (62.5%); culture system, 5/8 (62.5%); and experience of farm staff, 1/8 (12.5%). Multiple responses were permitted; therefore, percentages do not sum to 100%. Error bars represent 95% confidence intervals for the proportions, calculated using the score-test method without continuity correction.

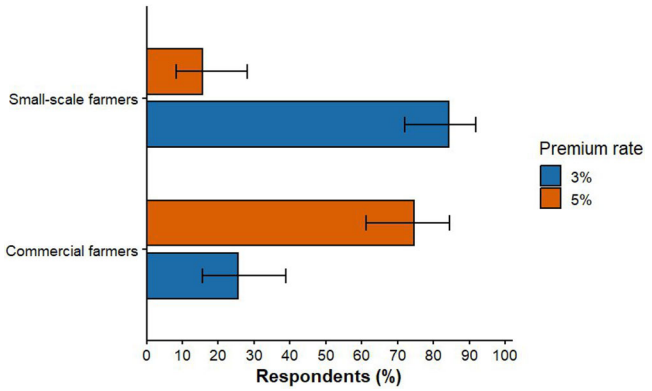

FIGURE 4 | Premium rates for aquaculture insurance reported by insurance providers in Lusaka and Kitwe districts, Zambia, June–September 2024 ($n = 51$). Bars represent the percentage of respondents reporting each premium rate for small-scale and commercial farmers. For small-scale farmers, 43/51 (84.3%) reported a 3% premium and 8/51 (15.7%) reported a 5% premium; for commercial farmers, 13/51 (25.5%) reported a 3% premium and 38/51 (74.5%) reported a 5% premium. Error bars represent 95% confidence intervals for the proportions, calculated using the score-test method without continuity correction.

as a viable option for mitigating risks faced by aquaculture enterprises, while 12 (23.5%) considered it relatively viable and 12 (23.5%) were unsure about its viability.

3.4 | Criteria Considered by Insurance Providers Prior to Offering Aquaculture Coverage

Among the eight insurance providers offering aquaculture insurance, pond location was the most frequently considered criterion (87.5%), whereas experience of farm staff was least frequently considered (12.5%). Production cost, number and size of ponds, species and culture system were each reported by 62.5% of providers (Figure 3).

3.5 | Risks Covered by Aquaculture Insurance

Among the eight institutions offering aquaculture insurance, all providers (8/8, 100.0%; 95% CI: 63.1-100.0%) identified fish disease, predation, and theft as risks covered by aquaculture insurance. Climate-related perils, including dry spells, droughts, and cyclones, were identified by 5 of the 8 providers (62.5%; 95% CI: 24.5-91.5%). In addition, liabilities were considered suitable for coverage by 4 providers (50.0%; 95% CI: 15.7-84.3%), while farm assets were identified by 3 providers (37.5%; 95% CI: 8.5-75.5%) as potential areas for insurance coverage..

3.6 | Premium Rates

Premium rates varied according to the type of farmer. For small-scale farmers, the 3% premium rate was reported by most respondents (84.3%), whereas the 5% rate was reported by

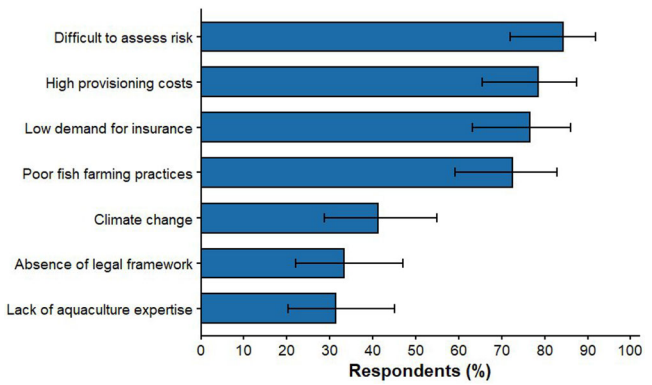

FIGURE 5 | Perceived challenges associated with the provision of aquaculture insurance in Lusaka and Kitwe districts, Zambia, June–September 2024 ($n = 51$). Bars represent the percentage of respondents identifying each factor as a challenge associated with aquaculture insurance provision. The denominator for all proportions was 51. Error bars represent 95% confidence intervals for the proportions, calculated using the score-test method without continuity correction. Multiple responses were permitted; therefore, percentages do not sum to 100%.

15.7%. For commercial farmers, the 5% premium rate was more commonly reported (74.5%) than the 3% rate (25.5%) (Figure 4).

3.7 | Challenges Associated With Aquaculture Insurance Provision

Insurance providers most frequently identified difficulties in assessing aquaculture risks (84.3%), high provisioning costs (78.4%) and low demand for insurance (76.5%) as challenges associated with aquaculture insurance provision (Figure 5). Poor fish farming practices were also frequently reported (72.5%). In comparison, fewer respondents identified climate change (41.2%),

TABLE 2 | Opportunities to improve aquaculture insurance identified by respondents in Lusaka and Kitwe districts, Zambia, June–September 2024 ($n = 51$). Values are presented as frequency (percentage), with 95% confidence intervals calculated using the score-test method without continuity correction.

Opportunity to improve aquaculture insurance	Respondents	Percentage (%)	Lower 95% CI	Upper 95% CI
Collaboration with other companies	51	100.0	93.0%	100.0%
Support from the government	45	88.2	76.6%	94.5%
Increased extension services on aquaculture insurance	45	88.2	76.6%	94.5%
Legally binding of aquaculture insurance	39	76.5	63.2%	86.0%

Note: Multiple responses were permitted; therefore, percentages do not sum to 100%. Percentages are based on all respondents ($n = 51$).

the absence of a legal framework (33.3%) and a lack of aquaculture expertise within insurance companies (31.4%) as challenges.

3.8 | Opportunities to Improve Aquaculture in Zambia

Respondents identified several opportunities for strengthening aquaculture insurance in Zambia (Table 2). Collaboration with other companies was unanimously identified as an opportunity (100%), while government support and increased extension services on aquaculture insurance were each reported by 88.2% of respondents. Making aquaculture insurance legally binding was also identified as an important opportunity by 76.5% of respondents. One respondent highlighted the potential role of government–insurance industry partnerships, noting, 'The government is investing in aquaculture, and if they can partner with insurance firms, more farmers might be able to benefit. It's a good idea, but it needs the right support.'

4 | Discussion

This study provides an institutional analysis of the risks, barriers and opportunities associated with aquaculture insurance in Zambia. Regarding the ownership of the investigated insurance companies and banks, this study revealed that Zambia has more private insurance companies compared to government-owned entities, a trend which is not surprising because of Zambia's privatization policies initiated in the 1990s. This privatization encouraged private sector investment by creating a conducive business environment, in line with what was reported by Musambachime (1999). From an institutional perspective, this reflects the role of formal regulatory frameworks in shaping market participation and encouraging private sector dominance. Our findings are consistent with those reported in other countries such as Kenya and the Netherlands, where private insurers dominate due to similar market liberalization policies (Kiragu 2014; Bertens and Vonk 2020).

Moreover, the present study revealed low aquaculture insurance provision, with an equal share of farm and indemnity-based insurance products. The low level of aquaculture insurance provision in Zambia may be attributed to the infancy of the aquaculture sector (Zhang et al. 2023; Mbewe et al. 2024; Mphande et al. 2024) and the lack of awareness of aquaculture insurance among small-scale fish farmers, as reported by Maulu et al. (2024). From a market failure perspective, this situation reflects information asymmetry and low effective demand, which discourage insurers from developing specialized products. However, the presence of private insurers in Zambia's aquaculture sector represents growth potential and indicates a significant investment opportunity, driven by government incentives and the sector's growth trajectory (Munkombwe et al. 2022). Furthermore, companies that had been operating for more than ten years were more likely to offer aquaculture insurance than newer companies, suggesting that institutional experience and underwriting capacity are important for developing specialized insurance products. Established insurers are more likely to possess the technical expertise and historical data required to assess aquaculture risks effectively (Giné et al. 2008; Van Anrooy et al. 2022). Similarly, companies offering aquaculture insurance demonstrated greater familiarity with the aquaculture industry than those that did not, highlighting the importance of sector-specific knowledge in risk assessment and product development (Townsend 1995). This finding suggests that improving insurers' understanding of aquaculture through technical training, research and collaboration with industry stakeholders could promote the expansion of aquaculture insurance in Zambia.

Concerning the viability of aquaculture insurance in Zambia, the findings further suggest that the viability of aquaculture insurance depends not only on market demand but also on the existence of key institutional and technical pillars that underpin sustainable insurance systems. These include reliable historical production and loss data, effective disease surveillance, robust climate information systems, enabling legal and regulatory frameworks, collaboration between government and private insurers, farmer awareness and efficient claims verification mechanisms. These pillars reduce information asymmetry, improve actuarial pricing and increase insurer confidence in underwriting aquaculture risks (Van Anrooy et al. 2022; Zitti and Guttormsen, 2023; FAO 2024a). The present findings indicate that while Zambia possesses growing institutional interest in aquaculture insurance, several of these foundational pillars remain underdeveloped, particularly comprehensive loss databases and specialized technical expertise required for risk assessment. The present study revealed that insurance institutions consider aquaculture insurance to be viable. This could be attributed to investments made in the aquaculture sector, especially government-led initiatives such as ZAEDP (Hasimuna, Mphande, Maulu, et al. 2025b), the rise in aquaculture production is fuelled by the expansion of

large-scale, capital-intensive commercial operations, especially through investments in cage culture, as well as recent investments from the Zambian government, WorldFish and other stakeholders supporting small-scale aquaculture (WorldFish 2024). In addition, government financial support through the CEEC and the Constituency Development Fund (CDF) may influence insurers to perceive aquaculture insurance as viable (Hasimuna et al. 2023; Mphande et al. 2023; Zhang et al. 2023). These interventions have resulted in the sector contributing about 75,000 metric tons in 2022, representing a 19% increase from 2021 (WorldFish 2024). Within an institutional framework, such government interventions act as enabling mechanisms that reduce uncertainty and signal market potential to private insurers. The support provided to the aquaculture sector may enhance farmers' ability to pay premiums and increase demand for insurance, thereby reinforcing viability, as also reported by Watson et al. (2018). Furthermore, this study demonstrated that a proportion of companies expressed uncertainty regarding the viability of aquaculture insurance. This may be attributed to the infancy of the sector, highlighting the need for increased investment and awareness creation.

Regarding the criteria considered by insurance providers prior to offering aquaculture coverage, the current study revealed that pond location is the most critical factor. This may be attributed to the fact that the location of production facilities reflects environmental, operational and risk-related factors that directly influence the likelihood and cost of claims. This finding aligns with Risk and Uncertainty Theory, which emphasizes the importance of measurable environmental variables in reducing uncertainty in risk assessment. Our findings are consistent with FAO (2024b), which noted that pond location significantly influences insurance availability. Proper site selection by trained personnel is therefore essential to minimize risk and reduce premium costs.

In this study, other important factors identified included production cost, number and size of ponds, species cultured and the type of culture system employed. This may be because these factors collectively reflect the operational and economic characteristics that insurers evaluate when estimating risk and potential losses. This is consistent with Mensah et al. (2024), who reported that insurers consider multiple production-related variables when assessing aquaculture insurance viability. These variables serve as proxies for risk measurement, which is central to actuarial decision-making under conditions of uncertainty. However, it was notable that the experience of farm workers was not highly prioritized. This may be due to the subjective nature of assessing human capital and the lack of standardized evaluation methods. Consequently, insurers may place greater emphasis on observable and quantifiable factors while overlooking human-related determinants of production performance, which could lead to gaps in risk assessment (Kim et al. 2025).

Regarding the risks covered by insurance companies, this study showed that all companies offering aquaculture insurance covered disease, theft and predation. Disease represents one of the most economically significant risks affecting aquaculture worldwide because outbreaks can cause rapid mortality, reduced growth, trade restrictions and substantial financial losses (Bwalya et al. 2020). In Zambia, outbreaks of Epizootic Ulcerative Syndrome (EUS) have been reported in natural water bodies and cultured fish (Huchzermeyer and Van der Waal 2012), while bacterial infections continue to affect fish health under poor environmental conditions (Siamujompa et al. 2023; Zulu et al. 2026). The occurrence of these diseases demonstrates that biological risks are not merely perceived threats but constitute documented hazards capable of causing significant production losses. Consequently, disease surveillance, biosecurity and insurance should be viewed as complementary components of an integrated aquaculture risk management strategy rather than independent interventions. This focus is unsurprising, as these risks represent the most significant threats to aquaculture productivity and sustainability (Legísima and Scott 2021; Tisdell et al. 2012; Van Anrooy et al. 2006; Luna et al. 2023; Folorunso and Yegosibe 2024). From a risk theory perspective, these are high-probability and high-impact risks, making them priority areas for insurance coverage. It was also encouraging to observe that some companies included climate-related risks, particularly in the context of drought and El Niño events experienced in Zambia (Banda et al. 2024; Food and Agricultural Organization (FAO) 2001; Paptsov et al. 2020; Ghosh et al. 2025; Siankwilimba et al. 2024). Recent climate variability has exposed Zambia to recurrent droughts, floods and increasing temperature extremes, all of which directly affect aquaculture production through declining water availability, reduced dissolved oxygen concentrations, damage to pond infrastructure and increased fish mortality (Mulenga et al. 2017; Mphande et al. 2026; Stadtbäumer et al. 2022). These climate-induced shocks are projected to increase under future climate change scenarios, suggesting that weather-related risks will become increasingly important determinants of aquaculture profitability. The incorporation of climate-related perils within insurance products therefore represents an important adaptation strategy capable of improving resilience among fish farmers while reducing the financial consequences of extreme weather events (Mphande et al. 2026).

Furthermore, the study revealed that only commercial farmers, with relatively higher financial capacity, could afford the premiums offered. Even at reduced rates, small-scale farmers remained largely excluded, emphasizing the need for tailored financial products and subsidies to improve inclusivity, as reported by Munkombwe (2024). This reflects a classic case of market failure, where high premiums and perceived risks limit access for vulnerable groups, thereby reducing market efficiency and inclusiveness. This finding is consistent with studies indicating that access to aquaculture insurance among small-scale farmers is constrained by affordability challenges (FAO 2024a; Maulu et al. 2024). The provision of subsidies has also been proposed as a mechanism to enhance participation in aquaculture insurance, particularly in China (Xu et al. 2025).

In this study, the inability to effectively assess aquaculture risks emerged as a major challenge for insurance providers. This may be attributed to a lack of expertise in both aquaculture and actuarial science, which complicates risk evaluation (Van Anrooy et al. 2022). This challenge is further compounded by the limited availability of historical production, mortality, disease and claims data that are necessary for actuarially sound premium calculations. Without reliable datasets describing the frequency and severity of aquaculture losses, insurers face considerable uncertainty when pricing insurance products, often resulting in higher premiums or

reluctance to enter the market altogether. Similar challenges have been reported across many African countries where aquaculture insurance remains underdeveloped because of weak information systems and inadequate institutional coordination (Mensah et al. 2024; Mphande et al. 2026). This challenge reflects both institutional weaknesses and market inefficiencies, particularly in relation to limited technical capacity and information gaps. In addition, low demand for aquaculture insurance was identified as a challenge, largely because many fish farmers are unaware of such products or are unable to afford premiums. This supports findings by Mensah et al. (2024), who reported low demand for aquaculture insurance in African countries. Increasing awareness through targeted outreach and education may help address this challenge (Xu et al. 2025).

Lessons from international experience further reinforce the findings of this study. In China, aquaculture insurance has expanded largely because government premium subsidies have reduced farmers' financial burdens while encouraging private insurers to participate in the market (Zheng et al. 2018; Yu and Yu 2021). Similarly, India has promoted aquaculture insurance through government-supported programmes and public–private partnerships that integrate insurance with broader fisheries development initiatives, thereby improving farmer awareness and increasing insurance uptake (Patil et al. 2025). In Vietnam, pilot shrimp insurance schemes demonstrated the importance of strong disease surveillance systems, reliable production records and government support for reducing information asymmetry between farmers and insurers (Nguyen et al. 2021; Tu et al. 2025). Likewise, Norway has developed a highly resilient aquaculture sector through comprehensive regulatory frameworks, strict aquatic animal health management, mandatory biosecurity measures and continuous environmental monitoring, all of which enhance insurers' confidence by providing reliable data for actuarial risk assessment (Asche et al. 2008; Maroni 2000). Moreover, in Japan, aquaculture insurance was first put forward in 1964 in the Laws of Fishery Disaster Compensation and the Japanese government ensured that insurance institutions participated in fishery insurance while providing fiscal support, including premium subsidies, administrative cost subsidies and loans with lower interests to fishermen and insurance institutions participated in fishery insurance (Yu and Yu 2021). These international experiences demonstrate that successful aquaculture insurance depends not only on insurance products but also on strong institutional support systems. The present findings indicate that Zambia currently lacks several of these institutional foundations, particularly comprehensive production and loss databases, coordinated disease surveillance, specialized technical expertise and supportive government mechanisms. Consequently, Zambia could adopt a phased institutional approach that strengthens these pillars while promoting collaboration among government agencies, insurers, research institutions, extension services and farmer organizations before scaling up commercial aquaculture insurance programmes. This study is subject to several limitations. First, the study was conducted only in Lusaka and Kitwe, which are major financial centres in Zambia, and therefore the findings may not fully represent institutions operating in other regions of the country. Second, the study focused primarily on insurance companies and banks, thereby providing a supply-side perspective on aquaculture insurance. Although these institutions play a central role in underwriting risks, designing insurance products and determining market feasibility, the study did not include other important stakeholders such as fish farmers, government agencies, regulators, producer organizations and development partners, all of whom influence the development and implementation of aquaculture insurance. Consequently, the findings should be interpreted within the context of the institutional perspectives examined. Future studies should adopt a multi-stakeholder approach to provide a more comprehensive understanding of the institutional, regulatory, financial and farmer-level factors shaping aquaculture insurance in Zambia. Third, the use of purposive sampling may introduce selection bias, reducing the statistical generalizability of the findings. However, purposive sampling was considered appropriate because the study sought information-rich respondents occupying decision-making positions within insurance institutions who possessed specialized knowledge relevant to aquaculture insurance. In addition, the relatively small sample size and reliance on self-reported data may introduce subjectivity in responses. Finally, the cross-sectional nature of the study limits the ability to capture temporal changes in aquaculture insurance development over time.

5 | Conclusion and Recommendation

This study provides an institutional analysis of the risks, barriers and opportunities associated with aquaculture insurance in Zambia. The findings indicate that, although the provision of aquaculture insurance remains limited, the sector demonstrates considerable growth potential, supported by government-led investments and an expanding private insurance market. Key factors influencing insurers' decision-making, such as pond location, production cost and culture system, highlight the technical and environmental complexities involved in aquaculture risk assessment. However, important challenges persist, and these include the limited consideration of human expertise in risk evaluation and the exclusion of small-scale farmers due to high premium costs. While the viability of aquaculture insurance is increasingly recognized, particularly in the context of government support and emerging public–private collaborations, constraints such as inadequate technical capacity in risk assessment and the absence of tailored legal frameworks continue to hinder sector development. Addressing these limitations will be critical for building a resilient and inclusive aquaculture insurance system. The findings should be interpreted alongside the broader institutional context in which aquaculture insurance operates. While this study specifically examined the perspectives of insurance service providers, the successful establishment of aquaculture insurance in Zambia will ultimately depend on coordinated action among insurers, government agencies, regulatory authorities, financial institutions, research organizations, extension services and fish farmers. Strengthening collaboration among these stakeholders will be essential for addressing institutional barriers, improving risk information systems and creating an enabling environment for sustainable aquaculture insurance.

To strengthen aquaculture insurance in Zambia, several measures are recommended. First, investment in capacity building is needed to develop expertise that integrates aquaculture knowledge with actuarial skills, thereby improving risk assessment. Second, the development of tailored insurance products, including

subsidized and microinsurance schemes, is essential to enhance access for small-scale farmers. Third, strengthening extension services and awareness initiatives can improve farmers' understanding and uptake of insurance products. Finally, establishing clear legal and regulatory frameworks, alongside promoting collaboration among key stakeholders, will be important for supporting the sustainable growth of aquaculture insurance.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The anonymized data supporting the findings of this study are available from the corresponding author upon reasonable request. The data are not publicly available because they contain information collected from participating institutions that could potentially compromise confidentiality.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.

Supplementary Materials: aff270316-sup-0001-SuppMat.pdf