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OPERATIONS OF AQUACULTURE EXPERIENCES: THE CASE OF THE PROVINCE OF AGUSAN DEL NORTE

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FREDELIO B. BAGNES
Graduate School of Business, University of the Visayas, Colon Street, Cebu City

Abstract

Aquaculture has emerged as a vital contributor to food security and rural development in the Philippines, yet its sustainability is increasingly challenged by environmental, logistical, and organizational pressures. This qualitative case study explores the operational realities of aquaculture cooperatives in Agusan del Norte, drawing on the lived experiences of cooperative leaders. By focusing on how people make sense of their own experiences and a descriptive single-case study design, the research captures insights from key informants through in-depth interviews.

The study identifies three core themes: environmental and climate-related disruptions, logistical and human resource constraints, and the strategic responses employed by cooperatives to maintain operational stability. Findings reveal that adaptive leadership, transparent governance, and equitable resource management are central to overcoming systemic challenges. Moreover, the integration of monitoring systems and member engagement practices enhances cooperative resilience and productivity.

This research contributes to the discourse on sustainable aquaculture by emphasizing the role of localized governance, participatory decision-making, and continuous capacity development. It offers practical recommendations for policymakers and stakeholders to support cooperative-led aquaculture through targeted interventions, technological innovation, and inclusive policy frameworks

Keywords: Aquaculture Cooperatives, Sustainable Fisheries Management, Operational Challenges, Community-Based Governance

Introduction

Over the last two decades, aquaculture has grown from something peripheral into a central player in how the world feeds itself. What used to be a niche area has steadily moved into the heart of global food production. Recent studies and reports in the field show a clear shift, more emphasis now falls on how fish farming impacts broader food systems, not just in terms of yield, but also in how it affects consumers, supply chains, and sustainability. The way the industry moves forward isn't shaped by production alone. It's increasingly being steered by values like equity, environmental responsibility, and long-term food security. As the sector continues to expand, its role in helping countries meet their Sustainable Development Goals becomes harder to ignore.

Aquaculture plays a crucial role in global food security, particularly through fish farming, which addresses the rising need for seafood. However, the industry faces challenges such as volatile feed prices. This research focuses on identifying the key factors affecting feed costs among aquaculture operators in the Caraga Region of the Philippines. The urgency for sustainable practices is underscored by recent findings: Cai and Leung (2020) highlight the depletion of fish stocks due to overfishing, while Crain et al. (2019) point to the ecological consequences of aquaculture expansion. Mobsby and Curtotti (2020) also emphasize the importance of training and regulatory frameworks to improve aquaculture operations.

In the same year, the agriculture, forestry, and fishing (AFF) sector in the Philippines contributed significantly to the country's Gross Domestic Product (GDP), amounting to around PHP 1.781 trillion. However, the Gross Value Added (GVA) of the agriculture, forestry, and fisheries (AFF) sector experienced a slight decline of 0.2 percent compared to the previous year. Specifically, in 2020, the fisheries subsector contributed PHP 223.2 billion to the GVA, which accounted for 12.5 percent of the AFF GVA and 1.3 percent of the Gross Domestic Product (GDP). This decline in the GVA of fisheries continued from 2019 to 2020, with a drop of 1.3 percent. The reasons behind this decline are partly attributed to the depletion of fish stocks resulting from overfishing, especially concerning aquaculture feeds (Cai, J., & Leung, P., 2020).

Further, the Philippines recorded a total fisheries output of 4.4 million metric tons. While commercial fisheries showed an upward trend, both municipal fisheries and aquaculture experienced declines. That year, municipal fisheries accounted for 25% of the total catch, commercial fisheries contributed 22%, and aquaculture made up the remaining 53% (Mobsby & Curtotti, 2020). Although aquaculture has helped meet the growing demand for seafood, its

expansion has led to significant environmental issues, including the degradation of mangrove forests and coastal wetlands, thereby intensifying threats to marine biodiversity (Crain et al., 2019).

The Philippine Fisheries Code of 1998 emphasizes the critical need for the responsible use and preservation of the nation's aquatic ecosystems. However, persistent issues such as excessive fishing and environmental harm continue to threaten the viability of the fisheries industry (Cai & Leung, 2020; Crain et al., 2019). Addressing these concerns is essential to strengthen the sustainability and adaptability of aquaculture operations.

Sustainable development is a central objective of public administration, requiring the integration of economic productivity, social inclusion, and environmental protection. In the context of aquaculture, this means balancing the livelihood needs of communities with the responsible use of natural resources and equitable governance. Public administrators play a key role in aligning local aquaculture operations with broader development goals by promoting policies and practices that ensure economic viability, foster cooperative participation, and safeguard ecological systems. As such, sustainability in aquaculture is not solely a technical concern, it is a governance imperative rooted in the core values of public service.

On the other hand, public decision-makers play a pivotal role in achieving sustainable development goals by crafting and enforcing policies that align local practices with national and global priorities. In aquaculture, this involves facilitating inclusive governance, investing in resilient infrastructure, and ensuring compliance with environmental standards. Their decisions directly shape how resources are managed, how communities engage in cooperative efforts, and how sustainability is pursued at the grassroots level. Through strategic planning and responsive leadership, public administrators act as enablers of long-term, balanced development.

Aquaculture isn't a one-size-fits-all sector. Its systems span a wide range of species, locations, producers, and consumer needs, making it nearly impossible to craft a universal roadmap for producing food that's both sustainable and healthy. What's needed instead is a type of governance that's rooted in science, with goals that are clear and well thought out yet open enough to allow room for different paths to get there. Too many rigid rules can choke innovation. The real challenge is finding the balance: giving industries, government bodies, and NGOs enough freedom to adapt and experiment, while still holding them to measurable standards for transparency, accountability, and public trust. Looking ahead, the sector won't have an easy ride. Climate change looms large. So do shifting public-private dynamics, unpredictable markets, and the lasting impacts of health crises like pandemics. The future is uncertain, but building flexibility into governance now could help steady the course later

The aquaculture industry in the Philippines has seen notable growth, especially in milkfish production. However, inconsistencies in output across different years reveal persistent challenges (Jolly et al., 2023). These fluctuations are often linked to disruptions in the supply chain and shifts in consumer demand, highlighting the need for a deeper understanding of the factors influencing feed pricing.

Despite technological advancements and increased investment in mariculture, the sector continues to grapple with issues such as supply chain instability and market volatility (Fujita et al., 2023). These ongoing challenges underscore the importance of comprehensive research into the operational dynamics of aquaculture and their implications for long-term sustainability.

In Agusan del Norte, post-harvest losses have become a pressing concern due to their environmental repercussions. Aquaculture has been associated with several ecological risks, including the spread of invasive species, nutrient pollution from waste discharge, contamination with pathogens like E. coli, disease transmission, and increased pressure on wild fish stocks for fishmeal production (Diana, 2009).

The aim of the study is to investigate the operations of aquaculture-based cooperatives in the Province of Agusan del Norte. Specifically, this will answer the following questions: 1). How are the operations of aquaculture-based cooperative experienced by the cooperative officials? 2). What implications can be derived from the findings of the study?

Literature Review

Aquaculture research spans diverse disciplines, from environmental science to organizational theory. One broad synthesis comes from Ahmed and Thompson (2019), who examined global aquaculture under their "blue dimensions" framework. They highlight how environmental impact, policy, and social aspects are all deeply interconnected.

Water quality and ecosystem resilience form another key concern. Boyd et al. (2020) traced the evolution of sustainable aquaculture, reviewing how changing climates and nutrient loads challenge production systems worldwide. They pointed to critical gaps in long-term sustainability an echo of Crain, Kroeker, and Halpern (2008), who showed how multiple stressors combine in marine environments, amplifying threats to aquaculture yet seldom addressed in risk management strategies.

Philosophical underpinnings shape how we understand and study these issues. Broido and Manning (2002) reminded researchers that our methods are built on epistemological and ontological assumptions. Creswell and Creswell (2018) further emphasized designing studies that align methodology with the questions we ask, especially when mixing qualitative and quantitative approaches. Locke (2001) called for grounded theory in management research, a fitting reminder for those tracing real-world industry practices and policies.

Governance, co-management, and community dynamics receive strong attention. Bush (2024) provided a practical guide through co-management frameworks linked to FAO policy. In parallel, Jolly et al. (2023) unpacked governance structures in aquaculture, showing how formal institutions interact with local practices. Both build on older but influential work from Pomeroy, Katon, and Harkes (2001), which argues that cooperative governance models in Asia only succeed when rules are clear and backed by meaningful community participation. ICA's Guidance Notes (2018) further underscore the value of cooperative principles in delivering transparency and trust.

Leadership and social capital seem to act as linchpins in several analyses. Gutiérrez, Hilborn, and Defeo (2011) offered evidence from fisheries that strong leadership and shared community norms boost compliance and improve management. Similar lessons appear in the FAO's 2017 and 2020 policy frameworks, which call for formal and informal institutions to step up in governance but note that translating these into practice requires cooperation, funding, and training.

On the technological front, Mathisen et al. (2016) and Fujita et al. (2023) explored digital tools like decision support systems (DSS) and offshore monitoring. These systems promise real-time insights on fish health, feed use, and water quality but uptake remains slow, especially in small-scale settings where cost and technical capacity are barriers.

Economic perspectives add another dimension. Engle and Stone (2019) mapped out operational inputs, costs, and financial structures needed to analyze profitability and productivity in aquaculture. In line with those concerns, Diana (2018) tackled how aquaculture practices influence biodiversity, one lens through which to consider the trade-offs of expansion versus conservation.

Theoretical frameworks such as Putnam's civic networks (1993), Pfeffer and Salancik's resource dependence (1978), and Ostrom's commons governance (1990) help tie these strands together. They confirm that aquaculture sits at the crossroads of social ecosystems, regulatory environments, environmental limits, and economic drivers.

Cultural and legal contexts also matter. In the Philippines, Republic Act No. 8550 (1998) sets the rules for fisheries, yet Aquino-centered policies still struggle with enforcement on the ground. Meanwhile, recent controversies, like the 2025 Guardian reports on Tasmanian salmon farming, show how environmental decline can erode public trust and trigger policy reviews.

Altogether, this body of literature reveals a central tension: aquaculture promises sustainability but only when combined with robust systems of governance, community participation, sound environmental practices, and careful economic planning. The technologies and frameworks are available. The challenge remains in weaving them into coherent, contextually appropriate models that work on the ground.

Methodology

This study used a qualitative case study approach to explore the governance practices and lived experiences of members within aquaculture-based cooperatives. Interviews were the primary data source, conducted with cooperative leaders, local officials, and community stakeholders. Semi-structured in design, these interviews allowed participants to reflect openly on challenges and institutional dynamics while keeping the discussion grounded in key themes such as leadership, policy, and community engagement. Interviews were held in various settings, fishpond sites, barangay halls, and municipal offices depending on what felt natural for participants. Informed consent was secured from all respondents, and ethical clearance was obtained prior to data gathering.

Data analysis followed a thematic process. As interviews progressed, transcripts were reviewed and coded manually, with recurring ideas clustered into patterns. Early insights often shifted as new narratives emerged, requiring constant comparison between data and developing themes. The process was reflexive and grounded in the actual stories shared. To uphold credibility, strategies like triangulation, member checking, and detailed field journaling were applied. Rather than relying on a predefined framework, the analysis aimed to stay faithful to the contexts and voices encountered in the field.

Findings

This section outlines the findings obtained through qualitative analysis of aquaculture cooperative operations. The results are organized into major thematic areas based on informant responses, highlighting key challenges,

operational strategies, resource management practices, sustainability efforts, and lessons learned. Each theme is analyzed in relation to existing literature to offer a well-rounded interpretation. The discussion blends practical insights from cooperative leaders with theoretical frameworks, emphasizing their implications for effective cooperative governance and long-term sustainability.

Description of Informants

The study's participants are primarily senior leaders within their respective aquaculture cooperatives, aged between 60 and 74 years. Most are married, with family sizes ranging from none to five children. Their educational attainment varies, including high school graduates and individuals with bachelor's degrees in disciplines such as Industrial Engineering, Accounting, Mining Engineering, and Secretarial Studies. The majority reside in Buenavista, while one participant is based in Magallanes. In terms of cooperative roles, the informants occupy significant leadership positions, including Board of Directors, Chairman, President, and Business Manager. Their tenure in cooperative management spans from two to five years. This demographic profile reflects a blend of leadership experience and educational diversity, which may shape their views on aquaculture operations and sustainability practices.

Theme 1: Challenges in Aquaculture Cooperative Operations. The experiences of aquaculture-based cooperatives in Agusan del Norte reveal a complex network of challenges that disrupt day-to-day operations and long-term sustainability. These challenges are not isolated but often interlinked, ranging from external environmental stressors to internal organizational limitations. The cooperative members' testimonies shed light on systemic and practical concerns that require urgent attention, particularly in regions where aquaculture is seen as a viable livelihood source but remains vulnerable to multiple risks. Each sub-theme below provides insight into a distinct but interconnected facet of these operational hurdles.

Sub-theme 1.1: Environmental and Climate Challenges. Climate change and environmental conditions significantly impact aquaculture operations. Unpredictable weather conditions, such as typhoons and extreme heat, disrupt feeding schedules and transportation logistics, leading to reduced fish yields.

Informant 1 mentioned that *"First is the climate change. It is difficult to transfer the feeds to fishcage. Second, sometimes, the pumpboat breaks down resulting to non-transfer of feeds. Lastly, the caretaker could not follow instructions causing water pollution."*

Informant 2 highlighted that, *"Doing emerygency harvest during bad weather typhoon Odette lack of personel to actual feed at sea my whole operation another challenge water pollution.*

These findings are consistent with the work of Boyd et al. (2020), who identified climate variability and water quality as critical constraints to sustainable aquaculture. Aquaculture cooperatives are increasingly exposed to environmental and climate-related risks. Irregular weather events such as typhoons and extreme heat disrupt feeding routines and transport systems, ultimately lowering fish production. A parallel situation has emerged in Australia, where salmon farming in Tasmania's Macquarie Harbour has sparked controversy due to environmental degradation, including water pollution and threats to endangered species like the Maugean skate (The Guardian, 2025). This highlights the urgent need for robust environmental regulations and adaptive strategies to reduce the impact of climate change on aquaculture systems.

Environmental unpredictability continues to be one of the most pressing issues faced by aquaculture operations in coastal and inland waters. Informants described how sudden weather changes, particularly typhoons, heavy rains, and prolonged dry spells, interrupt feeding schedules and damage infrastructure such as fish cages and transport vessels. For instance, storms can delay or completely halt the delivery of feeds, resulting in irregular nutrition for fish stock and heightened vulnerability to disease. Aside from the direct physical impact, climate disturbances also strain the logistical flow of labor and materials, compounding the operational burden.

These localized accounts are consistent with the broader literature. Boyd et al. (2020) underscored how climate variability poses serious risks to aquaculture productivity, affecting both water quality and species health. Similarly, the Tasmanian salmon farming crisis (The Guardian, 2025) offers a cautionary example of how unchecked aquaculture expansion in fragile ecosystems can lead to environmental degradation and biodiversity loss. For cooperatives in Agusan del Norte, there is a growing need to integrate adaptive strategies such as early-warning systems, climate-resilient infrastructure, and sustainable feeding technologies into their day-to-day planning.

Sub-theme 1.2: Logistical and Resource Management Issues. Reliable transportation and effective resource distribution are essential for maintaining productive aquaculture operations. When feed delivery is disrupted, it results in irregular feeding schedules, which can negatively affect fish health and hinder optimal growth.

Informant 3 noted, *"transporting feeds from shore to sea is a challenge, and caretakers sometimes fail to follow feeding schedules due to external factors such as personal problems."*

Similarly, Informant 5 noted, *"Transporting of feeds from shoreside to fishcage at sea. Another challenge is the caretaker not 100% focus on his job due to personal problem. One challenge is water pollution and environment policy implementation."*

Improving financial oversight and accounting practices is essential to promote transparency and ensure fair distribution of resources among cooperative members. Engle and Stone (2019) highlight that inadequate financial management in aquaculture can result in diminished profitability and inefficient use of resources, underscoring the need for well-structured financial systems.

Sustainable aquaculture cooperative operations depend heavily on effective logistics and resource management. Issues such as poor transportation infrastructure and irregular feeding routines can negatively impact fish health and development. The Food and Agriculture Organization (FAO) notes that small-scale aquaculture producers often struggle with market access due to logistical barriers and strict quality standards. Kassam et al. (2011) suggest that collective efforts through farmer organizations can improve both market reach and resource efficiency. Furthermore, the use of decision support systems (DSS) has been explored to address complex logistical and resource-related challenges in aquaculture. However, a systematic review by Mathisen et al. (2016) reveals that while DSS tools can enhance decision-making, their real-time application and integration with stakeholder engagement remain limited.

Logistical issues, particularly related to the delivery of feed and maintenance of equipment, emerge as another consistent challenge. Informants described the difficulty of transporting heavy fish feed from the mainland to fish cages, especially during rough seas. The task is further complicated when caretakers, for personal or logistical reasons, are unable to adhere to precise feeding schedules. Missed or inconsistent feeding not only weakens fish health but also increases waste, contributing to water pollution.

Poor coordination and limited financial transparency within cooperatives also surfaced as barriers. Without standardized documentation or proper monitoring tools, some members reported confusion about resource allocation and a perceived lack of fairness in profit sharing. As Engle and Stone (2019) argue, mismanagement of finances and operational resources directly undermines profitability and long-term viability in aquaculture enterprises.

These challenges emphasize the need for improved logistical planning and internal control systems. For instance, scheduling software or mobile-based monitoring tools could help caretakers stick to feeding routines, while regular financial reporting might increase transparency and accountability among cooperative members. The Food and Agriculture Organization (FAO) has also highlighted that the lack of reliable transportation systems remains a critical bottleneck for small-scale aquaculture ventures in developing regions.

Sub-theme 1.3: Human Resource and Organizational Challenges. A cohesive and collaborative team dynamic is essential for the effective and sustainable operation of aquaculture ventures.

Informant 4 emphasized that, *"First of all, the caretaker lacks cooperation for the benefit of the cooperative because he is not a member. It would have been better if he is a member and he knows the laws."*

Informant 5 suggested that, *"members should undergo training and be educated on environmental policies and responsibilities to ensure smooth operations."*

Informant 6 emphasized that, *"I suggest that there should be understanding among the members for an organized operation of the cooperative. The members should have knowledge and awareness when it comes to environmental issues."*

Informant 7 had a similar observation, *"Members should demonstrate unity and understanding for the benefit of the cooperative. Members need to attend meetings and pay their dues."*

Research by Gutiérrez et al. (2011) highlights that the presence of strong social capital and inclusive governance practices within cooperatives plays a crucial role in achieving operational effectiveness.

Effective human resource management and strong organizational cohesion are fundamental to the success of aquaculture cooperatives. Challenges such as limited collaboration among members and inadequate training can hinder operational efficiency. According to the FAO's guide on aquaculture co-management systems, fostering participatory decision-making and investing in capacity-building initiatives are crucial for achieving positive environmental, social, and economic outcomes (Bush, 2024). Additionally, research by Gutiérrez et al. (2011) emphasizes that effective leadership and the implementation of clear policies within cooperatives contribute to improved resource governance and stronger community involvement.

The difficulties encountered by aquaculture cooperatives underscore the need for adaptive management strategies. Environmental pressures call for the adoption of sustainable aquaculture practices, while logistical constraints highlight the importance of upgrading infrastructure and optimizing resource distribution. Addressing human resource challenges requires reinforcing cooperative governance and cultivating a culture of accountability and shared responsibility.

To navigate these challenges, aquaculture cooperatives should prioritize the development of comprehensive environmental policies, invest in efficient resource management systems, and expand training programs for both members and caretakers. Strengthening internal governance structures will also enhance adherence to operational standards and support the long-term sustainability of cooperative initiatives.

Theme 2: Strategies for Ensuring Smooth Cooperative Operations. The effective functioning of an aquaculture cooperative depends on strong leadership, the implementation of well-defined policies, and ongoing performance monitoring. Organizational stability is reinforced when all members comply with established guidelines and actively engage in collective decision-making processes.

Sub-theme 2.1: Monitoring and Supervision. Consistent oversight of daily operations enhances efficiency and enables early detection of potential issues before they develop into major problems.

Informant 1 mentioned that, *"As a manager of fishcage operation, the first thing I do is to monitor that the amount of feeds is accurate (PCR,) food consumption rate and fish health condition."*

Informant 7 stated that, *"close supervision of assigned officers and adherence to the approved work plan are essential for smooth operations."*

Informant 2, *"close monitoring as to actual operation based on work plan approved. See to it that all assigned officers are hands on to their respective assigned task."*

Informant 4, *"You need to extend your patience when handling your members. You need to give clear instructions to the caretaker and feeder."*

Informant 5, *"You need to obey the policies implemented by the BODs."*

Informant 7, *"Implement close monitoring of the operation, regulation of duties and of each member"*

Research by Henriksson et al. (2018) demonstrates that consistent monitoring and evaluation play a vital role in minimizing waste and boosting productivity in aquaculture systems.

Effective supervision is a cornerstone of successful aquaculture cooperative operations, ensuring compliance with feeding routines and health management protocols, which in turn supports higher output. The FAO advocates for the adoption of cluster management and improved operational practices to enhance governance and efficiency, particularly in small-scale aquaculture settings (Kassam et al., 2011). Additionally, the integration of decision support systems (DSS) tailored to aquaculture has shown promise in enabling real-time oversight and data-driven decision-making, although their widespread implementation remains in the early stages (Mathisen et al., 2016).

Effective monitoring and supervision are vital to maintaining operational discipline and ensuring the sustainability of aquaculture-based cooperatives. The ability to detect minor issues before they escalate allows cooperative managers to minimize losses, maintain optimal fish health, and improve resource use efficiency. Across the informant responses, a common thread emerges: close oversight, hands-on management, and clear delegation of tasks are seen as non-negotiable for successful daily operations.

One of the managers emphasized the technical side of oversight, such as tracking feed volume and fish health. Informant 1 detailed the importance of calculating the proper feed conversion ratio (FCR) to avoid both overfeeding and underfeeding, both of which have consequences on fish development and water quality. This attention to biological indicators highlights the increasing need for technical literacy among cooperative leaders, as aquaculture becomes more science-driven. Informant 2 and Informant 7 also stressed the need for strict adherence to the approved work plan and close supervision of officers and caretakers. They pointed out that having staff physically present and actively engaged in their roles creates an environment of accountability.

Beyond technical oversight, emotional intelligence and interpersonal management were also emphasized. Informant 4 noted that patience is critical when managing people particularly when dealing with members who may not fully understand the operational protocols. This highlights a lesser discussed, yet equally essential, aspect of supervision:

effective communication. Informants acknowledged that giving precise instructions, following up on assigned tasks, and regulating duties among members ensures smoother workflows and limits the chances of operational lapses.

Research supports these insights. Henriksson et al. (2018) emphasize that routine monitoring is not only crucial for biosecurity and environmental management but also for improving feed efficiency, which directly affects production costs and profitability. Their study shows that well-monitored systems produce less waste and result in more predictable harvests an advantage particularly important for small-scale cooperatives with limited capital. Similarly, Kassam et al. (2011) in their work on FAO guidelines, argue that structured monitoring, when integrated into cooperative governance models, can enhance transparency and reduce conflicts among members by ensuring everyone is aware of their duties and performance expectations.

In addition, the implementation of technology-driven monitoring such as decision support systems (DSS) - has been explored as a means to improve oversight. Mathisen et al. (2016) found that while DSS can enhance data analysis and real-time response, their integration in community-based aquaculture remains limited, often due to cost and training barriers. Still, the potential exists for such tools to augment traditional supervision, especially in remote or logistically challenging areas like coastal Agusan del Norte.

In aquaculture cooperatives, monitoring and supervision extend beyond merely enforcing compliance. They represent a shared responsibility among members to protect their collective investment. Ensuring regular documentation of operations, timely reporting of issues, and adherence to policies laid down by the Board of Directors, cooperatives not only improve their efficiency but also build a culture of trust and mutual accountability. These factors, when taken together, form the operational backbone of successful and sustainable aquaculture ventures.

Sub-theme 2.1, which focuses on monitoring and supervision, reflects key principles and functions of public administration, particularly in ensuring accountability, performance management, and service delivery at the grassroots level. In the context of aquaculture cooperatives, leaders adopt supervisory roles that parallel those of public administrators, such as overseeing daily operations, tracking compliance with plans, and ensuring that members and caretakers adhere to established standards. These supervisory practices not only promote operational discipline but also reinforce participatory governance an essential value in public administration. Moreover, the act of monitoring serves as a feedback mechanism that informs policy adjustments, guides decision-making, and prevents resource mismanagement. This mirrors the function of government oversight in public service institutions, where regular assessments are used to evaluate program effectiveness and identify areas for improvement. The presence of structured supervision within cooperatives also complements the role of external government agencies, such as local government units (LGUs) and the Bureau of Fisheries and Aquatic Resources (BFAR), which rely on internal cooperative systems to implement state-led programs effectively. Thus, monitoring and supervision within cooperatives are not just operational tasks they are governance functions rooted in accountability, transparency, and institutional responsiveness, aligning closely with the goals and practices of public administration.

Sub-theme 2.2: Leadership and Policy Implementation. The role of the Board of Directors (BOD) is crucial in establishing policies that guide cooperative members.

Informant 3 shared that, *"Implementation of policies involving human intervention to achieve time frame of full implementation of the plans and projects.*

Informant 8 pointed out that, *"the BOD meets twice a month to discuss issues and share decisions with the members."*

Informant 2 emphasized about allocation of resources. *"See to it that all resources are properly allocated to all members beneficiaries to maintain maximum productivity in our coop operation."*

Informant 5, *"There should be transparency in distributing the monetary resources to each members."*

According to Gutiérrez et al. (2011), well-defined governance structures within aquaculture cooperatives lead to better resource management and community engagement.

Strong leadership and clear policy frameworks are foundational to the effective functioning of aquaculture cooperatives. According to the FAO's aquaculture co-management guide, collaborative governance frameworks play a crucial role in enhancing resource management and stakeholder participation (Bush, 2024). Regular board meetings and transparent decision-making processes help build trust among members and ensure that policies are clearly communicated and effectively implemented.

The long-term sustainability of aquaculture cooperatives is closely tied to strong leadership and consistent monitoring. By adopting structured oversight systems and encouraging participatory governance, cooperatives can better manage operational challenges and improve productivity.

Sound cooperative management relies on clear leadership, systematic supervision, and strict policy enforcement. Through diligent oversight and robust governance, aquaculture cooperatives can minimize disruptions and promote sustainable practices.

Establishing routine monitoring protocols, maintaining transparent leadership, and ensuring policy compliance are key strategies for strengthening cooperative operations and securing their sustainability over time.

To facilitate efficient operations, aquaculture cooperatives should prioritize capacity-building programs aimed at enhancing leadership competencies and establishing robust monitoring frameworks. Actively involving members in the development of policies and decision-making processes fosters a sense of ownership and accountability are seen as key elements for cooperative success.

Sub-theme 2.2, which centers on leadership and policy implementation, directly reflects foundational concepts in public administration such as governance, institutional leadership, and policy enforcement. Within aquaculture cooperatives, leaders particularly the Board of Directors and management officers perform administrative roles similar to those of public officials. They craft internal policies, lead consultative meetings, allocate resources, and ensure compliance with organizational rules. These practices embody core elements of public administration: setting strategic direction, mobilizing collective action, and operationalizing policies for the common good. Moreover, their emphasis on participatory leadership, regular assemblies, and transparent decision-making aligns with democratic governance principles advocated in the public sector. Cooperative leaders also serve as intermediaries between members and external government agencies such as the Cooperative Development Authority (CDA), Department of Agriculture (DA), and Local Government Units (LGUs), implementing programs and complying with regulatory frameworks set by the state. This interface highlights the decentralization of governance, where local institutions like cooperatives adopt and localize national development goals. In this way, leadership and policy implementation within cooperatives serve as microcosms of public administration in action demonstrating how organized, accountable, and participatory leadership at the community level contributes to broader goals of transparency, equity, and sustainable development.

An important dimension that emerged from the participants' narratives is the **cooperative relationship between aquaculture cooperatives and local government units (LGUs)**. Several informants highlighted how the support of LGUs through technical assistance, capacity-building seminars, and logistical aid has contributed to sustaining cooperative operations despite environmental and economic pressures. This partnership illustrates a decentralized model of governance where local institutions collaborate to address sector-specific challenges. The LGUs often act as facilitators, providing linkages to national agencies such as the Bureau of Fisheries and Aquatic Resources (BFAR), implementing local ordinances that protect aquatic resources, and mobilizing funds or resources to assist cooperatives during typhoons or post-harvest losses. In return, the cooperatives serve as reliable grassroots partners in implementing local policies, complying with regulations, and advancing food security objectives. This mutual engagement demonstrates how **public administration principles are operationalized at the local level**, with LGUs and cooperatives working together to fulfill shared goals of economic resilience, environmental sustainability, and inclusive development. The cooperative-LGU dynamic also highlights the importance of participatory governance, where decisions are informed by the lived experiences of local stakeholders, fostering both accountability and responsiveness in the delivery of public services.

Theme 3: Resource Allocation and Utilization. Effective resource allocation is essential for optimizing productivity within aquaculture cooperatives. Ensuring that resources are distributed fairly and transparently not only supports operational efficiency but also builds trust and cohesion among members.

Sub-theme 3.1: Equitable Resource Distribution

Informant 4 highlighted that *"resources should be evenly distributed among members according to their capital build-up contributions."*

Informant 5 added that, *"transparency in financial distribution is necessary to maintain trust and avoid conflicts."*

Bush et al. (2019) highlight that equitable distribution of resources within cooperative fisheries plays a crucial role in promoting economic resilience and long-term sustainability

Transparent and fair resource allocation is vital for maintaining member trust and organizational unity in aquaculture cooperatives. The FAO also emphasizes that collective action through farmer organizations can improve market access and support fair resource sharing among small-scale producers (Kassam et al., 2011). Establishing clear guidelines that align resource distribution with members' contributions and needs fosters equity and minimizes conflicts.

In aquaculture cooperatives, the manner in which resources be they financial, material, or human are distributed and utilized can significantly influence the success and cohesion of the organization. Proper resource allocation goes beyond operational logistics; it directly affects the morale, trust, and commitment of cooperative members. When distribution systems are perceived as fair and transparent, members are more likely to stay engaged and supportive of the cooperative's goals. Conversely, ambiguity or favoritism in allocation may lead to discontent, internal conflict, or even withdrawal of support from members.

Aquaculture, by its nature, demands precise allocation of key inputs such as feed, equipment, manpower, and capital. If any of these are distributed disproportionately or without clarity, the ripple effects can compromise both the productivity of the fish farming operation and the integrity of the cooperative structure.

Sub-theme 3.2: Sustainable Resource Management. Efficient resource utilization involves planning for long-term sustainability.

Informant 1, *"To sustain the operation of the cooperative, first and foremost, there should always be cooperation and active participation among all members of the coop."*

Informant 3 explained that, *"we raise bangus fry until they become fingerlings before transferring them to fish cages for four months to ensure maximum productivity."*

Informant 2 suggested that, *"Follow strictly rules as stipulated in policy as approved and controlled by all members as discussed during general assembly meeting. Transparency on the operation particularly on money matters."*

Informant 3, *"Follow strictly standard operational procedure that is inherent to operation that will surely benefit the cooperative for longer sustainability of our operation."*

Informant 5, *"To ensure long term sustainability of the operation, it must be covered with transparency in all transactions involving coop operations."*

Informant 7, *"Continue those projects which are considered beneficial and build sound policies for the improvement of the coop."*

Informant 8, *"Follow standard protocol following established guidlines on our line or activities. bangus greymullet and fingerling production alike. Continue training and seminars needed to upgrade and update on latest development from government side and the related agencies."*

According to Ahmed and Thompson (2020), strategic resource management and capacity-building initiatives enhance productivity and profitability in aquaculture.

Sustainable management of resources ensures the long-term viability of aquaculture operations. The FAO's guidebook on aquaculture co-management outlines that collaborative approaches to resource management can lead to improved environmental stewardship and economic outcomes (Bush, 2024). Adopting practices such as rearing bangus fry to fingerling size before transferring them to grow-out cages illustrates a strategic approach to resource utilization aimed at enhancing productivity.

Promoting transparency in financial dealings and equitable distribution of resources fosters unity and trust within aquaculture cooperatives. Effective resource management by making use of sustainable fish farming techniques and sound financial planning can contribute a significant role in ensuring the long-term viability of cooperative operations.

To ensure long-term viability, aquaculture cooperatives should implement standardized financial procedures, uphold fair and transparent resource distribution, and invest in ongoing training programs. These practices are essential for optimizing resource utilization and strengthening cooperative sustainability.

Discussion

The findings bring to light the real-world weight of running aquaculture cooperatives in places like Agusan del Norte, where the environment, the people, and the system all meet, often with friction. Weather and climate are not abstract issues for these cooperatives; they are immediate, personal, and deeply disruptive. Several informants described how typhoons, unpredictable rains, and extreme heat throw feeding schedules into chaos and sometimes even damage equipment. These interruptions aren't just inconvenient, they cost time, money, and trust. The fact that such conditions mirror broader environmental concerns, like those reported in Tasmania's aquaculture crisis (The Guardian, 2025), reinforces that these are not isolated problems. They're systemic, and they're growing.

Logistical struggles and resource mismanagement also paint a picture that is both frustrating and familiar. Transporting feeds to fish cages sounds simple in theory, but informants shared how rough seas, equipment breakdowns, or even personal problems among caretakers can derail entire operations. What stands out is the human element: no matter how well-designed the operation is, it hinges on people showing up, staying consistent, and working together. This brings the spotlight on internal governance. Lack of training, unclear roles, and poor coordination among members, all these contribute to inefficiencies. The link between strong social capital and cooperative success, as Gutiérrez et al. (2011) argued, becomes evident when informants stress the need for shared responsibility, open communication, and unity.

Supervision and leadership emerge as central levers for keeping things running. Cooperative managers shared how close monitoring of feed usage, regular evaluations, and hands-on oversight are not optional, they're essential. But it's not all about checking boxes or crunching data. Patience, listening, and giving clear instructions matter just as much. The stories told by these leaders echo what Henriksson et al. (2018) and Kassam et al. (2011) documented about the value of consistent oversight and participatory governance in aquaculture. There's an administrative rhythm to these practices that align well with the core ideas of public administration, where accountability, transparency, and responsiveness shape service delivery.

What also comes through clearly is the significance of the relationship between cooperatives and local government units. Informants didn't just mention LGUs, they described them as partners, as sources of technical support and logistical lifelines during difficult times. This cooperative-government dynamic exemplifies decentralized governance in action. It's where national goals and grassroots realities meet, sometimes clumsily, sometimes effectively, but always necessarily. Cooperatives function here not just as economic units but as local governance actors, translating policy into practice and feeding real-world feedback back up the chain.

In the end, sustainability in aquaculture isn't just about technical fixes or more funding. It's also about culture, how cooperatives build trust, distribute resources fairly, manage their people, and stay resilient in the face of pressure. Strategic resource planning, ongoing training, and transparency aren't just best practices; they are survival strategies. As Ahmed and Thompson (2019) suggested, combining smart resource management with capacity-building is key to making aquaculture work, especially in the developing world. This study confirms that. And it adds a layer: sustainable aquaculture doesn't just depend on fish or feed, it depends on people working together, learning from each other, and adapting fast enough to keep the water flowing.

Conclusion

Running an aquaculture cooperative in Agusan del Norte is no easy task. It's shaped every day by unpredictable weather, hard-to-reach supplies, and the challenge of keeping people which includes the members, caretakers, and leaders on the same page. This study offered a close-up view of what that really looks like. The stories gathered from cooperative leaders made clear that success hinges not just on fish stocks or equipment, but on relationships, routines, and leadership that works.

Weather patterns continue to shift. Sea conditions remain rough. Yet these cooperatives persist, adapting as best they can. They keep feeding, keep repairing, keep organizing. That persistence speaks to something deeper: a quiet kind of governance that lives at the community level. When leaders monitor feed usage and enforce policies, when members meet regularly and raise concerns, they aren't just managing a business, they are participating in a form of public service. It may not look like government in the formal sense, but it carries many of the same responsibilities: transparency, fairness, and accountability.

This research did not find silver bullets. There are no simple solutions here. What it found instead were moments of clarity, when monitoring practices worked, when members felt heard, when policies were followed not out of obligation, but belief. These moments hint at the potential of aquaculture cooperatives not just as economic entities, but as spaces for inclusive governance and local development. If supported with better training, clearer policies, and stronger ties to LGUs, they could do even more.

Ultimately, the future of aquaculture in regions like Agusan del Norte rests on how well these small-scale systems are managed, both from within and in collaboration with state actors. It's about cooperation, in every sense of the word

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