

ADAPTIVE CO-MANAGEMENT IN REVITALIZING THE FUNCTION OF FISHERMEN'S COOPERATIVES WITHIN THE KALAMO SAMBER-BINYERI PROGRAM, BIAK NUMFOR REGENCY

Sri Handayani¹, Badu Ahmad¹, Ansar Arifin¹

¹Universitas Hasanuddin, Indonesia

Abstract: The Samber-Binyeri Modern Fishing Village (KALAMO) program has established infrastructure, fish purchasing activities, and market access; however, the continuity of its operations has not automatically strengthened the Samber Binyeri Maju Producer Cooperative (KSBM) as a member-owned organization. Studies on Adaptive Co-Management (ACM) have been limited in explaining conditions where adaptive processes function at the network level but remain uninstitutionalized within the cooperative. This research analyzes how knowledge generation, bridging organizations, and social learning support or constrain the revitalization of KSBM's institutional and business functions. A qualitative single-case study approach was employed, with KALAMO serving as the policy locus and KSBM as the unit of analysis. Data were collected between March and August 2026 through in-depth interviews with eight participants, observations, and document reviews. Analysis involved deductive-inductive thematic coding, pattern matching, and explanation building. The results indicate that while business knowledge has increased, data remain concentrated among specific individuals and partners. KSBM occupies a formal bridging position, whereas operational coordination is primarily driven by external actors. Learning has altered sales practices but has not yet evolved into a structured collective cycle. A cross-thematic synthesis identifies a mechanism of "external substitution of adaptive functions," wherein external actors sustain network operations by fulfilling internal cooperative functions that have not yet been institutionalized. This study distinguishes between the operational sustainability of the network and the institutionalization of adaptive functions within the member-owned organization. Revitalization requires shared data governance, periodic member learning, local facilitation, benefit transparency, and the gradual transfer of functions.

Keywords: Adaptive Co-Management; cooperative revitalization; fisher cooperative; knowledge generation; bridging organization; social learning; external substitution of adaptive functions

1. Introduction

Small-scale fisheries are central to the livelihoods and well-being of coastal communities, providing food, income, and employment through fishing, processing, distribution, and trade [31,17]. However, small-scale fishers commonly face constraints in capital, technology, information, post-harvest facilities, and participation in decisions affecting their livelihoods [11]. Their position in fisheries value chains is also influenced by relationships with traders, financiers, government institutions, and private businesses, which often differ substantially in their access to resources and bargaining power [32]. These conditions make organizational capacity an important component of fisheries development, particularly when modernization programs seek to connect fishers with infrastructure, markets, and business services.



Fisheries modernization initiatives commonly emphasize physical infrastructure and market connectivity, including cold storage, ice plants, processing facilities, fishing equipment, and market partnerships [17]. Such investments can improve fish quality, reduce post-harvest losses, and expand market opportunities. Nevertheless, infrastructure and market access alone do not necessarily generate sustained and equitable benefits for fishing communities. The effectiveness of modernization also depends on the capacity of local organizations to manage resources, coordinate collective action, process information, and distribute benefits among members [31, 34]. In Indonesia, this challenge is particularly important because small-scale fisheries involve millions of households whose livelihoods remain vulnerable to economic, environmental, and climate-related pressures [31]. Market opportunities may increase product value, but their benefits remain dependent on local capabilities, access arrangements, buyer relationships, and control over information and transactions [1].

Collective organizations therefore play an important role in translating fisheries modernization into sustainable local benefits. Fisher groups can strengthen collective capacity by enabling members to pool knowledge, manage resources, meet market requirements, and pursue shared objectives [34]. These functions become particularly significant when fisher organizations operate as cooperatives. As member-owned and democratically controlled organizations, cooperatives are expected to facilitate member economic participation, democratic control, education, training, and transparency of information (International Cooperative Alliance [ICA], 2015). However, cooperatives also face persistent governance tensions between member participation and professional business management, between board authority and member control, and between external support and organizational autonomy [13]. Consequently, a cooperative may continue to conduct economic transactions while its internal capacity for participation, accountability, information management, and collective decision-making remains weak.

This tension is evident in the Samber-Binyeri Modern Fishing Village Program, or KALAMO Samber-Binyeri, in Yendidori District, Biak Numfor Regency, Papua. The program was established as a pilot modern fishing village integrating fisheries infrastructure, business services, community capacity building, government support, and market linkages (Ministry of Marine Affairs and Fisheries [KKP], 2023, 2024a). The program includes cold storage, an ice plant, a workshop, fisher kiosks, a culinary center, and other facilities intended to support fisheries activities. Within this arrangement, the Samber Binyeri Maju Producer Cooperative (KSBM) functions as the collective organization through which fishers can manage business activities, utilize facilities, establish relationships with government institutions, and access markets (KKP, 2024a). KSBM initially recorded 27 members, while field data at the time of this study indicated an increase to 60 members. However, the growth in formal membership did not necessarily translate into equivalent participation in meetings, decision-making, business management, or benefit sharing.

The KALAMO program has nevertheless demonstrated substantial operational achievements. KSBM shipped 13.3 tons of fresh fish to Semarang in September 2024, followed by its tenth container shipment of 16 tons of frozen fish by June 2025. By that time, the total volume shipped had reached 153.82 tons, with an estimated value of IDR 2.456 billion (KKP, 2024b, 2025). These achievements indicate that fish procurement, cold-chain facilities, and market linkages have become operational. Yet, the continuation of these activities has occurred alongside important institutional weaknesses within KSBM. Member participation remains uneven, business data are not yet collectively owned and routinely used, accountability mechanisms are inconsistent, and some business units remain underdeveloped. Private partners and government facilitators continue to play substantial roles in pricing, purchasing procedures, data management, logistics, and day-to-day problem solving. Thus, the program can remain operational even when the cooperative has not yet fully mastered or institutionalized several functions necessary to sustain those activities.

This situation raises an important analytical problem. The continuity of economic activities may create the appearance of institutional success even when the member-owned organization remains dependent on external actors. A program may generate increasing transactions, market access, and operational outputs while the cooperative's capacity to manage knowledge, relationships, learning, and adaptation develops more slowly. The central issue, therefore, is not simply whether the KALAMO network is functioning, but whether the adaptive functions required to sustain that network have become institutionalized within KSBM.

Adaptive Co-Management (ACM) provides a useful framework for examining this relationship. Rather than viewing co-management simply as a formal division of authority, ACM emphasizes continuous problem solving, iterative learning, collaboration across levels, and institutional adaptation in response to changing conditions (Carlsson & Berkes, 2005; Armitage et al., 2009). Berkes (2009) highlights three interconnected processes that are particularly relevant to this study: knowledge generation, bridging organizations, and social learning. Knowledge generation concerns how information and experience are produced, combined, interpreted, and used. Bridging organizations connect actors with different forms of knowledge, authority, and resources. Social learning concerns how interaction and reflection generate changes in collective understanding and practice. Together, these processes provide a basis for assessing whether adaptive capacity becomes embedded in local institutions or remains dependent on external actors.

However, an important gap remains at the intersection of ACM and cooperative governance. Existing ACM research has primarily examined learning, networking, and institutional adaptation within communities and social-ecological systems, with considerable attention to processes operating at the network or system level (Berkes, 2009; Plummer et al., 2012). Less attention has been given to whether such adaptive processes become institutionalized within member-owned enterprises, where democratic control, ownership of business information, accountability, member participation, and benefit distribution are central concerns. Research on fisher groups has demonstrated the importance of collective capacity for accessing benefits (Wiranthi et al., 2024), while studies of fisheries cooperatives indicate that formal cooperative status alone does not guarantee effective collective action (Elsler et al., 2022). Nevertheless, these perspectives do not sufficiently explain how adaptive processes generated through government-supported modernization programs are transferred into and institutionalized within producer cooperatives.

This study addresses this gap by conceptualizing cooperative revitalization as the strengthening of KSBM's ability to perform and oversee its institutional and business functions as a member-owned organization. Revitalization is not understood simply as increasing transaction volume or maintaining existing activities. Rather, it involves strengthening member participation, information and transaction management, asset and business-unit oversight, accountability, market relationships, member learning, and transparent benefit distribution. This perspective makes it possible to distinguish between the sustainability of the wider KALAMO network and the institutionalization of adaptive functions within KSBM.

Accordingly, this study asks: To what extent and through what mechanisms do knowledge generation, bridging organizations, and social learning support or constrain the revitalization of KSBM's institutional and business functions within the KALAMO Samber-Binyeri program? The study aims to analyze how these three ACM processes contribute to or constrain cooperative revitalization and to identify the mechanisms through which adaptive functions become, or fail to become, part of KSBM's organizational practices.

The study makes three contributions. First, empirically, it provides an in-depth case of a fisher cooperative operating within a fisheries modernization program in Eastern Indonesia. Second, conceptually, it distinguishes network-level operational sustainability from the institutionalization of adaptive functions within a member-owned organization, thereby identifying the mechanism of “external substitution of adaptive functions,” in which external actors perform functions that the cooperative has not yet developed. Third, practically, the study proposes function transfer, shared ownership of business data, member learning, accountability, and benefit transparency as important indicators for evaluating whether fisheries modernization strengthens not only economic operations but also the institutional autonomy and collective capacity of fisher cooperatives.

2. RESEARCH METHODS

Research Design

This study employed a qualitative single-case study to examine the revitalization of fishermen's cooperative functions within the Adaptive Co-Management (ACM) framework. A qualitative approach was appropriate because the study sought to understand institutional processes, interactions among actors, and the ways in which knowledge, collaboration, and learning influenced the functioning of the cooperative. The KALAMO Samber-Binyeri program

was treated as the policy and program context, while the Samber Binyeri Maju Producer Cooperative (KSBM) served as the primary unit of analysis.

The analysis focused on three ACM processes identified by Berkes (2009), namely knowledge generation, bridging organizations, and social learning. These processes were examined in relation to the institutional and business functions of KSBM, including member participation, information management, business transactions, asset management, accountability, market relationships, and benefit distribution. Adaptive capacity was not treated as a separate analytical dimension but as a cross-cutting capability emerging from the interaction of these three processes.

2.2 Research Setting

The study was conducted within the KALAMO Samber-Binyeri program in Yendidori District, Biak Numfor Regency, Papua, Indonesia. KALAMO represents a modern fishing village initiative that integrates fisheries infrastructure, business services, community capacity building, government support, and market linkages. Within this program, KSBM functions as a collective organization for fishermen and is expected to facilitate business activities, utilization of fisheries facilities, relationships with government institutions, and market access.

The case was selected because KALAMO provides an appropriate context for examining the relationship between the operational continuity of a fisheries modernization program and the institutional capacity of a member-owned cooperative. Although the program has generated operational achievements, including fish procurement and market distribution, KSBM continues to face challenges related to member participation, collective information management, accountability, and dependence on external actors.

2.3 Data Collection

Data were collected between March and August 2026 using three complementary techniques: in-depth interviews, observation, and document review. In-depth interviews were conducted with eight participants to obtain information concerning the operation of KSBM, knowledge generation, relationships with external actors, learning processes, decision-making, business management, and organizational responsibilities.

Observations were conducted to examine the implementation of cooperative and program activities and interactions among KSBM members, government actors, private partners, and other relevant stakeholders. Document review was used to complement interview and observation data by examining relevant program and cooperative records. The combination of these data sources enabled the researchers to compare information across different forms of evidence and develop a more comprehensive understanding of the case.

2.4 Data Analysis

Data analysis employed **deductive-inductive thematic coding, pattern matching, and explanation building**. The deductive analysis was guided by the three ACM processes of knowledge generation, bridging organizations, and social learning (Berkes, 2009). These concepts provided the initial analytical categories for examining how adaptive processes operated within the KALAMO network and the KSBM cooperative.

Inductive coding was subsequently used to identify empirical patterns that emerged from the data. Particular attention was given to how information and knowledge were generated and shared, how relationships between KSBM and external actors were maintained, and how learning influenced organizational practices. Pattern matching was then used to compare the empirical findings with the three ACM processes, while explanation building was applied to identify the mechanisms through which these processes supported or constrained cooperative revitalization.

The analysis also examined the distribution of functions between KSBM and external actors. This was important for determining whether adaptive functions had become institutionalized within the cooperative or remained dependent on government facilitators and private partners. The cross-thematic analysis subsequently informed the identification of the mechanism referred to in this study as “external substitution of adaptive functions,” in which external actors perform functions that the cooperative has not yet fully developed or institutionalized.

2.5 Research Trustworthiness

The credibility of the findings was supported through the use of multiple data sources and analytical techniques. Information obtained through interviews was examined alongside observations and relevant documents to identify consistencies and differences in the accounts of organizational processes. The combination of deductive and inductive coding, followed by pattern matching and explanation building, also enabled the researchers to connect empirical evidence with the ACM framework while remaining attentive to patterns emerging from the case. This process supported a contextualized interpretation of how adaptive processes influenced the institutional and business functions of KSBM.

3. RESULTS AND DISCUSSION

The analysis identified four themes illustrating the relationship between the three Adaptive Co-Management (ACM) processes and the revitalization of the Samber Binyeri Maju Producer Cooperative (KSBM). The first three themes corresponded to the deductive analytical categories of knowledge generation, bridging organization, and social learning, while the fourth theme represented an inductive cross-process synthesis. The findings were developed through comparison of interviews, field observations, and documents. The quotations presented below were selected to demonstrate variations in experiences and perspectives among participants and were not intended to substitute for the broader body of evidence analyzed. Minor adjustments were made to oral repetitions and punctuation to improve readability without altering the meaning of the responses. The source codes refer to the KSBM leader (K-01), village government/cooperative supervisor (KP-01), fisheries extension officer (P-01), KSBM members (A-01 and A-02), non-member fisher (N-01), private-sector partner (M-01), and the Biak Numfor Regency Cooperative Office (DK-01). Because KP-01 and P-01 were interviewed in the same session, their statements are presented as KP/P-01. All eight participants were represented through the narrative, table, or direct quotations.

3.1 Knowledge Increased but Had Not Yet Become Collectively Owned by the Cooperative

The KALAMO program expanded knowledge concerning cooperative governance and fisheries business operations. DK-01 explained that cooperative administrators received training and socialization concerning cooperative regulations, while KP/P-01 indicated that government facilitators had previously assisted with recordkeeping, organizational arrangements, marketing, report preparation, and the implementation of annual member meetings. At the business level, activities such as weighing fish, comparing prices, calculating fishing costs, maintaining fish quality, and meeting buyer specifications also generated practical knowledge for fishers, cooperative administrators, and business partners.

The main problem was therefore not the absence of information but its unequal distribution and control. M-01 collected data concerning fish volume, size, purchase receipts, payments, prices, and transaction recapitulation because the company directly purchased fish from fishers. A-01 obtained information concerning prices and quality standards primarily from company personnel. KP/P-01 also explained that the cooperative knew the volume of fish and the fees received based on partner reports, but KSBM did not yet have a comparative recording system that was routinely managed and verified jointly by administrators and members.

This condition was explicitly reflected in the statement of KP/P-01:

“Although we do not have our own records, the partner already has its own records. We only know how many tons come in today. We receive a fee of five hundred rupiah per kilogram; I read it from the report.” (KP/P-01, joint interview)

At the same time, K-01 was able to explain the cooperative's sources of income, credit obligations, facility-use costs, and reporting requirements. KSBM had also previously implemented recordkeeping with assistance from facilitators. These findings indicate that an organizational knowledge base already existed. However, the knowledge remained attached to particular individuals and was not supported by routines that ensured the continued availability

of data when facilitators or managers changed. For example, K-01 had to request financial data held outside the cooperative when preparing accountability reports.

K-01 emphasized the importance of administrative capacity:

“Business is easy. Without good administration, it will not work. Administration must come first.” (K-01, in-depth interview)

The findings indicate that the KALAMO network had generated sufficient information to support fish purchasing and shipment activities, but this information had not yet fully become part of KSBM's organizational memory. Within the knowledge-generation process of ACM, revitalization was therefore not sufficiently demonstrated by the mere availability of data. Knowledge needed to be recorded, accessed, compared, and reused by administrators and members as a basis for decision-making. As long as key data remained concentrated among particular individuals or external actors, knowledge generation operated at the network level but had not yet been institutionalized within the cooperative.

3.2 KSBM Served as a Formal Bridge, while Operational Bridging Was Conducted by External Actors

Formally, KSBM occupied a central position in the relationships connecting fishers, KALAMO facilities, government institutions, and markets. Statements from K-01 and cooperation documents indicated that the cooperative served as a formal party in partnerships, represented the use of several assets, received facility rental income, and obtained fees based on fish volume. The initial partnership arrangement positioned KSBM as the party responsible for collecting raw materials, while the company acted as the buyer of fish prepared by the cooperative.

This arrangement changed when the cooperative was unable to collect supplies in accordance with business requirements. M-01 required approximately four months to obtain a single container. To prevent business activities from stopping, the company subsequently purchased and paid fishers directly, organized weighing activities, prepared receipts and transaction recapitulations, adjusted prices, and handled storage and shipment. KP/P-01 continued to provide coordination, facilitation, and access to resources, but day-to-day operational relationships between fishers and the market were increasingly managed by the private partner.

M-01 described this change as follows:

“Initially, we cooperated and acted only as the off-taker. The cooperative was supposed to prepare the raw materials. It took me four months to obtain one container. From a business perspective, this did not make sense. That is why I directly entered the field.” (M-01, in-depth interview)

A similar pattern was observed from the perspective of service users. A-01 explained that weighing and recording personnel came from the local community but worked for and were paid by the company. Payments, price information, storage, and shipment activities were also conducted through the company. A-01 summarized this experience by stating that although a cooperative leader existed, cooperative activities had not yet become operational. N-01, a non-member fisher, had used KALAMO facilities and sold fish through the program but did not clearly understand the membership procedures, rights to benefits, or the relationship between transactions and cooperative business outcomes. N-01 emphasized the need for greater socialization, clearer management arrangements, and price transparency.

A-01 stated:

“The chairman is there, but the activities are not running.” (A-01, in-depth interview)

These findings do not indicate that KSBM had no role at all. The cooperative continued to provide the formal institutional basis for asset utilization and partnerships and received income that contributed to meeting its business obligations. However, its position as a formal bridge did not correspond to an equivalent capacity to perform operational bridging. KSBM occupied a central position within the formal structure but did not yet control the flows

of information, transactions, and negotiations passing through that position. Within the bridging-organization process of ACM, revitalization therefore required more than the cooperative's presence in formal agreements. KSBM needed to be able to coordinate, negotiate, monitor, and account for cross-actor relationships to its members.

3.3 Learning Changed Practices but Had Not Yet Become a Collective Routine

Social learning was evident when transaction experiences changed how fishers evaluated alternative markets. M-01 conducted general socialization and house-to-house approaches to compare nominal market prices with net income after accounting for transportation, ice, waiting time, and the risk of fish remaining unsold. Some fishers subsequently recognized the value of payment certainty based on fish weight, particularly when their catches were large. This change in understanding was accompanied by changes in selling patterns and increased supply.

M-01 described the change as follows:

“Gradually, they realized that when selling at the market there was no price certainty. There were personal costs that had to be paid. Previously, I collected fish for four months for one container; it became one month for four containers.” (M-01, in-depth interview)

Other learning spaces emerged through training concerning cooperative governance, fish processing, recordkeeping, financial management, and operation of the ice unit. Statements from K-01, KP/P-01, and DK-01 indicated that meetings involving administrators, members, government representatives, extension officers, and private partners were used to discuss prices, member contributions, marketing, and facility utilization. These forums generated several concrete ideas, including deduction of member contributions from sales proceeds, regular fish markets, processing of smaller-sized fish, provision of local facilitators, and reactivation of business units.

However, these forums had not yet established a regular cycle of experience, reflection, decision-making, action, and evaluation. A-02 stated that agreements reached during meetings were not always implemented. DK-01 also explained that annual member meetings tended to be delayed and that some decisions had not been followed up. Training knowledge more frequently remained with particular participants rather than being redistributed to members. M-01 added that when trained individuals left because of social conflict or changed employment, the acquisition of skills had to begin again.

A-02 described this situation as follows:

“It seemed that there was an agreement earlier, but after the meeting ended, it was not implemented. So until today, it remains unresolved.” (A-02, in-depth interview)

The evidence therefore revealed two forms of learning occurring simultaneously. Operational learning was sufficiently effective to change selling decisions and facilitate the supply of fish. Organizational learning, in contrast, remained episodic because it depended on training, visits, or particular individuals and was not supported by regular forums, documentation, regeneration of skills, or systematic follow-up. Within the ACM social-learning process, behavioral change became an organizational capability only when experiences could be discussed collectively, decisions could be examined in terms of implementation, and knowledge could be transmitted so that the learning cycle continued despite changes in personnel or facilitators.

3.4 External Substitution of Adaptive Functions Sustained Operations without Completing Revitalization

Comparison of statements from K-01, KP/P-01, A-01, A-02, N-01, M-01, and DK-01 with field observations and available documents revealed a cross-theme pattern. When KSBM had not yet mastered data management, controlled operational relationships, or transformed experience into shared routines, these functions did not disappear. Instead, private partners and government facilitators filled the functional gaps so that fish purchasing, payment, storage, shipment, reporting, and problem-solving could continue. External support therefore generated continuity at the network level but did not automatically transfer knowledge, authority, and accountability into the cooperative.

Table 1. Cross-Process Synthesis of ACM and the Position of Adaptive Functions in KALAMO

ACM Process	Main Empirical Pattern	Dominant Function Performer	Meaning for KSBM Revitalization
Knowledge generation	Transactions generated data on prices, volume, quality, payments, costs, and logistics, but recording and analysis were primarily conducted by partners, facilitators, or particular individuals.	Private partners; government facilitators; particular administrators	Information supported operations but had not yet fully become shared data, organizational memory, or a basis for member decision-making.
Bridging organization	KSBM served as a formal party in partnerships and asset utilization, while purchasing, payment, supply coordination, storage, shipment, and some negotiations were conducted outside the cooperative's routines.	Private partners with support from village government and fisheries extension officers	The network remained connected, but operational control, bargaining power, and KSBM's accountability to members remained limited.
Social learning	Socialization and facilitation changed some selling practices, but forums, follow-up, documentation, and regeneration were not conducted regularly.	Partners; government facilitators; particular training participants	Behavioral change occurred, but knowledge and working practices could easily disappear when facilitators or personnel changed.

Source: Research findings based on interviews, field observations, and document review.

The synthesis presented in Table 1 demonstrates the mechanism of external substitution of adaptive functions. This mechanism operated through four interconnected sequences. First, limitations in personnel, data, working capital, and internal routines created functional gaps within KSBM. Second, partners or facilitators took over these functions so that operations could continue. Third, this external takeover generated visible operational achievements, including fish purchasing, price adjustments, increased supply, and shipment activities. Fourth, because the transfer of knowledge, authority, and accountability had not been designed progressively, operational achievements had not yet developed into capabilities that could be independently reproduced by the cooperative.

The need for continuous managerial or facilitation support was emphasized by DK-01:

“There must be a manager who focuses on the site and stays there to monitor all activity processes. Without a manager or a permanent cooperative facilitator to monitor development, management, and governance, the cooperative will not function well.” (DK-01, in-depth interview)

External substitution did not mean that the program as a whole had failed. Partner support maintained market access, provided payment certainty, enabled price adjustments, and preserved part of the cooperative's income. Government support also provided training, supervision, and access to resources. The central finding was that operational progress was moving faster than the institutionalization of capabilities within KSBM. Organizational revitalization would become evident when functions currently performed externally could be understood and monitored by members, negotiated by the cooperative, and gradually transferred into organizational routines.

As an inductive cross-process finding, external substitution of adaptive functions did not replace the concept of adaptive capacity. Rather, the mechanism explained the relationship between knowledge generation, bridging

organization, and social learning in the KSBM case. It distinguished network-level operational sustainability from the revitalization of a member-owned organization. Adaptive functions were available within the network, enabling KALAMO activities to continue, but KSBM had not yet fully reproduced those functions as part of its own organizational way of working.

4. Discussion

The findings demonstrate that the continuity of KALAMO activities and the revitalization of KSBM are related outcomes but should not be treated as equivalent. Fish purchasing, payment, storage, shipment, training, and cross-actor coordination demonstrate that adaptive functions are available at the network level. However, KSBM has not yet been fully revitalized because business knowledge, bridging functions, and learning cycles remain more strongly located among private partners, facilitators, or particular individuals than within cooperative routines. The central implication is that ACM processes can sustain KALAMO without necessarily becoming capabilities that are owned, monitored, and reproduced by KSBM and its members.

This distinction strengthens Berkes's argument that co-management can develop into ACM through continuous cycles of learning and problem-solving (Berkes, 2009). The KSBM case demonstrates that learning cycles operating at the network level do not necessarily produce institutionalization within the local organization that formally occupies the center of the program. Consequently, the emergence of ACM should not be assessed only through operational continuity or the number of actors connected through the network. It is also necessary to examine who controls knowledge, who performs bridging functions, and whether learning outcomes can be reproduced when partners or facilitators are no longer present.

4.1 Knowledge Generation: From Information Availability to Organizational Ownership

Berkes conceptualizes co-management as a knowledge partnership in which actors operating at different levels possess different capacities to generate and mobilize knowledge (Berkes, 2009). The findings support this perspective because KALAMO brings together fishers' experiential knowledge, government technical knowledge, transaction data, and market information held by private partners. However, the KSBM case adds an important condition for member-owned organizations: knowledge available within a network strengthens a cooperative only when data can be accessed, verified, interpreted, and reused by administrators and members.

The distinction between network knowledge and organizational knowledge helps explain why substantial amounts of information can exist without producing collective control. The multiple evidence base approach emphasizes that different knowledge systems need to be brought together equitably while preserving the integrity and contribution of each system (Tengö et al., 2014). Within a cooperative, this principle also concerns members' rights to understand the business information underlying organizational decisions. When records concerning volume, prices, payments, quality, and costs are primarily managed by external actors, the cooperative becomes dependent not only technically but also epistemically because it lacks an adequate information base for evaluating performance and negotiating its own interests.

The implication is not that KSBM must construct a completely independent data system separate from its partners. Instead, the cooperative requires shared data governance that clearly establishes access rights, recording responsibilities, verification procedures, data use, and reporting to members. This requirement is consistent with cooperative principles that position members as democratic controllers of the organization (ICA, 2015). It also addresses the governance tension that emerges when managers or partners possess substantially more information than members and administrators responsible for oversight (Cornforth, 2004). Knowledge generation therefore supports revitalization not simply when data exist, but when KSBM can transform information generated across actors into organizational memory and a basis for accountability.

4.2 Bridging Organization: Formal Position Does Not Equal Capacity to Control Relationships

The ACM literature explains that bridging organizations can provide spaces for interaction, mobilize resources, build trust, resolve conflicts, and connect actors across institutional levels (Hahn et al., 2006). KSBM formally occupies a position consistent with these functions because it participates in partnerships, asset utilization, and relationships between fishers and markets. However, the findings demonstrate that occupying a central position within a formal structure does not automatically create substantive bridging capacity. When supply flows, payments, data, logistics, and parts of the negotiation process are predominantly controlled by the private partner, KSBM becomes a formal node that does not yet fully control the relationships passing through it.

This finding extends the understanding of bridging organizations by emphasizing authority and accountability. Bridging processes are influenced by power relations, including the ability of particular actors to determine which information is used and whose interests receive attention (Crona & Parker, 2012). Within a cooperative, this issue becomes particularly important because external relationships are expected to remain under the democratic control of members. The principles of autonomy and independence do not prohibit collaboration with government or private companies, but they require such collaboration to preserve members' control over their cooperative (ICA, 2015).

External support should therefore be differentiated between complementary and substitutive functions. Support is complementary when a partner provides market access while simultaneously expanding KSBM's capacity to manage data, coordinate supply, verify payments, and negotiate changes. Support becomes substitutive when activities can continue only because external actors continuously perform core functions without a pathway for transferring authority and knowledge. This distinction explains how network connectivity can increase while the cooperative's bargaining power and accountability to members remain limited.

4.3 Social Learning: Behavioral Change Does Not Always Become Organizational Learning

Changes in how fishers evaluate prices, costs, market risks, and payment certainty demonstrate that interaction within KALAMO has generated meaningful learning. Nevertheless, social learning requires more than a change in an individual's understanding. Such changes need to spread and become embedded within a wider group or organization (Reed et al., 2010). Under this criterion, the increase in fish supply following socialization provides evidence of operational learning but is insufficient to demonstrate that KSBM has institutionalized social learning.

Berkes emphasizes joint problem-solving and reflection within learning networks as important mechanisms in the development of ACM (Berkes, 2009). The KSBM findings indicate that the weakest link is not the existence of meetings or training activities, but the repetition of the cycle involving experience, reflection, decision, action, and evaluation. When agreements are not followed up, training knowledge remains with individual participants, or skills disappear when trained personnel leave, the organization must restart the learning process. This explains why learning appears episodic even though training and meetings have taken place.

These findings are consistent with research on fisheries livelihood programs in Indonesia, which emphasizes the importance of local facilitation, participatory processes, collaboration, and sufficient implementation time (Stacey et al., 2021). They also reinforce findings concerning tuna fisher groups in Maluku that collective capacity involves more than the sum of individual skills and instead reflects the collective ability of members to work together and obtain benefits (Wiranthi et al., 2024). For KSBM, member forums therefore need to function as working spaces rather than merely administrative events. Each forum should connect transaction and service experiences with explicit decisions, assigned responsibilities, deadlines, implementation monitoring, and learning for the next cycle.

Member feedback is also central to this cycle. Trust is associated with member commitment and participation in cooperative governance (Barraud-Didier et al., 2012). Consequently, fishers' decisions to sell through or outside KSBM should be interpreted as information concerning the benefits they experience rather than simply as a matter of organizational loyalty. Social learning becomes stronger when experiences concerning prices, payments, services, and benefit distribution are brought back to cooperative forums and used to improve business decisions.

4.4 Theoretical Contribution: External Substitution of Adaptive Functions

The principal theoretical contribution of this study is the mechanism of external substitution of adaptive functions. Unlike assistance that merely adds resources, this mechanism demonstrates how external actors can replace internal functions that have not yet been institutionalized, thereby allowing operations to continue. The four empirical stages identified in Section 4.4 functional gaps, external takeover, operational achievements, and the closure of institutionalization problems explain how dependency can remain hidden behind apparent program success.

The concept does not replace adaptive capacity. Rather, it provides a cross-process explanation of where adaptive functions are located and how operational continuity can become separated from organizational strengthening. External support is not inherently negative because government institutions and private partners can provide resources, knowledge, and access that a cooperative may not be able to develop immediately. However, substitution becomes an institutional problem when support is not accompanied by planned function transfer, member access to information, and accountability mechanisms.

The mechanism provides three theoretical refinements to the application of ACM in member-owned organizations. First, analysis needs to distinguish the presence of ACM processes within the network from their institutionalization inside the local organization. Second, short-term success needs to be assessed together with the organization's ability to reproduce the relevant functions when external actors change or withdraw. Third, bridging organizations should be evaluated not only according to the number of connections they establish but also according to the distribution of control, access to knowledge, and accountability to members. This refinement complements the argument that outcomes in fisheries cooperatives depend on effective collective action rather than merely on the legal form of the cooperative (Elsler et al., 2022).

The resulting proposition is conditional. The greater the extent to which knowledge generation, bridging, and learning are performed externally without verifiable transfer, the more likely it is that operational continuity will conceal weak cooperative revitalization. Conversely, external support can become a foundation for revitalization when it progressively increases KSBM's capacity to know, decide, negotiate, implement, and account for these functions to its members. This proposition is not intended as a universal claim but can be examined in other cooperatives or producer organizations responsible for partnership-based modernization programs.

4.5 Implications for KSBM Revitalization and KALAMO Evaluation

The first policy implication is the need to shift evaluation from program outputs toward functional ownership. Fish volume, shipment frequency, operational facilities, and the number of training activities remain important, but these indicators should be complemented by questions concerning who records and verifies transactions, who determines or negotiates procedures, who follows up decisions, and whether KSBM can perform these functions when facilitators are absent. Such an approach allows program evaluation to distinguish network achievements from progress in organizational revitalization.

The second implication is the need for a gradual and monitorable function-transfer plan. The initial stage can prioritize shared access to data concerning prices, volume, quality, payments, costs, and fees, accompanied by verification procedures involving administrators and member representatives. The next stage can transfer responsibilities such as transaction recapitulation, supply coordination, communication of price information, and complaint handling, supported by clear performance measures. Subsequent stages should ensure that member meetings regularly address performance, benefits, problems, corrective decisions, and follow-up results.

The third implication concerns the role of managers or local facilitators. They should function as supporters of member governance rather than replacements for the cooperative. Their roles should include explicit mandates, task divisions, knowledge-transfer targets, and reporting obligations approved by administrators and understood by members. Abrupt withdrawal of support may disrupt operations, while unlimited support may prolong dependency. A gradual facilitation approach therefore provides a middle path by reducing external takeover as KSBM's capacity increases without disrupting market relationships and technical support that remain necessary.

5. Limitations and Directions for Future Research

Several limitations should be considered when interpreting the contribution of this study. As a single-case study involving eight participants, the research prioritized explanatory depth and comparison across perspectives rather than population representativeness. Data were collected between March and August 2026, meaning that the findings represent the revitalization process at a particular stage and do not yet capture the long-term outcomes of function transfer. Some evidence was also based on participants' accounts of practices and working relationships, although these accounts were compared with available observations and documents.

Future research could examine the mechanism of external substitution of adaptive functions through comparative studies involving several fisher cooperatives with different levels of external support. Longitudinal research is particularly important for determining whether data sharing, local facilitation, and role transfer produce durable routines after external facilitators reduce their involvement. Future studies could also include larger numbers of women members, business-unit workers, and fishers who choose not to transact through cooperatives, allowing greater attention to variations in perceived benefits and experiences of exclusion.

6. CONCLUSIONS

This study concludes that knowledge generation, bridging organization, and social learning have operated within the KALAMO network but have not yet been fully institutionalized as routine practices within the Samber Binyeri Maju Producer Cooperative (KSBM). Business-related data remain largely controlled by particular individuals or external partners, operational bridging is predominantly performed by external actors, and learning forums have not yet developed into a continuous cycle of reflection, decision-making, action, and evaluation that can be reproduced within the cooperative. Consequently, the continuity of fish purchasing, payment, storage, and shipment activities does not, by itself, demonstrate the revitalization of the member-owned cooperative.

Theoretically, this study distinguishes network-level operational sustainability from the institutionalization of adaptive functions within a local member-owned organization. The mechanism of **external substitution of adaptive functions** explains how external actors can sustain operations by filling functional gaps within the cooperative while knowledge, authority, and accountability have not yet been adequately transferred to KSBM. This finding indicates that the assessment of Adaptive Co-Management in member-owned organizations should consider not only whether adaptive processes are present, but also who controls, performs, and is accountable for those processes.

The revitalization of KSBM therefore requires gradual function transfer, collective ownership of business data, regular member learning forums, local facilitation, and transparent reporting of benefits. Government and private-sector partners remain important in supporting the cooperative, but their involvement needs to be designed to strengthen KSBM's capacity to manage relationships, make decisions, and account for outcomes to its members. Accordingly, the progress of KALAMO should be evaluated not only through economic outputs but also through the increasing institutional independence and adaptive capacity of KSBM.

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