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Structural Drivers, Barriers, and Institutional Actors in an Indonesian Sheep Export Supply Chain: A Retrospective ISM Case Study

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ABSTRACT

Background: Export-oriented livestock supply chains require coordination among animal procurement, farmer-based fattening, finance, regulatory compliance, and export intermediation. This study examined the structural relationships among needs, barriers, and institutional actors in the sheep export supply chain of CV Gumukmas Multi Farm in Jember, Indonesia.

Methods: A retrospective descriptive single-case study used archived evidence collected during August–October 2020 and March–May 2021. Data sources included observation, semi-structured interviews, company records, expert discussions, and structured Interpretive Structural Modeling questionnaires. Three purposively selected domain experts represented company management, ruminant-livestock academia, and the livestock authority. The ISM assessment comprehensively covered seven supply-chain needs, nine barriers, and ten institutional actors.

Results: The historical chain connected livestock traders, the focal enterprise, 87 partner farmers, and PT Inkopmar Cahaya Buana as the export intermediary. Capital availability emerged as the principal independent driver among supply-chain needs. Lengthy export licensing was the most fundamental barrier, whereas capital limitation, sheep shortage, and limited transparency were also upstream constraints. Financial institutions were the strongest independent institutional actor; suppliers, exporters, livestock authorities, government agencies, and investors occupied linkage positions.

Conclusion: The findings support a sequenced improvement pathway that begins with workable financing and regulatory coordination, followed by linked investments in internal breeding, feed technology, farmer capability, and partnership transparency. The study contributes a historically situated ISM interpretation of live-animal export coordination. Because the case relied on one enterprise, three experts, and incomplete archived numerical matrices, the hierarchy should inform case-specific prioritisation and be updated through a contemporary, fully auditable multi-stakeholder study.

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INTRODUCTION

Livestock export supply chains occupy a difficult position in contemporary agri-food systems because commercial opportunity often depends on coordination beyond the control of any single producer. A live-animal shipment can fail even when farm-level production is adequate, because procurement, health requirements, logistics, finance, border documentation, and buyer timing must align. This interdependence creates a paradox for smaller enterprises: access to foreign demand can promise scale and income, while the coordination needed to serve that demand can expose them to new forms of volatility. Research increasingly treats resilience as a system capability emerging from relationships, resource flexibility, and governance rather than from inventory or production capacity alone (Davis et al., 2021; Godde et al., 2021; Wieland, 2021). For small-ruminant enterprises, limited financial buffers, informal supplier dependence, animal availability, and husbandry quality make this problem especially acute (Ali et al., 2021; Dubeuf et al., 2023; Nguyen et al., 2023). Understanding the structural order of these conditions is therefore essential for moving from a list of constraints to a defensible improvement strategy.

The case of CV Gumukmas Multi Farm illustrates this coordination problem in an export-oriented sheep enterprise in Gumukmas, Jember Regency, East Java. During the 2020–2021 study period, the company reported potential monthly demand of approximately 5,000 sheep for Malaysia and 1,000 sheep

for Brunei Darussalam, but realised supply was approximately 1,000 sheep per year for Malaysia and 350 sheep per year for Brunei. The enterprise depended on traders in Jember, Lumajang, Banyuwangi, and Bondowoso for young sheep, distributed animals to 87 partner farmers for three to four months of fattening, and relied on an export intermediary to connect with foreign buyers. These arrangements exposed the enterprise to fluctuating procurement prices, uneven animal availability, variable farmer capability, and administrative timing. Comparable research shows that agri-food resilience weakens when resource access and cross-organisational coordination are misaligned with disruption risks (Hadachek et al., 2024; Zhong et al., 2024). The empirical problem is thus not simply insufficient sheep supply but an interconnected configuration of operational, financial, regulatory, and institutional dependencies.

Financial capacity is especially consequential in livestock supply chains because expenditure precedes revenue at several points in the production cycle. Working capital is required to acquire animals, purchase feed, support animal health, finance transport, and absorb the delay between fattening and payment. When export permission is uncertain, early procurement can create holding costs and biological risks, whereas delayed procurement can raise prices and cause lost demand. Supply-chain research shows that resilience depends on the capacity to mobilise and reconfigure resources under uncertainty (Ivanov, 2021; Queiroz et al., 2022; Sturm et al., 2023). Evidence from agri-food and manufacturing networks further identifies financial resilience as a complement to operational and technological capability rather than a substitute for them (Ali et al., 2022; Gupta et al., 2023). Identifying the fundamental drivers is therefore more useful than recommending simultaneous, undifferentiated improvement in finance, technology, and collaboration.

Regulatory processes add a further layer of complexity because livestock exports are governed by public requirements that affect private operational decisions. Export licensing, animal-health administration, documentation, and coordination with competent authorities can alter when a firm can safely commit to procurement and production. In small enterprises, even a modest delay can disrupt feed budgets, partner-farmer planning, transport scheduling, and the availability of animals that meet buyer specifications. Studies of agri-food supply chains emphasize visibility, preparedness, and institutional collaboration as core resilience capabilities (Hobbs, 2021; Zhao et al., 2024). However, regulation is often treated as an external context rather than as a structurally connected source of influence within the supply chain. A systems-oriented analysis is therefore needed to determine whether administrative constraints are secondary obstacles or deeper drivers of supply-chain vulnerability.

Prior studies provide several relevant but incomplete insights. Research on small-ruminant production documents the importance of producer capability, market channels, animal supply, and value-chain organisation for enterprise development (Dubeuf et al., 2023; Nguyen et al., 2023). Broader agri-food research links resilience to network relationships, resource orchestration, diversification, and adaptive capability (Ali et al., 2021; Silva et al., 2021; Stevens & Teal, 2024; Zhao et al., 2022). Digital and managerial capability studies likewise show that isolated tools do not produce durable gains without complementary routines and knowledge integration (Birkel et al., 2023; Cadden et al., 2023; Khurana et al., 2022; Matarazzo et al., 2021). Scholarship on supply-chain finance identifies constrained funding as a barrier to small-enterprise performance, but commonly treats it as one explanatory variable among many. These contributions establish interdependence but do not reveal the hierarchy through which needs and barriers influence one another in a live-animal export setting.

Interpretive Structural Modeling is well suited to this problem because it converts contextual expert judgments into a hierarchy of driving and dependent elements. Recent ISM applications in agri-food systems demonstrate its value for distinguishing fundamental barriers from highly interactive linkage factors and identifying intervention priorities (Kumari et al., 2023; Singh et al., 2024). Nevertheless, published applications commonly focus on sustainability barriers, technology adoption, or broad food-system challenges rather than jointly examining operational needs, barriers, and institutional actors in a small-ruminant export chain. They also rarely connect the hierarchy to a resilience perspective explaining why particular dependencies should be addressed before downstream symptoms. The research gap is therefore empirical and conceptual: evidence remains limited on how finance, licensing, breeding capacity,

farmer capability, feed technology, and supporting institutions are structurally ordered within one export-oriented sheep supply chain. A case-sensitive ISM approach can retain local operational knowledge while making these relationships explicit and actionable.

Accordingly, this study examines the sheep export supply chain of CV Gumukmas Multi Farm as a retrospective case based on field evidence collected in 2020–2021. It identifies the hierarchy of supply-chain needs, determines the structural position of major barriers, and maps the relative influence of institutional actors. Interpretive Structural Modeling distinguishes independent drivers, linkage elements, and dependent outcomes in each analytical domain. Theoretically, the study extends a supply-chain resilience perspective by representing resource dependence and regulatory uncertainty as an expert-derived structural hierarchy in a live-animal export context. Practically, it offers a sequenced pathway for firms and supporting institutions, beginning with levers that influence multiple downstream conditions. The contribution is deliberately bounded: it does not estimate causal effect sizes or current export performance, but provides a transparent interpretation of the archived case evidence.

METHOD

2.1 Research Design and Study Setting

This study used a descriptive qualitative single-case design supported by Interpretive Structural Modeling (ISM). The design was selected because the study sought to structure contextual relationships among supply-chain elements rather than estimate population parameters or test causal effects. The case was CV Gumukmas Multi Farm, an export-oriented sheep-fattening enterprise in Gumukmas, Jember Regency, East Java, Indonesia. Field activities took place from August to October 2020 and from March to May 2021. The unit of analysis comprised supply-chain needs, barriers, and institutional actors associated with the enterprise's ability to procure, fatten, coordinate, and export sheep. All market and operational information is therefore reported as historically situated evidence from the field period, not as a current market assessment.

2.2 Participants, Instruments, and Data Quality

Participants were selected purposively using an expert-system logic. Three experts contributed to the structural assessment: a member of the company management, an academic specialising in ruminant livestock, and a representative of the livestock authority. They were included because their roles provided direct knowledge of sheep production, fattening practices, institutional regulations, and the focal business operations. Data were collected using an observation guide, semi-structured interview prompts, company documents, expert discussions, and structured ISM questionnaires. Content adequacy was addressed through iterative identification and refinement of the seven needs, nine barriers, and ten institutional actors during expert discussion. The archived material does not contain rater-level matrices or a formal inter-rater coefficient, so the study reports an expert-derived hierarchy without claiming psychometric reliability or statistical consensus.

Table 1. Case context and analytical scope

Component	Documented condition
Enterprise and location	CV Gumukmas Multi Farm, Gumukmas, Jember Regency, East Java, Indonesia
Field period	August–October 2020 and March–May 2021
Operational chain	Traders → CV Gumukmas Multi Farm → partner farmers → exporter → foreign buyers
Partner-farmer network	87 partner farmers; approximately 30–150 sheep per farmer
Fattening period	Approximately 3–4 months
Export intermediary	PT Inkopmar Cahaya Buana

Component	Documented condition
Reported realised supply	Approximately 1,000 sheep/year to Malaysia and 350 sheep/year to Brunei Darussalam

Note. All conditions are retained from the archived field evidence and must not be interpreted as a 2026 update.

Table 1 defines the empirical boundary of the retrospective case and distinguishes documented conditions from later market assumptions. The partner-farmer network and fattening duration show that animal procurement, on-farm production, and export preparation were distributed across organisations. The realised supply figures characterise historical operational scale rather than current export performance. The table also identifies PT Inkopmar Cahaya Buana as the intermediary through which buyer-facing export information entered the chain. These details justify the study's focus on coordination among financial, regulatory, production, and intermediary actors. They should not be extrapolated beyond the 2020–2021 observation period.

2.3 Data Collection Procedure

Data collection proceeded sequentially from case diagnosis to structural assessment. Direct observation and company documents identified the actors, activities, and operational flows within the sheep supply chain. In-depth interviews then elicited needs, constraints, and institutional relationships affecting procurement, fattening, finance, technology, and export preparation. The preliminary elements were discussed with the expert panel and refined into three analytical sets: supply-chain needs, barriers, and institutional actors. Experts completed structured ISM assessments of contextual relationships among sub-elements, and completed records were checked against field notes and company documentation before processing. This sequence grounded the ISM structure in archived case evidence rather than generic factors.

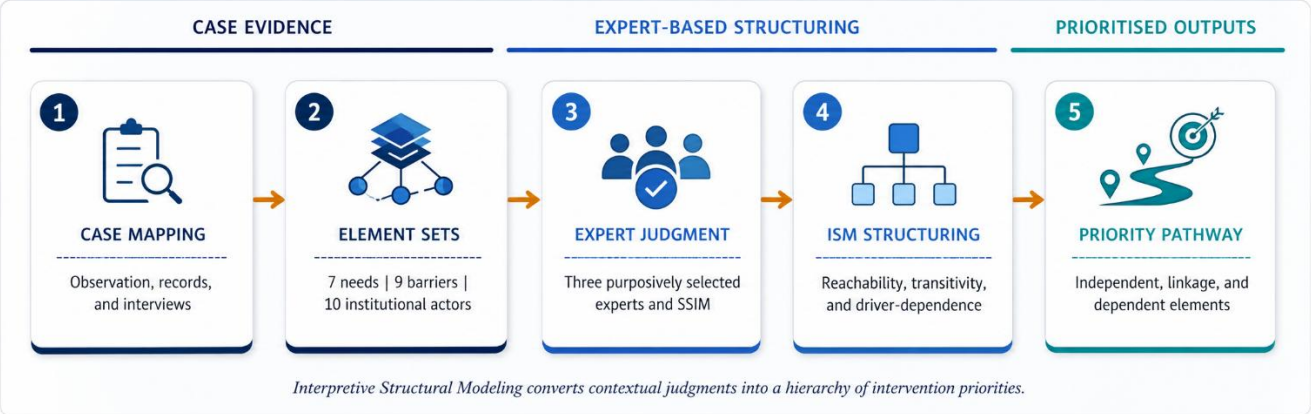

Figure 1. Research and ISM analysis workflow

Figure 1 presents the ordered workflow used to translate case evidence and expert judgments into an ISM-based hierarchy. It begins with field diagnosis and document review so that the analytical elements remain anchored in the enterprise context. The next stages show expert refinement, SSIM construction, reachability analysis, and hierarchy interpretation. The figure is placed in the Method section because it represents the analytical procedure rather than an empirical result. Its sequence also clarifies that recommendations were interpreted only after the relationships among elements had been considered. The figure does not imply the availability of numerical matrix outputs that were absent from the archived record.

2.4 Interpretive Structural Modeling and Decision Rules

The ISM analysis followed the procedure established by Warfield (1976). For each analytical set, experts assessed pairwise contextual relationships using a Structural Self-Interaction Matrix (SSIM): V indicated an influence from element i to element j, A indicated an influence from j to i, X indicated reciprocal influence, and O indicated no significant relationship. The SSIM was converted into a binary

reachability matrix and examined using the transitivity principle. Driving power and dependence were used to classify elements as autonomous, dependent, linkage, or independent, and hierarchical levels were interpreted as a sequence of structural influence. Processing was supported by ISM VAXO software. Because the archive contains final classifications but not numerical SSIM, reachability, or level-partition outputs, this revision reports only results that can be verified from the original case record.

Table 2. Elements retained in the ISM analysis

Analytical domain	Sub-elements
Supply-chain needs	Sheep supply; competent partner farmers; additional capital; increased income; export quota fulfilment; feed technology; internal breeding capacity
Supply-chain barriers	Sheep supply shortage; farmer fund-use noncompliance; capital limitation; limited feed technology; lengthy export licensing; limited transparency; insufficient farmer training; absence of internal breeding; weak farmer economic conditions
Institutional actors	Sheep suppliers; exporter; feed suppliers; transportation company; partner farmers; livestock authority; financial institutions; universities; government; investors

Note. The wording reproduces the analytical elements in the archived manuscript. "Increased income" is interpreted as a downstream outcome in the results rather than as an intervention variable.

Table 2 lists the complete element sets submitted to the archived ISM process. Separating needs, barriers, and actors prevents an operational requirement from being conflated with a constraint or a supporting institution. The needs set captures desired capabilities, whereas the barrier set captures conditions that impede their development. The actor set identifies organisations whose influence was assessed separately from the operational elements. This separation enables the later hierarchy to indicate both what should be prioritised and who may help enable action. Increased income is retained as a downstream outcome rather than being interpreted as an intervention lever.

RESULTS AND DISCUSSION

Results

3.1 Supply-Chain Configuration

The observed sheep export supply chain involved livestock suppliers, CV Gumukmas Multi Farm, partner farmers, and PT Inkopmar Cahaya Buana as the export intermediary. Suppliers consisted mainly of livestock traders operating in Jember, Lumajang, Banyuwangi, and Bondowoso. The company coordinated procurement, distribution of animals to partner farmers, quality control, and preparation for export. Partner farmers maintained sheep for approximately three to four months before animals were selected for export. PT Inkopmar Cahaya Buana connected the chain with foreign buyers and transmitted information on export demand. This configuration made the enterprise dependent on coordination across procurement, farmer-based production, and export intermediation.

3.2 Structural Position of Supply-Chain Needs

Seven needs were evaluated through the ISM procedure. Availability of capital emerged as the principal independent element and was interpreted as the major leverage point in the needs structure. Sheep supply, farmer competence, feed technology, and internal breeding capacity occupied linkage positions because they had both substantial driving relevance and dependence on related conditions. Fulfilment of the export quota was positioned as an intermediate dependent outcome. Increased income of supply-chain actors represented the final dependent outcome in the hierarchy. The resulting structure indicates that income growth was not treated as a direct intervention but as a consequence of coordinated upstream capabilities.

3.3 Structural Position of Supply-Chain Barriers

Nine barriers were identified in the archived case. Lengthy export licensing occupied the most fundamental position in the barrier hierarchy. Capital limitation, sheep supply shortage, and limited

transparency with partner farmers were classified as independent drivers. The absence of an internal breeding system was classified as a linkage barrier. Limited feed technology, insufficient farmer training, weak farmer economic conditions, and farmer fund-use noncompliance were dependent barriers. This pattern placed administrative uncertainty and resource constraints upstream of several farm-level and production-level difficulties.

3.4 Institutional Actors and Integrated Priorities

Ten institutional actors were evaluated in the ISM structure. Banks and other financial institutions emerged as the strongest independent institutional driver. Sheep suppliers, exporters, livestock authorities, government agencies, and investors were positioned as strategic linkage actors. Partner farmers were identified as operational actors, whereas feed suppliers, transportation companies, and universities or research institutions were highly dependent supporting actors. The classification indicates that the supply chain was not governed by the focal enterprise alone. Its development depended on coordinated action across finance, regulation, supply, production, and export intermediation.

Table 3. Verified final ISM classifications

Analytical domain	Independent driver(s)	Linkage element(s)	Dependent outcome(s)
Supply-chain needs	Availability of capital	Sheep supply; farmer competence; feed technology; breeding capacity	Export quota fulfilment; increased income
Supply-chain barriers	Lengthy export licensing; capital limitation; sheep supply shortage; limited transparency	Absence of internal breeding	Limited feed technology; insufficient training; weak economic conditions; fund-use noncompliance
Institutional actors	Banks/financial institutions	Suppliers; exporter; livestock authority; government; investors	Partner farmers; feed suppliers; transportation company; universities/research institutions

Note. The table reports only the classifications available in the archived study. It does not report unverified numerical driver-power or dependence scores.

Table 3 consolidates the verified terminal classifications across the three ISM domains, distinguishing independent upstream leverage points, mutually dependent linkage elements, and downstream dependent conditions. Because the archived record did not preserve numerical driver-power or dependence scores, the table provides an interpretive prioritisation rather than a reproducible numerical ISM audit trail.

Discussion

The prominence of capital availability indicates that the core problem was not merely a shortage of animals but a constrained capacity to synchronise resources across the production cycle. In supply-chain resilience terms, capital functioned as an enabling resource that allowed the firm to convert market information into procurement, feed, technology, and breeding decisions. This interpretation supports the view that resilience arises from the mobilisation and reconfiguration of complementary resources rather than from a single operational asset (Ivanov, 2021; Sturm et al., 2023). It also aligns with evidence that financial resilience complements operational and technological capability in supply networks (Ali et al., 2022; Gupta et al., 2023). The finding extends this literature by locating finance structurally upstream of sheep availability, farmer capability, feed technology, and breeding capacity within a live-animal export case. The practical implication is that interventions focused only on sourcing more animals are unlikely to be durable unless the working-capital mechanism that supports procurement and production continuity is strengthened first.

The placement of lengthy export licensing as the fundamental barrier gives regulatory uncertainty a more central role than it usually receives in enterprise-level livestock discussions. Licensing affects the firm before production decisions are finalised because uncertainty can delay procurement, alter the timing of fattening, and increase exposure to price movements. This pattern is consistent with resilience scholarship that stresses preparedness, visibility, and inter-organisational coordination when supply chains face time-sensitive disruptions (Hobbs, 2021; Zhao et al., 2024). It also refines broader agri-food ISM findings, which identify policy and institutional conditions as important but do not always show how they cascade into animal procurement and financing decisions (Singh et al., 2024). In this case, regulation is not simply an external compliance burden; it becomes part of the operational architecture of the export chain. This interpretation supports closer procedural coordination between the enterprise, livestock authority, and relevant government agencies as a risk-reduction measure rather than a purely administrative activity.

The linkage position of sheep supply, farmer competence, feed technology, and internal breeding capacity highlights a second structural insight: several apparent solutions are themselves mutually dependent. Developing an internal breeding unit can reduce reliance on trader-based procurement, but it requires capital, technical knowledge, animal-health management, and long-term coordination. Similarly, better feed-processing technology may improve productivity only when partner farmers have the skills and incentives to apply it consistently. This reasoning is compatible with small-ruminant value-chain studies that associate performance with animal supply, producer capability, market organisation, and institutional support (Dubeuf et al., 2023; Nguyen et al., 2023). It also echoes evidence that digital and operational technologies improve resilience only when embedded in complementary capabilities and routines (Birkel et al., 2023; Khurana et al., 2022; Matarazzo et al., 2021). The contribution of the present study is to make this complementarity explicit as a structural linkage rather than treating breeding, technology, and training as separable projects.

The institutional hierarchy further shows that financial institutions and public or market-facing actors need to be analysed as a governance system. Banks and financial institutions were the strongest independent actor because access to funding affected livestock procurement and the capacity to invest in supply-chain development. Suppliers, exporters, livestock authorities, government, and investors formed a linkage cluster, indicating that their influence was substantial but interdependent. This result is consistent with research that describes supply-chain resilience as an ecosystem property arising from coordinated relationships among heterogeneous actors (Silva et al., 2021; Yuan et al., 2024; Zhao et al., 2022). At the same time, it provides a more specific institutional account of how those relationships matter in an Indonesian sheep export setting. The implication is that partnership design should include financial arrangements, information-sharing routines, and regulatory communication, rather than relying on informal coordination among the focal firm and partner farmers alone.

The classification of farmer fund-use noncompliance, weak economic conditions, insufficient training, and limited feed technology as dependent barriers requires a cautious interpretation. These issues were salient in the field record, including cases in which funds intended for feed were not fully used for that purpose, but the hierarchy suggests that they should not be reduced to individual behavioural failure. They may instead reflect the downstream effects of economic insecurity, weak transparency, and constrained capability development. This interpretation accords with food-SME research showing that resilience and performance depend on the interaction of organisational resources, regional relationships, and support systems (Ali et al., 2021; Cadden et al., 2023; Silva et al., 2021). It also cautions against training-only interventions, because instruction without workable incentives, finance, and information systems may leave the upstream conditions unchanged. The study therefore contributes a more contextual explanation of farmer-level challenges by locating them within the wider governance and resource structure of the supply chain.

These findings should be interpreted within the study's evidentiary limits. The analysis is based on one enterprise, three expert perspectives, and field conditions documented in 2020–2021; it does not establish current regulatory conditions, market demand, or the magnitude of causal effects. The absence

of archived numeric SSIM and reachability matrices also prevents a renewed statistical or sensitivity assessment of the reported hierarchy. Nevertheless, the case offers a historically grounded contribution by showing how a live-animal export chain can be conceptualised as an ordered system of dependencies rather than as a collection of isolated deficiencies. Future research should update the case with a broader multi-stakeholder panel, report complete SSIM, reachability, level-partition, and MICMAC outputs, and compare several exporters. Such work could test whether the sequencing identified here remains robust under contemporary trade rules, financing mechanisms, and animal-supply conditions.

Implications

The findings imply that improvement programmes should be sequenced according to structural influence rather than implemented as a disconnected set of farm-level activities. For managers, the first priority is an appropriate working-capital arrangement that can bridge procurement, fattening, and payment cycles while export decisions remain time sensitive. For public and industry actors, predictable licensing communication and coordinated documentation can reduce uncertainty before it cascades into procurement and feed commitments. Internal breeding, feed technology, farmer capability, and information transparency should then be developed as linked investments rather than independent projects. This sequencing provides a practical governance logic for allocating limited resources across a small livestock-export system. It also extends resilience theory by showing that finance and regulation may jointly form upstream enabling conditions in a live-animal export chain.

Limitations

This retrospective study is limited by its single-case design, three purposively selected experts, and the 2020–2021 data period. It provides an expert-derived structural interpretation rather than population inference, effect-size estimation, or a current assessment of sheep export performance. The archived evidence did not preserve rater-level SSIM files, numerical reachability matrices, level partitions, or a MICMAC coordinate plot. Accordingly, the revised article does not fabricate numerical values, reliability coefficients, or sensitivity results that cannot be audited. The classifications should therefore be read as historically grounded prioritisation evidence rather than universal rankings for Indonesian livestock exporters. Differences in contemporary regulation, buyer requirements, financing terms, disease control, and animal availability may alter the hierarchy in a new study.

Suggestions And Future Research

Future research should update this case with a contemporary multi-stakeholder panel involving producers, partner farmers, suppliers, exporters, quarantine and livestock authorities, logistics providers, investors, and financial institutions. Researchers should publish the complete ISM audit trail, including the SSIM, reachability matrix, transitivity checks, level partitions, MICMAC plot, consensus procedure, and sensitivity analysis. The resulting hierarchy should be linked to measurable outcomes such as export fulfilment, procurement lead time, animal mortality, feed conversion, gross margin, and buyer reliability. Comparative designs across provinces, species, and export-market destinations could establish whether finance and licensing retain their upstream status. Longitudinal work could additionally test how structural priorities shift following changes in trade rules, animal-health requirements, or financing mechanisms. Combining ISM with network analysis or qualitative process tracing would deepen explanation of how institutions convert formal rules into operational effects.

CONCLUSION

This study shows that the sheep export supply chain of CV Gumukmas Multi Farm was structured by interdependent needs, barriers, and institutional actors. Capital availability was the principal independent driver among supply-chain needs, while export licensing delays formed the most fundamental barrier. Financial institutions were the strongest independent institutional actor, and suppliers, exporters, authorities, government, and investors constituted a strategic linkage cluster. The

findings support a sequenced strategy in which access to finance and regulatory coordination precede investment in breeding, feed technology, farmer capability, and partnership transparency. The article contributes a historically bounded ISM interpretation of live-animal export coordination, not a current or causal estimate of supply-chain performance. Its conclusions should therefore guide future investigation and case-specific decision making alongside updated data and a fully reported multi-stakeholder ISM analysis.

AUTHOR CONTRIBUTION STATEMENT

Afif Fajar Mey Wulandari contributed to conceptualization, investigation, data collection, data curation, formal analysis, and preparation of the original draft. Dhanang Eka Putra contributed to methodology, supervision, validation, interpretation of findings, critical revision, and final approval of the manuscript. Both authors contributed to the study design, reviewed the final manuscript, and accept responsibility for the integrity and accuracy of the work.

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