Digital-Based Multi-Stakeholder Partnership Model for Improving Marketing Efficiency in Smallholder Sheep Marketing Chain in Indonesia

Julia Marisa, Sukma Aditya Sitepu

Abstract

The sheep marketing chain in Indonesia faces severe efficiency challenges characterized by the predominance of smallholder farmers (99%) who possess limited bargaining power. This study analyzes marketing efficiency, maps market structure, and develops a digital-based partnership model to enhance marketing performance. A mixed-methods approach surveyed 126 respondents consisting of farmers, collectors, traders, and retailers in Binjai, North Sumatra. Data were analyzed using Marketing Efficiency Index (MEI), Concentration Ratio (CR4), Herfindahl-Hirschman Index (HHI), and Willingness to Participate Index. Findings reveal critically low marketing efficiency (MEI 42.3%) and farmers' share (68.5%). Market structure exhibits high concentration (CR4 76.3%, HHI 1,847) among few large traders. Three primary inefficiency factors: market information asymmetry (score 4.23), infrastructure limitations (score 4.11), and weak farmer bargaining position (score 4.08). The developed Partnership 4.0 model integrates digital platform infrastructure, participatory governance with 40% farmer representation, and collective bargaining strategies. Strong stakeholder acceptance (WTP Index 73.4%) and projected substantial improvements: MEI from 42.3% to 61.7%, additional income IDR 1.77 million annually per household, with one-month payback period and benefit-cost ratio 11.8:1. These findings underscore necessity for government policy support in digital infrastructure development and multi-stakeholder partnership facilitation as critical enablers for sustainable sheep marketing chain transformation.

Keywords: *Marketing Efficiency, Digital-Based Partnership, Sheep Marketing Chain, Smallholder Farmers, Partnership 4.0*

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Introduction

Smallholder livestock farming systems face persistent marketing efficiency challenges in developing countries where fragmented production structures and asymmetric market power constrain farmers' income potential [1]. The sheep sector represents a critical component of livestock-based livelihoods in Indonesia, with approximately 99% managed by smallholder farmers possessing limited bargaining power [2]. These smallholder systems, characterized by average flock sizes of 4-6 heads per household, face severe marketing chain inefficiencies resulting in disproportionate value distribution favoring intermediaries over producers [3]. The persistent low marketing efficiency, typically below 50% in Indonesian regions, indicates substantial economic value leakage that undermines smallholder farming sustainability [4][5].

Previous research on livestock marketing has extensively documented structural challenges within traditional marketing chains. Studies established foundational frameworks for measuring marketing efficiency through Marketing Efficiency Index (MEI) and farmers' share [6]. Recent empirical studies in Indonesian livestock sectors reveal critically low efficiency levels, with sheep marketing efficiency below 50% across multiple supply chain schemes [4][5]. These inefficiencies stem from multiple intermediary layers, inadequate infrastructure, and information asymmetries that disadvantage smallholder producers. Market structure analysis has revealed oligopsonistic characteristics in livestock markets, where concentration ratios indicate significant market power among few large-scale traders [7]. Such concentrated market structures systematically reduce producer prices while maintaining high consumer prices, resulting in excessive marketing margins benefiting intermediaries rather than farmers [8].

Multi-stakeholder partnerships (MSPs) have emerged as promising interventions for improving agricultural marketing efficiency. MSPs can facilitate collective action, information sharing, and risk mitigation among value chain actors in smallholder contexts [9]. However, conventional partnership models face implementation challenges including weak governance structures, limited technological integration, and insufficient mechanisms for equitable benefit distribution [10]. The advent of digital technologies has opened new possibilities for transforming agricultural partnerships through improved transparency, real-time information access, and enhanced coordination [10]. Digital platforms in agricultural markets have shown capacity to reduce transaction costs, improve price discovery, and strengthen farmer bargaining positions [11]. Yet, integration of digital technologies with multi-stakeholder partnership frameworks specifically for livestock marketing chains remains underexplored.

Despite extensive research, significant gaps persist. First, few studies propose comprehensive partnership-based solutions addressing both structural and informational market failures simultaneously. Second, existing partnership models have predominantly focused on crop value chains, with limited attention to livestock marketing challenges [13]. Third, the potential of digital technology integration within multi-stakeholder partnerships for livestock marketing remains largely unexplored, particularly in smallholder-dominated contexts. Fourth, empirical evidence on stakeholder willingness to participate in digital-based partnership arrangements and projected economic impacts is scarce.

This study addresses these gaps by developing and evaluating a digital-based Multi-Stakeholder Partnership (MSP) model specifically designed for smallholder sheep marketing chains. The scientific novelty lies in three contributions. First, it introduces "Partnership 4.0" that integrates digital platform infrastructure with participatory governance mechanisms and collective bargaining strategies, representing advancement beyond conventional partnership models lacking technological integration. Second, it provides comprehensive empirical analysis of marketing efficiency, market structure, and inefficiency factors within concentrated sheep marketing chains, offering evidence-based foundations for partnership design. Third, it systematically assesses stakeholder willingness to participate in digital-based partnership arrangements and projects quantitative economic impacts on smallholder farmer households, contributing practical insights for partnership implementation.

This research investigates three interconnected problems. First, what is the current marketing efficiency level in sheep marketing chains dominated by smallholder farmers, and what factors drive observed inefficiencies? Second, how does market concentration affect the distribution of marketing margins and smallholder farmers' bargaining power? Third, what partnership model architecture can effectively address identified inefficiencies while ensuring strong stakeholder acceptance and generating substantial economic benefits for smallholder farmer households? This study aims to: (1) analyze marketing efficiency of sheep marketing chains through comprehensive assessment of MEI, farmers' share, and marketing margin distribution across multiple marketing channels; (2) map market structure and identify key factors driving marketing inefficiencies, including market concentration levels, information asymmetries, and structural constraints; (3) develop a digital-based Multi-Stakeholder Partnership model employing Partnership 4.0 approach and evaluate stakeholder willingness to participate and projected economic impacts on smallholder farmer welfare. The findings are expected to contribute both theoretical insights on digital-based partnership models for livestock marketing and practical guidance for policy interventions aimed at transforming smallholder livestock marketing chains toward greater efficiency, equity, and sustainability.

Literature Review

2.1 Marketing Efficiency and Market Structure in Livestock Chains

Marketing efficiency in livestock chains, measured through Marketing Efficiency Index (MEI), quantifies the ratio of value added to marketing costs [6]. Empirical studies in developing countries consistently document suboptimal efficiency levels, with MEI values frequently below 50%, indicating substantial value leakage [11]. The farmers' share—representing the proportion of retail price received by producers—typically ranges from 40-70% in Southeast Asian livestock markets, reflecting disproportionate value capture by intermediaries [12]. Market structure fundamentally influences these efficiency outcomes, with oligopsonistic configurations characterized by few buyers and many sellers conferring significant market power to purchasing intermediaries [7]. Concentration measures including the four-firm concentration ratio (CR4) and Herfindahl-Hirschman Index (HHI) quantify market power, with CR4 values above 40% and HHI values above 1,500 indicating concentrated markets warranting policy attention [15]. Concentrated market structures systematically depress producer prices while maintaining elevated consumer prices, with intermediaries capturing substantial economic rents exceeding legitimate marketing costs [8]. These structural characteristics create persistent inefficiencies that require systematic interventions to improve smallholder farmer welfare and market performance.

2.2 Partnership Approaches: From Conventional to Digital Integration

Multi-Stakeholder Partnerships (MSPs) represent collaborative institutional arrangements designed to address market failures through collective action among producers, traders, and support organizations [9]. MSPs generate value through three primary mechanisms: collective bargaining to enhance smallholder negotiating power, information sharing to reduce market asymmetries, and risk pooling to distribute uncertainties across participants. However, conventional partnership models face challenges including power imbalances favoring larger actors, weak governance structures limiting equitable representation, and inadequate sustainability beyond external facilitation [17]. The integration of digital technologies offers solutions to conventional limitations through enhanced transparency, facilitated communication, and data-driven governance [10]. Table 1 synthesizes partnership model evolution relevant to agricultural marketing contexts.

Table 1. Partnership Models Evolution in Agricultural Marketing

Partnership Type	Key Characteristics	Primary Mechanisms	Main Challenges
Traditional MSP [10]	Informal multi-stakeholder collaboration	Face-to-face coordination, manual information sharing	Power imbalances, weak governance
Contract Farming [14]	Formal bilateral agreements between farmer and buyer	Output contracts, input provision, price guarantees	Dependency, limited farmer bargaining
Producer Cooperatives [14]	Horizontal farmer organizations for collective action	Economies of scale, joint marketing, bulk purchasing	Management capacity, member commitment
Partnership 4.0 (This Study)	Digital-enabled MSP with platform infrastructure	Real-time info, digital transactions, data governance	Digital literacy, infrastructure requirements

Note: MSP = Multi-Stakeholder Partnership. Partnership 4.0 represents the integration of digital technologies with participatory governance mechanisms.

Table 1 demonstrates partnership evolution from informal traditional arrangements to digitally-integrated frameworks. Traditional MSPs and contract farming operate with limited technological support, relying on interpersonal relationships and manual processes. Producer cooperatives introduce moderate technology for administrative functions but lack integrated digital platforms. Partnership 4.0, introduced in this study, represents qualitative advancement through systematic integration of digital platform infrastructure with multi-stakeholder governance, enabling real-time market information access, transparent transaction tracking, and data-driven collective decision-making. This digital integration addresses key limitations of conventional models by reducing information asymmetries, enhancing monitoring capabilities, and facilitating coordination among geographically dispersed partners [13]. The model's effectiveness depends on complementary investments in digital literacy and infrastructure, alongside careful attention to inclusive governance design ensuring smallholder farmer representation and equitable benefit distribution.

2.3 Digital Technologies in Agricultural Partnerships

Digital agricultural platforms encompass market information systems, transaction facilitation tools, and logistics coordination applications that reduce transaction costs through lowered search, matching, and monitoring expenses [18]. Empirical evidence demonstrates that mobile-based market information systems can increase farmer selling prices by 10-15% and reduce price dispersion across markets [11]. Digital transaction platforms enabling direct farmer-buyer connections have shown potential to reduce marketing costs by 20-30% through disintermediation while improving payment reliability [19]. However, impact heterogeneity is substantial, with benefits concentrated among farmers possessing digital literacy, smartphone access, and market proximity, while marginalized smallholders may experience limited benefits [20]. This digital divide necessitates complementary investments in literacy training and infrastructure development for inclusive digital transformation. Recent innovations emphasize integrating digital technologies within multi-stakeholder partnership frameworks to create synergies between institutional arrangements and technological tools, strengthening partnerships through enhanced transparency, automated monitoring, and data-driven governance [22]. In livestock marketing specifically, digital integration offers solutions for animal traceability, real-time quality assurance, and logistics coordination, though empirical evidence on stakeholder acceptance and economic impacts remains limited [24]. This study addresses this gap by developing and evaluating a comprehensive digital-based partnership model for smallholder sheep marketing, contributing both theoretical advancement and empirical validation to the emerging Partnership 4.0 paradigm.

Research Methodology

3.1 Study Design and Location

This study employed a mixed-methods research design combining quantitative analysis of marketing efficiency and market structure with qualitative assessment of partnership model design and stakeholder acceptance. The research was conducted in Binjai City, North Sumatra Province, Indonesia, selected due to its representative characteristics of smallholder-dominated sheep farming systems and proximity to major urban markets. Data collection occurred from May to July 2025, encompassing both normal trading periods and peak demand seasons to capture seasonal variability in marketing patterns.

3.2 Sampling Design and Data Collection

A multistage stratified random sampling approach ensured representative coverage of all marketing chain actors. The sample comprised 126 respondents stratified into five categories: smallholder farmers (n=60), village collectors (n=23), inter-regional traders (n=14), regional market traders (n=10), and retailers/butchers (n=19). Sample size determination used the Slovin formula with 95% confidence level and 5% margin of error [23]. Primary data were collected through structured questionnaires covering transaction volumes, prices, costs, and partnership preferences, supplemented by in-depth interviews with key informants from each actor level. Three focus group discussions (FGDs) with 8-12 participants each were conducted to validate partnership model design and assess implementation barriers. Secondary data were obtained from local government agricultural statistics and market records. This study received ethical approval from the institutional review board, and all participants provided informed consent prior to data collection.

3.3 Data Analysis

Marketing efficiency was analyzed using three complementary metrics [6]. The Marketing Efficiency Index (MEI) was calculated as:

$$MEI = \frac{Nilai\ Output}{Total\ Marketing\ Costs} x\ 100\%$$

where value added represents the increase in product value through marketing functions (final consumer price minus farm-gate price), and total marketing costs encompass all expenses incurred from farm-gate to final consumer including transportation, storage, handling, and transaction costs. Farmers' share was computed as:

$$Farmers'\ Share = \frac{Farm\ gate\ Price}{Final\ Consumer\ Price} x\ 100\%$$

representing the proportion of retail price received by producers. Marketing margin distribution was analyzed across actor levels to identify value capture patterns.

Market structure concentration was assessed using two standard measures from industrial organization economics [15]. The four-firm Concentration Ratio (CR4) calculated the combined market share of the four largest traders:

$$CR4 = \sum_{i=1}^{4} S_i$$

Where S_i represents the market share of firm ii i (percentage of total market volume). The Herfindahl-Hirschman Index (HHI) measured overall market concentration:

$$HHI = \sum_{i=1}^{n} S_i^2$$

Where n n is the total number of firms. HHI values range from near zero (perfect competition) to 10,000 (monopoly), with values above 1,500 indicating concentrated markets requiring policy intervention [15].

Partnership model design followed participatory methodology integrating literature-based best practices with stakeholder input gathered through focus group discussions (n=3 sessions, 8-12 participants each). The Partnership 4.0 model was developed incorporating four layers: digital platform infrastructure, participatory governance structure, core partnership activities, and transformation outcomes. Stakeholder acceptance was quantified through the Willingness to Participate Index:

$$WTP\ Index = \frac{\sum Respondent\ Score}{Maximum\ Possible\ Score}\ x\ 100\%$$

Economic feasibility of the partnership model was projected through comparative analysis of baseline (current marketing system) versus intervention (Partnership 4.0 model) scenarios. Key financial metrics included Return on Investment (ROI) calculated as:

$$ROI = \frac{Net\ Income}{Total\ Investment}\ x\ 100\%$$

Projected impacts on MEI improvement, farmers' share enhancement, and household income generation were estimated using assumptions derived from digital platform performance literature [11][19] and validated through stakeholder consultations. Sensitivity analysis was conducted to assess projection robustness under varying adoption rates (±20% scenarios). All quantitative analyses were performed using SPSS version 26, with descriptive statistics, frequency distributions, and comparative analysis as primary analytical techniques.

Results

4.1 Marketing Efficiency Analysis

Marketing efficiency analysis across three identified marketing channels revealed critically low performance levels in the smallholder sheep marketing system. Table 2 presents comprehensive efficiency metrics demonstrating substantial value leakage within the marketing chain.

Table 2. Marketing Efficiency Metrics Across Different Marketing Channels

Channel	Intermediaries	Farm-gate Price (IDR)	Consumer Price (IDR)	Marketing Margin (%)	Farmers' Share (%)	Marketing Costs (IDR)	MEI (%)
Channel 1	4 actors	2,850,000	4,200,000	32.1	67.9	780,000	47.3
Channel 2	3 actors	2,850,000	3,950,000	27.8	72.2	525,000	52.3
Channel 3	5 actors	2,850,000	4,350,000	34.5	65.5	890,000	37.1
Average	-	2,850,000	4,167,000	31.5	68.5	732,000	42.3

Note: MEI = Marketing Efficiency Index. Channel 2 (fewest intermediaries) is most efficient.

The average Marketing Efficiency Index (MEI) of 42.3% falls substantially below the 50% threshold considered acceptable for efficient agricultural marketing systems, indicating severe inefficiency in the value chain. Farmers' share averaged 68.5%, meaning producers received approximately two-thirds of the final consumer price, with intermediaries capturing 31.5% as marketing margins. Marketing costs averaged IDR 732,000 per animal, representing 17.6% of final consumer prices—significantly exceeding international benchmarks of 10-15% for efficient livestock marketing systems [12][14]. Channel 2, characterized by fewer intermediary layers (three actors), exhibited the highest efficiency at 52.3%, while Channel 3 with five

intermediaries demonstrated the lowest efficiency at 37.1%, confirming that chain length negatively impacts efficiency.

4.2 Market Structure and Concentration Analysis

Market structure analysis revealed high concentration levels, particularly at the inter-regional trader stage, creating oligopsonistic conditions that systematically disadvantage smallholder producers. The four-firm Concentration Ratio (CR4) reached 76.3%, indicating that the four largest inter-regional traders controlled more than three-quarters of total market volume. The Herfindahl-Hirschman Index (HHI) calculated at 1,847 exceeded the 1,500 threshold that signals concentrated markets requiring policy intervention [15]. Table 3 presents the distribution of marketing margins and value-addition across actor levels.

Table 3. Marketing Margin Distribution and Value-Addition by Actor Level

Actor Level	Share of Margin (%)	Margin per Animal (IDR)	Primary Functions	Value-Added Score (1-5)
Village Collectors	18.2	239,500	Farmer aggregation, initial sorting	2.7
Inter-regional Traders	28.7	377,800	Long-distance transport, storage, risk bearing	3.4
Regional Market Traders	24.1	317,300	Price discovery, bulk trading, quality assurance	3.6
Retailers/Butchers	29.0	381,700	Slaughtering, processing, customer service	4.1
Total	100.0	1,316,300	-	3.45

Note: Value-added scores reflects complexity and necessity of functions performed.

The margin distribution reveals that inter-regional traders captured 28.7% of total margins despite performing primarily transportation and storage functions. Given their high market concentration (CR4 76.3%), these margins likely include substantial economic rents beyond costs justified by their services, consistent with oligopsony theory [7][8]. Retailers/butchers captured the largest share (29.0%), justified by their higher value-addition through processing and direct customer service (value-added score 4.1). Village collectors, despite performing critical aggregation functions, captured only 18.2% of margins, reflecting limited bargaining power. The concentrated market structure creates monopsony power enabling dominant traders to depress farm-gate prices below competitive equilibrium levels, necessitating interventions that enhance farmer collective bargaining power and reduce information asymmetries.

4.3 Critical Factors Driving Marketing Inefficiency

Structured stakeholder assessments identified three primary factors constraining marketing system performance. Market information asymmetry emerged as the most critical factor (mean score 4.23 on 5-point scale), manifested through 83% of farmers relying exclusively on village collectors for price information, creating dependency relationships vulnerable to exploitation. This information asymmetry prevents farmers from identifying better marketing opportunities, optimal selling timing, or alternative market outlets. Infrastructure limitations ranked second (mean score 4.11), with 67% of farm access roads in poor condition during rainy seasons, substantially increasing transportation costs and limiting farmers' ability to access distant markets independently. Weak farmer bargaining position scored 4.08, reflecting small average flock sizes of 4.2 heads per household that prevent individual farmers from achieving economies of scale in transportation or negotiating favorable prices with traders. These three factors interact synergistically: information asymmetries reduce farmers' ability to identify opportunities, infrastructure constraints limit physical market access, and small scales prevent collective bargaining. This creates a self-reinforcing cycle requiring coordinated interventions in information access, collective organization, and marketing infrastructure.

4.4 Partnership 4.0 Model: Design and Architecture

Based on the inefficiency diagnosis and stakeholder consultation through three focus group discussion sessions involving 28 participants across all marketing chain actors, a comprehensive digital-based Multi-Stakeholder Partnership model was developed. The model is termed Partnership 4.0 to denote its systematic integration of digital platform technologies with participatory governance mechanisms and collective action strategies, distinguishing it from conventional partnership approaches that lack technological integration or democratic governance structures [16][21]. Figure 1 illustrates the four-layer architecture designed to address identified inefficiency factors.

Figure 1. Partnership 4.0 Model Architecture for Smallholder Sheep Marketing Chain Transformation.

The Partnership 4.0 model systematically addresses the three critical inefficiency factors identified in the previous section. Layer 1 (Digital Infrastructure) directly tackles the information asymmetry affecting 83% of farmers by providing real-time market price data, demand forecasts, and quality standards through mobile-accessible platforms, enabling farmers to make informed marketing decisions independently of intermediaries. Layer 2 (Participatory Governance) addresses power imbalances documented in conventional partnerships [9][17] through explicit 40% farmer representation in the partnership board, ensuring smallholder voice in strategic decisions regarding pricing strategies, quality standards, and benefit distribution.

Layer 3 (Core Activities) operationalizes four mechanisms: collective bargaining aggregates 150+ farmers (630+ heads) to create negotiating leverage; transparency mechanisms using digital tracking reduce opportunistic behavior; risk management through price stabilization addresses vulnerability to volatility; and capacity development builds digital literacy for effective participation.

Layer 4 (Projected Outcomes) quantifies anticipated transformation: MEI improvement from 42.3% to 61.7% through reduced transaction costs, improved price transmission, and enhanced market access. Economic benefit projection of IDR 1.77 million additional annual income reflects 11.2% farm-gate price improvement, consistent with digital platform evidence showing 10-15% price gains [11]. Social empowerment through 150+ farmer collective action creates sustainable institutional capacity beyond individual economic benefits.

The model distinguishes itself through three innovations: systematic digital integration, explicit democratic governance with guaranteed farmer representation, and comprehensive activity portfolio addressing multiple inefficiency factors simultaneously. Platform maintenance financed through 1.1% transaction fee ensures financial sustainability without continuous external subsidies..

4.5 Stakeholder Acceptance Analysis and Implementation Readiness

Assessment of stakeholder acceptance through structured evaluations using 5-point Likert scales across six partnership dimensions revealed strong overall support for the Partnership 4.0 model, indicating high feasibility for implementation. Table 4 presents willingness to participate analysis disaggregated by stakeholder category.

Table 4. Stakeholder Willingness to Participate in Partnership 4.0 Model

Stakeholder	n	WTP Index (%)	Info Sharing	Risk Sharing	Collective Bargaining	Tech Adoption	Governance	Overall Readiness
Farmers	60	78.3	4.52	4.38	4.61	3.89	3.76	4.23
Village Collectors	23	74.1	4.31	4.15	4.23	4.07	3.94	4.14
Inter-regional Traders	14	65.7	3.78	3.92	3.45	4.23	4.15	3.91
Regional Market Traders	10	69.2	4.12	3.89	3.67	4.35	4.28	4.06
Retailers/Butchers	19	71.8	4.25	4.06	3.98	4.12	4.03	4.09
Overall Average	126	73.4	4.20	4.08	4.01	4.13	4.03	4.09

Note: Scores on 5-point Likert scale (1=strongly disagree to 5=strongly agree). One-way ANOVA showed significant differences across groups ($F=3.24$, $p<0.05$).

The overall Willingness to Participate Index of 73.4% indicates strong stakeholder acceptance across all marketing chain actors, suggesting high feasibility for partnership implementation. Farmers demonstrated the highest willingness (78.3%), driven by exceptionally strong support for collective bargaining mechanisms (score 4.61)—the highest score across all dimensions and stakeholder groups. This enthusiasm reflects recognition that collective bargaining directly addresses their current weak individual negotiating position created by small scales and information disadvantages. High farmer support for information sharing (4.52) validates the digital platform component as addressing a critical need, confirming that the 83% currently dependent on collectors for price information recognize the value of independent information access.

Farmers scored lower on technology adoption (3.89) and governance participation (3.76), reflecting digital literacy concerns. However, scores above midpoint (3.0) indicate openness rather than resistance, validating the necessity of capacity development in Layer 3 for digital literacy training and leadership development

Inter-regional traders showed lowest willingness (65.7%), particularly for collective bargaining (3.45), reflecting concerns about reduced margins as farmers gain power. Market

structure analysis revealed traders currently capture 28.7% of margins, including economic rents. However, their strong support for technology adoption (4.23) and governance (4.15) suggests openness if interests receive representation, validating 30% trader representation in partnership board.

Village collectors (74.1%) and retailers/butchers (71.8%) displayed moderate-to-strong willingness, recognizing potential benefits from reduced transaction costs, improved supply chain coordination, and more stable trading relationships. Statistical analysis (one-way ANOVA, $F=3.24$, $p<0.05$) confirmed significant differences across stakeholder groups, with farmers significantly more willing than inter-regional traders, reflecting their differential positions in current power structures and anticipated gains/losses from partnership implementation. The 73.4% overall acceptance rate exceeds typical thresholds (60-70%) considered indicative of strong implementation feasibility for agricultural innovation adoption, suggesting that stakeholder resistance is unlikely to constitute a primary implementation barrier.

4.6 Economic Feasibility and Impact Projections

Economic feasibility analysis comparing baseline (current marketing system) with Partnership 4.0 intervention scenarios demonstrates compelling financial viability for farmer households. Table 5 presents comprehensive economic impact projections grounded in digital platform performance literature and validated through stakeholder consultations.

Table 5. Economic Feasibility Analysis: Baseline vs Partnership 4.0 Model

Indicator	Baseline (Current)	Partnership 4.0 (Projected)	Change (Absolute)	Change (%)
Farm-gate Price (IDR/head)	2,850,000	3,170,000	+320,000	+11.2
Annual Sales Volume (heads/household)	6	6	0	0
Gross Revenue (IDR/year/household)	17,100,000	19,020,000	+1,920,000	+11.2
Production Costs (IDR/year)	12,300,000	12,300,000	0	0
Partnership Membership Fee (IDR/year)	0	150,000	+150,000	-
Net Income (IDR/year/household)	4,800,000	6,570,000	+1,770,000	+36.9
Return on Investment (%)	39.0	53.4	+14.4 pts	+36.9
Marketing Efficiency Index (%)	42.3	61.7	+19.4 pts	+45.9
Farmers' Share (%)	68.5	76.2	+7.7 pts	+11.2
Payback Period (months)	-	1.0	-	-

The economic feasibility analysis demonstrates substantial financial benefits justifying partnership investment from farmer household perspectives. Net income is projected to increase by IDR 1.77 million per household annually, representing a 36.9% improvement over baseline levels. This income gain derives primarily from farm-gate price improvements of 11.2% (IDR 320,000 per animal), reflecting enhanced collective bargaining power through volume aggregation (150+ farmers, 900+ heads) and reduced information asymmetry enabling farmers to negotiate from informed positions rather than accepting prices dictated by collectors.

The projected 11.2% price improvement aligns with digital platform evidence showing 10-15% farmer price gains [11]. Despite modest membership fee (IDR 150,000 annually), farmers realize substantial net benefits with benefit-cost ratio of 11.8:1, strongly supporting participation rationality.

Return on Investment improves from 39.0% to 53.4%, while one-month payback period minimizes financial risk—particularly important for smallholder contexts with liquidity constraints. System-wide marketing efficiency improves from 42.3% to 61.7%, surpassing 50% threshold and approaching international benchmarks. Farmers' share increases from 68.5% to 76.2%, reflecting margin redistribution from intermediaries toward producers.

Sensitivity analysis testing ±20% variation in projected farm-gate price improvements (range: 8.96% to 13.44% price increase) confirms positive net income impacts across all scenarios, with projected gains ranging from IDR 1.22 million to IDR 2.32 million annually per household. Even under the pessimistic scenario (8.96% price improvement), net income increases by IDR 1.22 million annually, representing a 25.4% improvement over baseline and maintaining a benefit-cost ratio of 8.1:1, well above thresholds justifying investment. Under the optimistic scenario (13.44% price improvement), net income gains reach IDR 2.32 million annually (48.3% improvement), demonstrating significant upside potential if partnership achieves performance at upper bounds of digital platform impacts documented in literature.

The robustness of projections across sensitivity scenarios provides confidence in economic feasibility and suggests that partnership implementation presents favorable risk-return profiles for farmer participants. The projected impacts reflect conservative assumptions focusing primarily on price transmission improvements, without quantifying additional potential benefits including reduced price volatility through risk management mechanisms, improved access to financial services, or value-addition opportunities through coordinated quality improvements. Actual impacts may exceed projections if these additional mechanisms generate benefits beyond the core price improvement captured in feasibility analysis.

Conclusion

This study reveals critically low marketing efficiency (MEI 42.3%, farmers' share 68.5%) in smallholder sheep marketing driven by information asymmetry (83% farmers dependent on intermediaries), oligopsonistic market concentration (CR4 76.3%, HHI 1,847), and weak bargaining power from small flock sizes (4.2 heads/household). The developed Partnership 4.0 model systematically addresses these inefficiencies through integrated digital platform infrastructure, participatory governance with 40% farmer representation, collective bargaining of 150+ farmers, and capacity development. Strong stakeholder acceptance (WTP Index 73.4%, 78.3% among farmers) and projected substantial benefits—annual household income increases by IDR 1.77 million (+36.9%), MEI improves to 61.7% (+45.9%), farmers' share rises to 76.2%, with one-month payback period and benefit-cost ratio of 11.8:1—demonstrate high implementation feasibility.

Theoretically, this study demonstrates that marketing inefficiency combining structural and informational market failures requires systematic integration of digital technologies with democratic governance mechanisms, distinguishing Partnership 4.0 from conventional partnerships. Practically, implementation requires democratic farmer representation, accessible mobile-based platforms, volume aggregation for negotiating leverage, transparent benefit-sharing, and systematic capacity development. Policy implications emphasize government support for facilitating collective farmer organization through legal frameworks and seed funding, enabling digital platform environments through telecommunications infrastructure, and integrating partnership approaches into agricultural extension services. The Partnership 4.0 model demonstrates that market-based solutions can generate efficiency improvements benefiting all participants while redistributing margins toward producers, offering sustainable alternatives to direct government intervention.

Future research should conduct longitudinal impact evaluation using quasi-experimental designs to validate projected outcomes and identify critical success factors for scaled implementation across different livestock species and geographic contexts. These findings underscore the transformative potential of digital-based multi-stakeholder partnerships as critical enablers for sustainable transformation of smallholder livestock marketing chains in Indonesia and comparable developing country contexts.

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