

Sustainable Rice Value Chain and Local Economic Policy: Building Competitiveness in Sidodadi Village

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Abstract

This study examines the sustainable rice value chain in Sidodadi Village and evaluates how local economic policies can enhance regional competitiveness within Indonesia's agricultural sector. Rice production remains central to rural livelihoods, yet smallholder farmers face persistent challenges, including limited market access, inadequate post-harvest infrastructure, and fragmented policy frameworks. Through a mixed-methods case study approach combining qualitative interviews with 45 stakeholders and quantitative value chain analysis across 120 farm households, this research identifies critical bottlenecks in production, processing, and distribution stages. Findings reveal that coordinated local policies integrating sustainable agricultural practices, cooperative strengthening, and digital market linkages can increase farmer income by 23-31% while reducing environmental degradation. The study contributes two original frameworks: a multi-stakeholder governance model for rice value chains and a localized policy toolkit adaptable to smallholder contexts. Policy implications emphasize decentralized decision-making, investment in agro-processing facilities, and capacity building for farmer organizations. These interventions collectively build competitive advantage while ensuring environmental sustainability and social equity in rural economies.

Keywords: Sustainable Agriculture; Rice Value Chain; Local Economic Policy; Rural Competitiveness; Smallholder Farmer

I. INTRODUCTION

A. Background

Rice production in Indonesia represents a critical nexus of food security, rural livelihoods, and economic development. As the third-largest rice producer globally after China and India, Indonesia cultivates approximately 10 million hectares of rice paddies annually, with smallholder farmers managing over 90% of this production. In North Sumatra province, rice cultivation serves as the primary income source for approximately 1.8 million rural households, contributing significantly to regional food security and agricultural GDP. However, the sector faces mounting pressures from climate variability, land conversion, and shifting demographic patterns that threaten long-term sustainability.

Sidodadi Village in Deli Serdang Regency exemplifies these challenges while simultaneously offering insights into potential solutions. Located in the fertile agricultural belt surrounding Medan, the village comprises 850 farm households cultivating an average of 0.45 hectares per family. Recent data from 2024-2025 indicates that rice productivity in the region averages 5.3 tons per hectare, slightly above the national average of 5.2 tons per hectare but significantly below the achievable yields of 9-10 tons per hectare demonstrated in sustainable agriculture pilot programs across Java and Central Sulawesi.

The rice value chain in Sidodadi Village exhibits several structural inefficiencies that limit farmer income and competitiveness. First, fragmented production leads to weak bargaining power in input procurement and output marketing. Second, inadequate post-harvest infrastructure results in quality degradation and price penalties, with farmers losing an estimated 18-22% of potential revenue due to improper drying, storage, and milling facilities. Third, limited access to agricultural credit constrains adoption of productivity-enhancing technologies and sustainable farming practices. Finally, the absence of coordinated local economic policies creates gaps between production capabilities and market opportunities.

Recent policy developments at the national level provide both opportunities and imperatives for local action. Indonesia's commitment to achieving rice self-sufficiency by 2025, with production targets of 32 million tons annually, requires significant productivity improvements at the village level. The government has allocated Rp 5 trillion for enhancing rice and corn absorption capacity, including construction of 100 new warehouses in major producing regions. Additionally, the adoption of Sustainable Rice Platform standards has demonstrated potential for simultaneously increasing yields and reducing environmental impacts, with pilot programs showing 25% yield increases alongside 40% reductions in chemical nitrogen use.

Local economic policy emerges as a critical lever for translating national objectives into tangible improvements in farmer welfare and competitive positioning. Village-level policies can address context-specific constraints, facilitate collective action, and create enabling conditions for value chain upgrading. This study investigates how coordinated policy interventions at the local level can transform rice value chains in Sidodadi Village, providing a replicable model for similar smallholder contexts across Indonesia and Southeast Asia.

B. Problems

This study addresses several interconnected challenges facing the sustainable development of rice value chains in smallholder contexts:

- 1. Productivity Gap and Sustainability Trade-offs**
Despite favorable agro-ecological conditions, rice productivity in Sidodadi Village remains 45-48% below achievable yields observed in sustainable agriculture programs. Farmers face a perceived trade-off between maximizing short-term production through intensive chemical inputs versus adopting sustainable practices that may require learning investments and transitional yield penalties.
- 2. Value Chain Coordination Failures**
The rice value chain in the village operates with minimal horizontal coordination among farmers and weak vertical linkages to processors and markets. This fragmentation undermines economies of scale in input procurement, limits bargaining power in output markets, and prevents collective investment in quality improvement infrastructure. Individual farmers bear disproportionate transaction costs while capturing only 35-42% of final consumer prices.
- 3. Post-Harvest Infrastructure Deficits**
Sidodadi Village lacks adequate facilities for drying, storage, and primary processing. Farmers typically sell unhusked rice immediately after harvest to avoid storage losses, accepting prices 12-18% below those available to farmers with proper post-harvest facilities. The absence of community-scale infrastructure perpetuates a low-quality, low-price equilibrium that discourages quality investments.
- 4. Policy Fragmentation and Implementation Gaps**
While national policies promote rice self-sufficiency and sustainable agriculture, implementation at the village level remains fragmented and under-resourced. Local governments possess policy authority but often lack technical capacity and financial resources for effective intervention. The disconnect between

national priorities and local realities creates implementation gaps that undermine policy effectiveness.

- 5. Limited Access to Finance and Technology**
Smallholder farmers in Sidodadi face significant barriers to accessing formal agricultural credit and productivity-enhancing technologies. Commercial banks perceive rice farming as high-risk and low-return, while government-subsidized credit programs suffer from bureaucratic complexity and inadequate disbursement. Technology adoption remains constrained by information asymmetries, risk aversion, and insufficient demonstration effects.
- 6. Market Information Asymmetries**
Farmers operate with incomplete information about market prices, quality premiums, and demand patterns. This information deficit strengthens middleman positions and prevents farmers from capturing value through timing sales, quality differentiation, or direct marketing arrangements. Digital solutions exist but require infrastructure, training, and institutional support for effective deployment.

II. RESEARCH METHODOLOGY

A. Types of Research

This study employs a mixed-methods case study design combining quantitative value chain analysis with qualitative institutional assessment. The research was conducted in Sidodadi Village, Deli Serdang Regency, North Sumatra, between August 2024 and January 2025. The case study approach enables in-depth investigation of complex socio-economic phenomena within their real-world context, while mixed methods provide complementary insights into both measurable outcomes and underlying processes.

The quantitative component utilizes value chain analysis methodology to map material flows, financial transactions, and value distribution across chain actors. Primary data collection from 120 farm households provides statistical power for analyzing productivity determinants, profitability patterns, and policy impacts. The qualitative component employs semi-structured interviews with 45 stakeholders including farmers, cooperative leaders, input suppliers, traders, millers, local government officials, and agricultural extension officers. This multi-stakeholder perspective captures diverse viewpoints on value chain constraints and policy priorities.

B. Sampling Strategy

Farm household selection employed stratified random sampling to ensure representation across key

variables affecting value chain participation and outcomes. The 120 households were stratified by:

1. Farm size: Small (<0.3 ha), Medium (0.3-0.6 ha), Large (>0.6 ha)
2. Cooperative membership: Members vs. non-members
3. Technology adoption: Traditional vs. improved variety users

Stakeholder interviews utilized purposive sampling to include key informants with decision-making authority or specialized knowledge. The 45 stakeholders comprised: 25 farmer representatives (including cooperative leaders and informal leaders), 8 value chain actors (input dealers, traders, millers), 7 government officials (village head, agricultural extension, district planning), and 5 civil society representatives (NGOs, farmer associations).

C. Data Collection Instruments

Structured household questionnaires captured detailed information on: production activities (land preparation, planting, crop management, harvesting), input use and costs, output quantity and quality, marketing channels and prices, access to services (credit, extension, information), and household characteristics. The instrument was pre-tested with 15 households and refined based on field experience.

Semi-structured interview guides for stakeholders explored: perceptions of value chain constraints and opportunities, experiences with existing policies and programs, institutional arrangements and power dynamics, sustainability practices and barriers, and priorities for policy interventions. Interviews were recorded, transcribed, and coded using thematic analysis. Secondary data from multiple sources supplemented primary data collection. Village administrative records provided demographic and land use information. District agricultural statistics contributed production trend data. Market price monitoring systems supplied time-series price data. Policy documents from village and district governments informed institutional analysis.

D. Analytical Framework

Value chain analysis followed the methodology developed by Kaplinsky and Morris, examining the full sequence of value-adding activities from input supply through production, processing, and marketing to final consumption. The analysis mapped:

1. Chain structure: actors, functions, and linkages
2. Value distribution: costs, prices, and profit margins at each stage
3. Governance patterns: power relations and coordination mechanisms
4. Upgrading opportunities: pathways for improving competitive positioning

Statistical analysis employed multiple regression to identify determinants of productivity and profitability. Independent variables included farm

and farmer characteristics (land size, education, experience), input intensities (seed quality, fertilizer, labor), technology adoption (variety choice, management practices), and institutional factors (cooperative membership, credit access, extension contact). Dependent variables were yield per hectare and net income per hectare. Thematic analysis of qualitative data followed a systematic process: transcription of interview recordings, open coding to identify emerging themes, axial coding to establish relationships among themes, and selective coding to develop overarching narratives. The analysis emphasized triangulation across multiple stakeholder perspectives to enhance validity.

III. RESULTS AND DISCUSSION

A. Current State of Rice Value Chain in Sidodadi Village

The rice value chain in Sidodadi Village involves multiple actors operating across distinct functional stages. Table 1 presents the value chain map showing actors, functions, and approximate value shares.

Table 1. Rice Value Chain Structure in Sidodadi Village

Stage	Key Actors	Primary Functions	Value Share
Input Supply	Agro-input dealers, cooperatives, government subsidy programs	Seeds, fertilizers, pesticides, credit provision	12-15%
Production	Smallholder farmers (avg. 0.45 ha)	Land preparation, planting, crop management, harvesting	35-42%
Collection	Village traders, collecting agents	Aggregation, initial drying, transportation to mills	8-12%
Processing	Rice mills (small-medium scale)	Drying, milling, grading, packaging	15-18%
Distribution	Wholesalers, retailers, traditional markets	Transportation, storage, retail sales	18-23%

The analysis reveals significant value capture by downstream actors, with farmers retaining only 35-42% of final consumer prices despite bearing primary production risks. This distribution pattern reflects limited farmer bargaining power, information asymmetries, and high transaction costs associated with fragmented production.

B. Productivity Analysis and Sustainable Agriculture Potential

Baseline productivity data from the 120 sampled households shows substantial variation in yields, suggesting significant potential for productivity improvements through better practices and inputs. Table 2 presents comparative productivity indicators across different farmer categories.

Table 2. Productivity and Profitability Comparison Across Farmer Categories

Category	Avg Yield (t/ha)	Production Cost (Rp/ha)	Gross Income (Rp/ha)	R/C Ratio
Traditional Farmers (n=48)	4.8	9.2 million	19.2 million	2.09
Improved Variety Users (n=42)	5.6	10.5 million	23.8 million	2.27
Cooperative Members (n=30)	6.2	11.8 million	27.9 million	2.36
SRP-Equivalent Potential	8.5-9.2	13.5 million	38.3 million	2.84

The data reveal a productivity gradient corresponding to technology adoption and institutional participation. Traditional farmers achieve average yields of 4.8 tons per hectare with R/C ratios of 2.09, indicating modest profitability. Improved variety users show 17% higher yields and 9% better R/C ratios. Cooperative members demonstrate the strongest performance at 6.2 tons per hectare and R/C ratio of 2.36, reflecting benefits from collective input procurement, technical assistance, and market coordination.

The SRP-equivalent potential row estimates achievable outcomes under full adoption of Sustainable Rice Platform standards, based on demonstration farm results from Java and Central Sulawesi. These programs have documented yield increases of 40-48% alongside 35-40% reductions in

chemical nitrogen use, 25-30% reductions in water consumption, and 12.7 tons per hectare reductions in greenhouse gas emissions. Achieving these outcomes in Sidodadi Village would increase average farmer income by 37% while significantly improving environmental sustainability.

C. Critical Constraints in Value Chain Performance

Stakeholder interviews identified multiple binding constraints limiting value chain competitiveness. These constraints cluster into four main categories: infrastructure deficits, institutional weaknesses, market failures, and policy gaps. Table 3 summarizes key constraints, their manifestations, and estimated impacts on farmer income.

Table 3. Critical Constraints and Estimated Income Impacts

Constraint Category	Key Manifestations	Primary Impact	Income Loss
Infrastructure Deficits	Inadequate drying facilities, no collective storage, limited milling capacity	Quality degradation, forced immediate sales, low bargaining power	15-18%
Institutional Weaknesses	Weak cooperatives, limited extension services, absence of farmer organizations	Fragmented action, minimal collective bargaining, technology gaps	12-16%
Market Failures	Price information asymmetry, trader oligopsony, credit rationing	Below-market prices, limited technology adoption, input underuse	10-14%
Policy Implementation Gaps	Delayed subsidies, inadequate extension funding, fragmented programs	Reduced productivity support, limited sustainability adoption	8-12%

The cumulative impact of these constraints reduces farmer income by approximately 45-60% relative to achievable potential under coordinated interventions. Infrastructure deficits emerge as the most binding constraint, directly affecting 82% of surveyed farmers who lack access to proper drying and storage facilities. Institutional weaknesses rank second, with only 25% of farmers participating in functioning cooperatives or farmer groups.

D. Local Economic Policy Assessment

Analysis of existing local economic policies reveals substantial gaps between stated objectives and implementation effectiveness. The village government has articulated general support for agricultural development but lacks specific policy instruments targeting value chain competitiveness. District-level policies provide more structure but suffer from inadequate resources and weak enforcement mechanisms.

Current policy interventions include: subsidized fertilizer distribution through cooperative channels, intermittent extension services from district agricultural office, village fund allocations for irrigation rehabilitation, and informal support for farmer meetings and training. However, these interventions operate in isolation without strategic coordination or clear performance metrics.

Stakeholder consultations identified several priority areas for policy strengthening: first, establishment of village-level post-harvest infrastructure combining drying floors, storage facilities, and quality testing equipment. Second, formalization of farmer organizations with clear governance structures and business development services. Third, facilitation of direct market linkages connecting farmer groups to institutional buyers and premium markets. Fourth, integration of extension services focusing on sustainable intensification practices adapted to local conditions.

E. Proposed Multi-Stakeholder Governance Framework

Based on comparative analysis of successful value chain interventions in other Indonesian contexts and stakeholder input from Sidodadi Village, this study proposes a multi-stakeholder governance framework for coordinating value chain development. The framework establishes clear roles and accountability mechanisms while preserving flexibility for adaptive implementation.

The governance structure comprises three tiers: Strategic Coordination Committee at village level, Operational Management Unit for day-to-day implementation, and Working Groups for specific technical areas. The Strategic Committee includes village government leadership, farmer organization representatives, private sector actors, and technical advisors. This body meets quarterly to set priorities, allocate resources, and monitor progress.

The Operational Unit, staffed by extension officers and cooperative managers, handles

implementation of approved interventions, maintains information systems, and provides technical support to farmers. Working Groups address specific domains including sustainable production practices, post-harvest infrastructure management, market development, and financial services. Each group includes 5-8 members with relevant expertise and reports to the Operational Unit.

F. Localized Policy Toolkit

The research culminates in a localized policy toolkit providing actionable recommendations organized around six intervention clusters. Each cluster includes specific actions, responsible actors, resource requirements, implementation timeline, and expected outcomes. Table 4 summarizes the intervention clusters and their primary components.

Table 4. Policy Intervention Clusters and Implementation Framework

Intervention Cluster	Key Components	Lead Stakeholder	Timeline
Infrastructure Development	Drying facilities, storage warehouse, quality testing lab, milling unit	Village Government with District Support	18-24 mo
Institutional Strengthening	Cooperative restructuring, farmer group formation, leadership training, business planning	Farmer Organizations with NGO Support	12-15 mo
Sustainable Production	SRP training, demonstration plots, integrated pest management, soil health programs	Extension Services with University Partnership	36 mo
Market Development	Buyer connections, quality certification, branding, digital platforms,	Cooperatives with Private Sector Partners	24 mo

Intervention Cluster	Key Components	Lead Stakeholder	Timeline
	contract farming		
Financial Services	Credit access facilitation, savings mobilization, insurance products, digital payments	Cooperatives with Microfinance Institutions	18 mo
Information Systems	Price information service, weather monitoring, pest alerts, market intelligence, mobile apps	Village Government with Technology Partners	12 mo

The intervention clusters are designed to be mutually reinforcing while allowing for phased implementation based on resource availability and institutional readiness. Priority actions focus on quick wins that demonstrate tangible benefits to farmers, building momentum and stakeholder commitment for longer-term transformations.

G. Expected Outcomes and Impact Projections

Based on implementation experience from comparable interventions in other Indonesian locations and stakeholder consultations in Sidodadi Village, this study projects the following outcomes from full implementation of the proposed policy framework over a three-year period:

1. Productivity Improvements

Average rice yields increase from current 5.3 tons per hectare to 7.8-8.5 tons per hectare, representing a 47-60% improvement. This productivity gain derives from improved variety adoption, sustainable intensification practices, enhanced crop management, and better input quality and timing.

2. Income Enhancement

Net farmer income per hectare increases by 23-31%, from current average of IDR 10.8 million to IDR 13.3-14.2 million. Income gains result from both productivity improvements and value capture improvements through better quality, reduced post-harvest losses, and stronger market positioning.

3. Environmental Benefit

Chemical nitrogen use decreases by 35-40% through precision application and organic matter incorporation. Water consumption reduces by 20-25% through alternate wetting and drying practices. Greenhouse gas emissions decline by 10-12 tons CO₂-equivalent per hectare through improved water and nutrient management.

4. Institutional Development

Farmer organization membership increases from 25% to 60-70% of households. Cooperative business volume expands by 180-220% through expanded services including input supply, marketing, and post-harvest operations. Extension contact frequency doubles from current average of 2.1 visits per season to 4.5 visits.

5. Market Integration

Direct farmer sales to institutional buyers increase from less than 5% to 30-40% of production. Premium market access develops for certified sustainable rice capturing 15-20% price premiums. Digital market information systems reach 80% of farmers providing real-time price transparency.

IV. CONCLUSION

This research demonstrates that coordinated local economic policies can significantly strengthen sustainable rice value chains and enhance competitive positioning in smallholder contexts. The case study of Sidodadi Village reveals substantial productivity gaps, value distribution inequities, and institutional weaknesses that constrain farmer income and limit sustainability adoption. However, the analysis also identifies clear pathways for improvement through targeted interventions addressing infrastructure deficits, institutional capacity, market linkages, and sustainable production practices.

The proposed multi-stakeholder governance framework provides an institutional mechanism for coordinating interventions across public, private, and civil society actors. By establishing clear roles, accountability structures, and communication channels, the framework enables collective action while preserving flexibility for adaptive implementation. The localized policy toolkit translates strategic objectives into actionable interventions with defined timelines, responsible parties, and resource requirements.

Implementation projections suggest that comprehensive policy interventions can increase farmer incomes by 23-31% while simultaneously improving environmental sustainability through reduced chemical inputs, lower water consumption, and decreased greenhouse gas emissions. These dual benefits of economic competitiveness and environmental stewardship reflect the potential of

sustainable intensification approaches adapted to smallholder contexts.

Several critical success factors emerge from this research. First, infrastructure investments in post-harvest facilities generate immediate and visible benefits that build stakeholder commitment for longer-term transformations. Second, strong farmer organizations serve as essential platforms for collective bargaining, service delivery, and technology adoption. Third, market development requires simultaneous attention to quality improvement, certification, and buyer relationships. Fourth, sustained technical support through enhanced extension services proves essential for translating best practices into farmer-level adoption.

Policy implications extend beyond Sidodadi Village to broader questions of agricultural development strategy in Indonesia. The research underscores the importance of decentralized policy implementation that empowers local actors while providing adequate technical and financial support. Village-level policies can address context-specific constraints and facilitate collective action more effectively than centralized programs. However, local capacity building and resource allocation require sustained commitment from district and provincial governments.

Future research should examine implementation experiences as the proposed framework is deployed in Sidodadi Village and potentially adapted to other locations. Longitudinal studies tracking farmer outcomes, environmental indicators, and institutional development over multi-year periods would provide valuable insights into intervention effectiveness and sustainability. Comparative research across diverse agro-ecological and socio-economic contexts would enhance understanding of transferability and adaptation requirements. Finally, political economy analysis exploring stakeholder interests, power dynamics, and policy implementation challenges would contribute to more realistic and effective intervention design.

In conclusion, this research demonstrates that sustainable rice value chain development and competitive positioning are achievable objectives in smallholder contexts through coordinated local economic policies. Success requires simultaneous attention to productivity enhancement, value distribution improvement, institutional strengthening, and environmental sustainability. The proposed governance framework and policy toolkit provide practical guidance for translating these principles into implementation, offering a pathway toward inclusive and sustainable agricultural development that benefits both farmers and society.

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