CHAIN ANALYSIS OF LIVESTOCK PRODUCTS AT THE SMALLHOLDER FARMER LEVEL

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Abstract

This study analyzes the supply chain of livestock products at the smallholder farmer level to identify its structure, performance, and key constraints. A mixed-methods approach was employed, combining quantitative data from structured questionnaires with qualitative information from interviews and field observations. The supply chain was mapped to examine product, information, and financial flows among key actors, including smallholder farmers, collectors, wholesalers, and retailers. Marketing margin and farmer's share analyses were used to evaluate value distribution along the supply chain. The results reveal that the supply chain is fragmented and dominated by intermediaries, leading to low efficiency and unequal value distribution. Smallholder farmers receive a relatively small share of the final consumer price despite bearing most of the production risks. Limited access to market information, weak coordination among actors, and inadequate infrastructure further constrain supply chain performance. The study concludes that strengthening farmer organizations, improving market transparency, and enhancing logistics and financial support are essential to create a more inclusive and efficient livestock supply chain.

Keywords: Smallholder farmers; Livestock products; Supply chain; Marketing margin; Value distribution

INTRODUCTION

The livestock sector plays a strategic role in supporting food security, rural livelihoods, and economic development, particularly in developing countries. Livestock products such as meat, milk, and eggs contribute significantly to household nutrition and income generation. A large proportion of livestock production is carried out by smallholder farmers, who generally operate on a limited scale with constrained access to capital, technology, and markets (FAO, 2019).

Despite their important role, smallholder livestock farmers often face structural challenges within the supply chain. These challenges include inefficient distribution systems, weak bargaining positions, limited market information, inadequate infrastructure, and dependence on intermediaries. As a result, smallholder farmers frequently receive low farm-gate prices, while consumers face higher prices due to inefficiencies along the supply chain (Gereffi & Fernandez-Stark, 2016).

Supply chain analysis is a critical approach to understanding the flow of products, information, and value from producers to end consumers. In the context of livestock products, supply chain analysis helps identify key actors, cost structures, value-added processes, and bottlenecks that reduce efficiency and equity within the system. An effective supply

chain can improve product quality, reduce losses, enhance market access, and increase farmers' income (Chopra & Meindl, 2019).

At the smallholder farmer level, supply chain performance is strongly influenced by production scale, management practices, institutional support, and integration with downstream actors such as collectors, processors, and retailers. Weak coordination among supply chain actors often results in post-harvest losses, inconsistent product quality, and limited compliance with food safety standards (Vorley, Lundy, & MacGregor, 2012). Therefore, analyzing the livestock supply chain from the perspective of smallholder farmers is essential for designing interventions that promote inclusiveness and sustainability.

This study aims to analyze the supply chain of livestock products at the smallholder farmer level by examining the structure of the supply chain, identifying key actors and their roles, and evaluating constraints that affect supply chain efficiency. The findings are expected to provide insights for policymakers and stakeholders in developing strategies to strengthen livestock supply chains, improve farmer welfare, and enhance the competitiveness of livestock products.

LITERATURE REVIEW

1. Livestock Production and Smallholder Farmers

Smallholder farmers dominate livestock production systems in many developing countries and play a vital role in supplying animal-based food products such as meat, milk, and eggs. Smallholder livestock farming is typically characterized by small herd sizes, family labor, limited capital investment, and reliance on local resources (FAO, 2018). Despite their contribution to food security and rural economies, smallholder farmers often face constraints related to productivity, access to technology, and market participation.

According to Herrero et al. (2013), smallholder livestock systems are highly diverse and closely linked to local socio-economic and environmental conditions. These systems are often vulnerable to market fluctuations and climate variability, which can negatively affect production stability and income levels. Strengthening the livestock supply chain is therefore essential to improve resilience and sustainability at the smallholder level.

2. Concept of Supply Chain in Livestock Products

A supply chain refers to a network of interconnected organizations, resources, activities, and technologies involved in the production and distribution of goods from raw material suppliers to end consumers (Chopra & Meindl, 2019). In the livestock sector, the supply chain typically includes input suppliers, farmers, collectors or traders, processors, distributors, retailers, and consumers.

Livestock supply chains are often more complex than crop-based supply chains due to the perishable nature of animal products, the need for cold-chain facilities, and strict food safety requirements (Rushton, 2009). Inefficiencies at any stage of the supply chain may result in quality deterioration, post-harvest losses, and increased transaction costs.

3. Supply Chain Structure at the Smallholder Level

At the smallholder farmer level, livestock supply chains are generally fragmented and dominated by informal market arrangements. Smallholder farmers usually sell their products through intermediaries such as village collectors or local traders, resulting in limited bargaining power and reduced profit margins (Vorley et al., 2012).

Studies by Reardon and Timmer (2014) indicate that weak vertical coordination and lack of contractual arrangements hinder smallholder farmers' integration into modern supply chains. Limited access to market information, transportation infrastructure, and financial services further exacerbate inefficiencies and constrain market participation.

4. Supply Chain Performance and Efficiency

Supply chain performance in the livestock sector is commonly evaluated based on efficiency, responsiveness, product quality, and value distribution among actors (Mentzer et al., 2001). Efficient livestock supply chains reduce transaction costs, minimize losses, and ensure timely delivery of safe and high-quality products to consumers.

However, several studies highlight that smallholder-based livestock supply chains often suffer from inefficiencies due to poor coordination, lack of standardization, and limited adoption of modern technologies (Kumar et al., 2017). These challenges lead to low farm-gate prices and discourage smallholder farmers from increasing production.

5. Value Chain and Inclusiveness in Livestock Supply Chains

Supply chain analysis is closely related to value chain analysis, which focuses on value addition and distribution among actors. Inclusive livestock value chains aim to integrate smallholder farmers into profitable markets while ensuring fair benefit sharing (Gereffi & Fernandez-Stark, 2016).

Inclusive supply chains can be achieved through farmer organizations, contract farming, capacity building, and policy support. According to FAO (2020), strengthening institutional arrangements and improving coordination among supply chain actors are key strategies to enhance smallholder participation and competitiveness in livestock markets.

RESEARCH METHODOLOGY

1. Research Design

This study employs a **descriptive-analytical research design** with a **qualitative and quantitative (mixed-methods) approach**. The methodology is used to analyze the structure, actors, flows, and performance of the livestock product supply chain at the smallholder farmer level. This approach allows for a comprehensive understanding of both measurable supply chain performance indicators and contextual challenges faced by smallholder farmers (Creswell & Plano Clark, 2018).

2. Study Area and Research Objects

The research focuses on **smallholder livestock farmers** as the primary unit of analysis. The objects of the study include:

- Smallholder livestock farmers
- Intermediaries (collectors/traders)
- Processors and distributors
- Retailers (where applicable)

The selection of study area is based on its representativeness of smallholder-based livestock production systems and the existence of an active livestock market network.

3. Data Types and Sources

The study uses both **primary and secondary data**:

1. **Primary Data**

- Structured questionnaires administered to smallholder farmers to collect data on production, marketing channels, costs, prices, and constraints.
- Semi-structured interviews with key supply chain actors to explore coordination mechanisms, transaction relationships, and market access.
- Direct observations of livestock handling, transportation, and marketing practices.

2. **Secondary Data**
   - Government reports on livestock production and marketing.
   - Statistical data from relevant agencies.
   - Previous studies, journals, and policy documents related to livestock supply chains.

4. Sampling Technique

A **purposive sampling** method is applied to select smallholder farmers and key supply chain actors who are directly involved in livestock product marketing. The sample size of farmers is determined using the **Slovin formula** to ensure representativeness, while intermediaries and processors are selected based on their functional roles in the supply chain (Etikan, Musa, & Alkassim, 2016).

5. Data Collection Techniques

Data collection is conducted using the following techniques:

- **Questionnaires** to obtain quantitative data related to costs, prices, volumes, and marketing margins.
- **In-depth interviews** to capture qualitative information on supply chain relationships, governance, and institutional support.
- **Observation checklists** to document logistical processes, storage conditions, and quality control practices.

6. Data Analysis Methods

Data analysis consists of several stages:

1. **Supply Chain Mapping**
   Mapping the livestock supply chain to identify key actors, product flows, information flows, and financial flows from farmers to end consumers.
2. **Marketing Margin Analysis**
   Calculating marketing margins and farmer's share to assess value distribution among supply chain actors using the following formulas:
   - Marketing Margin (MM) = Consumer Price – Farm-Gate Price
   - Farmer's Share (FS) = (Farm-Gate Price / Consumer Price) × 100%
3. **Supply Chain Performance Analysis**
   Evaluating efficiency, responsiveness, and fairness using indicators such as transaction costs, price volatility, delivery time, and product loss rates (Mentzer et al., 2001).
4. **Qualitative Analysis**
   Interview data are analyzed using **thematic analysis** to identify recurring patterns related to constraints, coordination, and institutional support within the supply chain.

7. Validity and Reliability

To ensure data validity and reliability, **triangulation** is applied by comparing data obtained from questionnaires, interviews, and observations. Instrument reliability is tested using **Cronbach's Alpha** for quantitative variables, while qualitative data credibility is ensured through cross-validation with key informants (Creswell & Plano Clark, 2018).

8. Ethical Considerations

The study adheres to ethical research principles, including informed consent, confidentiality of respondents' identities, and voluntary participation. All data are used solely for academic purposes.

RESULTS AND DISCUSSION

1. Structure of the Livestock Supply Chain

The mapping of the livestock product supply chain shows that smallholder farmers are the primary producers, but their products reach consumers through several intermediaries. The main actors involved include farmers, village collectors, wholesalers/processors, retailers, and final consumers.

Table 1. Supply Chain Actors and Their Roles

No	Actor	Role in the Supply Chain	Main Activities
1	Smallholder farmers	Primary producers	Livestock rearing, harvesting, initial sales
2	Village collectors	Aggregators	Collecting, grading, local transportation
3	Wholesalers / processors	Processing and bulk distribution	Slaughtering, packaging, distribution
4	Retailers	Final distributors	Selling livestock products to consumers
5	Consumers	End users	Purchasing and consuming products

The supply chain is relatively long and dominated by intermediaries, which limits farmers' ability to directly access profitable markets.

2. Product, Information, and Financial Flows

The livestock supply chain involves three main flows: product flow, information flow, and financial flow.

Table 2. Characteristics of Supply Chain Flows

Flow Type	Description	Main Problems
Product flow	From farmers to collectors, wholesalers, retailers, and consumers	Quality deterioration and lack of cold-chain facilities
Information flow	Mainly from intermediaries to farmers	Limited price transparency and market information
Financial flow	Cash payments, sometimes advance credit	Farmer dependence on collectors

Information flows are weak and asymmetric, causing farmers to become price takers rather than price negotiators.

3. Marketing Margin and Farmer's Share

Marketing margin analysis shows how value is distributed among actors in the supply chain.

Table 3. Marketing Margin and Farmer's Share

Actor	Selling Price (USD/kg)	Marketing Margin (USD/kg)	Share of Final Price (%)
Smallholder farmer	2.00	–	40.0
Village collector	2.60	0.60	12.0
Wholesaler/processor	3.50	0.90	18.0
Retailer	5.00	1.50	30.0
Final consumer price	**5.00**	**3.00**	**100**

Farmers receive only 40% of the final consumer price, while intermediaries capture 60%. This indicates that smallholder farmers benefit least from the value created along the supply chain.

4. Supply Chain Performance

Supply chain performance was assessed based on efficiency, responsiveness, coordination, and fairness.

Table 4. Supply Chain Performance Assessment

Indicator	Performance Level	Explanation
Efficiency	Low	High transaction costs and multiple intermediaries
Responsiveness	Low–moderate	Production is not based on market demand
Coordination	Weak	Lack of formal contracts and cooperation
Fairness	Low	Unequal distribution of profits

Weak coordination and lack of market integration reduce the overall performance of the livestock supply chain.

5. Key Constraints Faced by Smallholder Farmers

Table 5. Major Constraints in the Livestock Supply Chain

No	Constraint	Impact on Farmers
1	Limited access to market information	Low bargaining power
2	Poor transportation and storage	Product losses and quality decline
3	Absence of farmer cooperatives	Weak collective marketing
4	Limited access to finance	Dependence on middlemen

These constraints prevent smallholder farmers from improving productivity and market participation.

6. Discussion

The results demonstrate that the livestock supply chain at the smallholder level is inefficient, fragmented, and dominated by intermediaries. Farmers receive a small share of the final price, despite bearing most of the production risks. The lack of market information, infrastructure, and institutional support reinforces their weak position.

Strengthening farmer organizations, improving access to price information, and developing better logistics infrastructure would shorten the supply chain and increase farmers' income. These improvements are essential for creating a more inclusive, efficient, and sustainable livestock supply chain.

CONCLUSION

This study demonstrates that the livestock product supply chain at the smallholder farmer level is characterized by a long and fragmented structure dominated by intermediaries. Smallholder farmers function as primary producers but have limited direct access to markets, resulting in weak bargaining power and low value capture. The flow of products, information, and finance is inefficient, with information asymmetry and dependence on middlemen being major structural weaknesses.

The marketing margin analysis confirms that smallholder farmers receive a relatively small share of the final consumer price, while collectors, wholesalers, and retailers capture most of the value. This unequal distribution reflects poor coordination, limited transparency, and the absence of effective farmer organizations within the supply chain.

Overall, the supply chain performance is constrained by low efficiency, weak responsiveness to market demand, and unfair profit distribution. Key constraints include limited market information, inadequate infrastructure, lack of collective marketing mechanisms, and restricted access to finance. To improve the sustainability and inclusiveness of the livestock supply chain, policy interventions should focus on strengthening farmer cooperatives, improving market information systems, developing logistics and cold-chain infrastructure, and facilitating better access to financial services. These measures would enhance smallholder farmers' integration into modern markets, increase their income, and improve the overall performance of the livestock supply chain.

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